RECOMMENDATIONS FOR FUTURE RESEARCH AND DATA NEEDS FROM RECENT STOCK ASSESSMENTS, STAR PANEL REPORTS, SSC METHODOLOGY REVIEWS, AND PAST ADVISORY BODY REPORTS ON OFF YEAR SCIENCE IMPROVEMENTS

Table of Contents

Recommendations from the 2017 Assessment Cycle 1

2016 Catch Reconstruction Workshop Report; Sampson et al. 2017 1

2016 Productivity Workshop Report; Dorn et al. 2017 2

2017 SSC Groundfish Subcommittee Review of Assessment Methodology Review; Sampson et al. 2017 4

2017 SSC Review of Recommendations from Science Workshops and Assessment Methodology Reviews; Agenda Item I.2.a, REVISED Supplemental SSC Report, March 2017 11

2017 Arrowtooth Flounder Update Assessment; Sampson et al. 2017 14

2017 Blackgill Rockfish Update Assessment; Field and He 2017 15

2017 Blue and Deacon Rockfishes Assessment; Dick et al. 2017 16

2017 Blue and Deacon Rockfishes STAR Panel Report; Dorn et al. 2017 18

2017 California Scorpionfish Assessment; Monk et al. 2017 19

2017 California Scorpionfish STAR Panel Report; Dorn et al. 2017 21

2017 Lingcod Assessment; Haltuch et al. 2017 22

2017 Lingcod STAR Panel Report; Sampson et al. 2017 22

2017 Pacific Ocean Perch Assessment; Wetzel et al. 2017 23

2017 Pacific Ocean Perch STAR Panel Report; Sampson et al. 2017 23

2017 Yelloweye Rockfish Assessment; Gertseva et al. 2017 24

2017 Yelloweye Rockfish STAR Panel Report; Field et al. 2017 25

2017 Yellowtail Rockfish Assessment; Stephens et al. 2017 26

2017 Yellowtail Rockfish STAR Panel Report; Field et al. 2017 27

Recommendations from the 2015 Assessment Cycle 28

2015 SSC Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental SSC Report, September 2015 28
2015 GMT Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental GMT Report, September 2015 30
2015 GAP Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental GAP Report, September 2015 33
2015 Nearshore Assessments Workshop Report; Sampson et al. 2015 34
2015 Arrowtooth Flounder Data-Moderate Assessment; Agenda Item D.8, Attachment 5, June 2015 36
2015 Black Rockfish Assessment; Cope et al. 2016 36
2015 Black Rockfish STAR Panel Report; Cooper et al. 2015 38
2015 Scientific and Statistical Committee's Groundfish Subcommittee Mop-up Stock Assessment Review Panel Meeting Black Rockfish Report; Field et al. 2015 39
2015 Bocaccio Assessment; He et al. 2015 40
2015 Bocaccio STAR Panel Report; Dorn et al. 2015 41
2015 Canary Rockfish Assessment; Thorson and Wetzel 2015 41
2015 Canary Rockfish STAR Panel Report; Jagielo et al. 2015 42
2015 Chilipepper Rockfish Assessment; Field et al. 2015 43
2015 China Rockfish Assessment; Dick et al. 2016 43
2015 China Rockfish STAR Panel Report; Dorn et al. 2015 45
2015 Darkblotched Rockfish Assessment; Gertseva et al. 2016 46
2015 Darkblotched Rockfish STAR Panel Report; Jagielo et al. 2015 47
2015 Oregon Kelp Greenling Assessment; Berger et al. 2015 48
2015 Oregon Kelp Greenling STAR Panel Report; Sampson et al. 2015 48
2015 Petrale Sole Update Assessment; Stawitz et al. 2016 50
2015 Sablefish Assessment; Johnson et al. 2016 50
2015 Widow Rockfish Assessment: Hicks and Wetzel 2015 51
2015 Widow Rockfish STAR Panel Report; Sampson et al. 2015 52
2015 Pacific Fishery Management Council and the National Marine Fisheries Service Northwest and Southwest Fisheries Science Centers Groundfish Stock Assessment Process Review Workshop; Agenda Item F.7, Attachment 8, April 2016 54

Recommendations from the 2013 Assessment Cycle 64
2013 SSC Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental SSC Report, September 2013 64
2013 GMT Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental GMT Report, September 2013 66
2013 GAP Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental GAP Report, September 2013 68
2013 Aurora Rockfish Assessment; Hamel et al. 2013 69
2013 Aurora Rockfish STAR Panel Report; Sampson et al. 2013 69
2013 Cowcod Assessment; Dick and MacCall 2014 71
2013 Cowcod STAR Panel Report; Jagielo et al. 2013 71
2013 Data-Moderate Assessments: Cope et al. 2015 71
2013 Data-Moderate STAR Panel Report; Dorn et al. 2013 72
2013 Longspine Thornyhead Assessment; Stephens and Taylor 2014 74
2013 Longspine Thornyhead STAR Panel Report; Key et al. 2013 74
2013 Pacific Sanddab Assessment; He et al. 2013 74
2013 Pacific Sanddab STAR Panel Report; Jagielo et al. 2013 75
2013 Rougheye and Blackspotted Rockfishes Assessment; Hicks et al. 2014 76
2013 Rougheye and Blackspotted Rockfishes STAR Panel Report; Sampson et al. 2013 77
2013 Shortspine Thornyhead Assessment; Taylor and Stephens 2014 78
2013 Shortspine Thornyhead STAR Panel Report; Key et al. 2013 79

Recommendations from the 2012 Assessment Cycle 79
2012 Data-Moderate Assessments Methodology Review Meeting Report; Dorn et al. 2012 79

Recommendations from the 2011 Assessment Cycle 81
2011 SSC Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental SSC Report, September 2011 81
2011 GMT Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental GMT Report, September 2011 84
2011 GAP Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental GAP Report, September 2011 87

2011 Data-Poor Assessments (excerpt of long term research recommendations); Dorn et al. 2011 89
2011 Blackgill Rockfish Assessment; Field and Pearson 2011 90
2011 Blackgill Rockfish STAR Panel Report; Gertseva et al. 2011 90
2011 Bocaccio Update Assessment; Field 2011 92
2011 Darkblotched Rockfish Update Assessment; Stephens et al. 2011 93
2011 Dover Sole Assessment; Hicks and Wetzel 2011 93
2011 Dover Sole STAR Panel Report; Wespestad et al. 2011 94
2011 Greenspotted Rockfish Assessment; Dick et al. 2011 95
2011 Greenspotted Rockfish STAR Panel Report; Gertseva et al. 2011 96
2011 Pacific Ocean Perch Assessment; Hamel and Ono 2011 97
2011 Pacific Ocean Perch STAR Panel Report; Conser et al. 2011 97
2011 Petrale Sole Assessment; Haltuch et al. 2011 98
2011 Petrale Sole STAR Panel Report; Conser et al. 2011 99
2011 Sablefish Assessment; Stewart et al. 2011 99
2011 Sablefish STAR Panel Report; Wespestad et al. 2011 101
2011 Spiny Dogfish Assessment; Gertseva and Taylor 2011 102
2011 Spiny Dogfish STAR Panel Report; Tsou et al. 2011 103
2011 Widow Rockfish Assessment; He et al. 2011 103
2011 Widow Rockfish STAR Panel Report; Tsou et al. 2011 104
2011 Yelloweye Rockfish Update Assessment; Taylor and Wetzel 2011 104
2011 Groundfish and Coastal Pelagic Species Stock Assessment Review Workshop; National Marine Fisheries Service Northwest Fisheries Science Center and Pacific Fishery Management Council; Online Webinar 105

Recommendations from the 2017 Assessment Cycle

2016 Catch Reconstruction Workshop Report; Sampson et al. 2017

Lessons Learned from the Workshop and Recommendations

- Most of the discrepancies identified by the workshop exercise were in the Washington catch reconstruction. Readers should appreciate that this reconstruction is a work in progress; additional time is required to fully develop and debug the Washington reconstruction.
- Additional follow up work is needed to evaluate the source(s) of the discrepancies between the workshop reconstructions for darkblotched rockfish and the landings reported in the assessment.
- Digitizing more of the recreational data in California that are currently available only as paper records should be prioritized and funding provided to extend the data series further into the past.
- Some historical landings of fish reported as being for animal food (mink food) may have been waste carcasses rather than whole fish. Analysts developing catch reconstructions should attempt to confirm that landings reported as animal food or scrap-fish have not been double-counted (e.g., once when sold as whole fish, a second time after processing when sold as mink food).
- Research is needed to evaluate the costs and benefits of splitting current market categories to finer and finer levels. At issue is how fishers / fish processors will use the additional categories (e.g., will they be willing and able to fully comply with sorting to species) and whether additional sampling will be required to derive reasonably reliable estimates of the compositions of the additional categories.
- Concerns were expressed regarding the representativeness of the biological samples taken from the landed catch and whether sampling should be proportional to landings for a given trip type. Sampling at the ports is conducted more on an opportunistic basis rather than proportional to the landings. Special problems can arise at locations where the processing plant operator is uncooperative about allowing sampling to occur (e.g., because it interferes with operations of the fillet line). An evaluation of which locations (or vessels) get sampled regularly and which do not might help identify potential problems that could be resolved by informal communication with the uncooperative processing plant operator or by using more drastic measures.
- An unresolved question for catch reconstructions is what analysts should do when data are unavailable for either the basic landings series or the catch compositions (for species or areas). The Bayesian methods being developed and tested seem a significant improvement over the existing data borrowing procedures, but the approach will not be fully developed nor thoroughly reviewed in time to produce catch reconstructions for the 2017 assessments.
- Approaches for borrowing data across time periods or spatial regions should consider variability between periods or areas rather than using arbitrary rules. Some analysts have the view that data borrowing should not extend between ports, but model-based approaches could be used to test this supposition. Providing rationale and documentation for the decisions made and alternatives forgone during preparation of a catch reconstruction is an important aspect of the process.

- Sometimes in reconstructions it is necessary to use interpolation to fill in data gaps, but there is no agreed standard procedure. How interpolation is handled is case-specific, depending on the duration being interpolated over and what conditions in the fishery may have changed. There can be shifts in species distributions as well as in where the fisheries operate.
  Recommendation: During the development of stock assessments there should be a review by state data stewards early in the process of the historical catch reconstructions to ensure that STAT teams are aware of any items that should be considered regarding how to fill in data gaps in landings or species compositions.
- During the workshop there were examples of historical landings being reported as the weights of fillets rather than whole fish.
  Recommendation: Conversion factors to expand landed weights to whole fish should be standardized for fish that are processed at sea and landed as headed and gutted product, as fillets, or as just livers.
- The historical annotated landings database (HAL) includes the data reported by the Pacific Marine Fisheries Commission (in the so-called PMFC "big book").
  Recommendation: A copy of the HAL database should be placed in the PacFIN system.
  Recommendation: Copies of state catch reconstructions and contributing databases should be transferred to PacFIN so there is a single repository. A process will need to be established so reconstructions in PacFIN can be updated as the states make revisions to their reconstructions.
  Recommendation: The existing California catch reconstruction should be revised to account for unspecified sole.
- Because species compositions on the fishing grounds are generally depth dependent, there is good potential for using fishing depths to improve estimates of species compositions, especially in the context of the historical period for which there were few if any direct samples of species compositions.
  Recommendation: Model-based methods for hindcasting landings should explore the potential for using trawl logbook data (tow locations and/or tow depths) to inform the estimates of species proportions that are applied to landings. Trawl logbook data are available back to the 1960s for Oregon, to the 1950s for Washington, and back even further for California.
- Accounting for at-sea discards remains a significant challenge, especially for catch reconstructions. The topic of discards was barely touched on during the current workshop and should be considered as a possible focus of a future workshop. The reasons for discarding probably were market driven in early years and due to regulations (e.g., trip limits) in later years. Thus the magnitude of discards will likely vary through time as a result.
  Recommendation: Current historical catch reconstructions only account for the landed portion of the catch. The Council should consider sponsoring a workshop to explore methods and data series that could be used to account for at-sea discards in historical catch reconstructions.

2016 Productivity Workshop Report; Dorn et al. 2017

The Panel the identified a number of recommendations and conclusions on how to make progress on the issues addressed by the workshop.

1) Use of the Beverton-Holt stock-recruit curve and other two-parameter curves forces a strong relationship between steepness (i.e., the curvature of the SR relationship) and management parameters such as stock size at MSY, FMSY, and the SPR that maximizes yield. These

relationships are not a reflection of life history or population dynamics, but rather an outcome of the choice of a mathematical model with limited flexibility.

2) Three-parameter curves and non-parametric curves do not have these strong relationships, and this may provide some advantages. However, experience in working with such models in fisheries management is limited.
3) In most cases, there is not enough information in stock assessment data to support reliable estimation of the parameters of three-parameter stock-recruit curves. Therefore use of three-parameter curves will be highly reliant on the use of priors to provide stable estimation while enabling flexibility. A similar situation exists even for the two-parameter Beverton-Holt curve, where a prior for steepness has been recommended by the SSC for use in stock assessments for this same reason.
4) There was a diversity of scientific opinion regarding whether there should be a move towards use of three-parameter stock recruit models in stock assessment. Some on the Panel thought that it was better to continue using the Beverton-Holt stock recruit relationship (or even a constant mean) purely as a descriptor of the relationship between stock size and abundance. Others on the Panel favored adoption of three-parameter curves in stock assessments.
5) To make progress resolving these issues, the Panel recommends directed research on several topics:
    a. Continued simulation-estimation tests for both two-parameter and three-parameter models in stock assessments.
    b. Evaluation of different three-parameter models and alternative leading parameters for incorporation into Stock Synthesis.
    c. Exploration and evaluation of three-parameter curves in stock assessments, either when developing stock assessments, or for existing models.
    d. Further development of priors for leading parameters of stock-recruit models is needed, such as BMSY/B0, and slope at the origin. Non-parametric approaches to meta-analysis should be considered to directly estimate leading parameters.
6) The current practice of evaluating sensitivity to steepness in stock assessments by likelihood profiles and in decision tables should be continued.
7) Estimates of mean steepness for West Coast rockfish have apparently increased from around 0.6 to 0.8 based on meta-analysis of rockfish stock assessments. This increase in rockfish steepness suggests that the F50% harvest rate for rockfish can no longer be considered a risk neutral proxy for FMSY, as was originally intended. This could result in a potential loss of long-term yield of about 20%. These conclusions depend on accepting the Beverton-Holt curve as an appropriate way to model the stock recruit relationship, an approach that is now under question.
8) The Panel recommends that dynamic B0-based reference points be included the West Coast stock assessment toolbox, since they may be helpful to understand stock dynamics under regime shifts and directional climate change. The dynamic B0 output has been a routine part of the Stock Synthesis output for several assessment cycles, so all that is needed are guidelines for using it. The approach may be useful for specific groundfish stocks, but should be evaluated using MSE for the specific stock in question before being applied. The ongoing MSE work with sablefish is an example of evaluation that should take place.
9) Estimating and including autocorrelated recruitment during population forecasts can decrease forecast error if autocorrelation is substantially different from zero (e.g., $\rho>0.25$). If the sample

autocorrelation is >0.25, then this value should be used when forecasting abundance in rebuilding plans.

10) If there is sufficient support from the West Coast science centers, a follow-up workshop should be scheduled for the next off assessment year in 2018, to evaluate progress on the above research recommendations.

2017 SSC Groundfish Subcommittee Review of Assessment Methodology Review; Sampson et al. 2017

Introduction

The Groundfish Subcommittee of the Scientific and Statistical Committee (SSC) met to review new methods proposed for use in groundfish stock assessments prepared for the Pacific Fishery Management Council. The meeting was held at the Northwest Fisheries Science Center facility in Montlake on 25th January 2017 and at the neighboring Seattle Yacht Club on the 26th. The meeting began with a welcome by the Subcommittee chair, Dr. David Sampson (Oregon State University), followed by a round of self-introductions from the attendees, a brief review of the agenda and assignment of reporting duties. Appended to this report are a list of reviewers and attendees, as well as the meeting agenda.

Use of the Dirichlet Multinomial Likelihood for Compositional Data

Dr. Jim Thorson (Northwest Fisheries Science Center, NWFSC) gave a presentation on weighting compositional data using the Dirichlet multinomial, which is an option in the new 3.30 version of Stock Synthesis. Thorson et al. (In Press) provides details about the Dirichlet multinomial approach, which in essence treats the effective sample size for a multinomial compositional data series as an estimable parameter and accomplishes the tuning of compositional weights (relative adjustments to effective sample sizes) without the need for iterative reweighting as done in recent assessments using the methods of McAllister and Ianelli (1997) or Francis (2011). The Dirichlet multinomial appears to have a very similar effect on assessment results as the McAllister-Ianelli (MI) reweighting approach but has the advantage of being fully objective and repeatable. Thus using the Dirichlet approach would automatically take care of reweighting during auxiliary analyses (e.g., bridging runs) that typically do not include reweighting the compositional data.

The Dirichlet approach, like the MI approach but unlike the Francis method, does not account for correlations among the compositional data. Dr. Thorson noted that the Francis method only addresses correlated residuals at one level (among bins in a given year) but there are also correlations among years in a given bin, between sexes, and among fleets. He suggested that these correlations should be accounted for in the structure of the model itself rather than in the weighting of the compositional data. He also proposed that the iterative McAllister-Ianelli, iterative Francis method, and the Likelihood-based Dirichlet-multinomial option could all be used in the upcoming round of assessments, with the selection of the method being left to the STAT.

Dr. Thorson noted that the Dirichlet approach, as currently implemented in SS 3.30, has the property that the lower bound for the effective sample size is one, which could have the unintended effect of upweighting small samples. However, the code could potentially be changed to allow for a consistent proportional change to the effective sample sizes, even if the resulting effective sample size would be less than one.

There was general consensus by review panel members that the Dirichlet multinomial approach seems to be at least as good as the MI method (mainly due the automation of the tuning and thus reproducibility). When setting initial composition sample sizes the STATs should use the number of tows (for survey data) or trips (for fishery data), or a set of initial values based on a composite of the numbers of fish sampled and the number of tows or trips.

The Groundfish Subcommittee recommends that STATs by default use the Francis method (TA1.8) for weighting age-, and length-, and conditional age-at-length compositional data. Assessment documents should include sensitivity runs that use (a) the MI harmonic mean weighting approach as well as (b) the Dirichlet multinomial likelihood approach, as a mechanism to gauge the uncertainty associated with the choice of methodology.

C. Application of the Generalized Linear Mixed Model with Spatial Autocorrelation to Survey Data

Dr. Jim Thorson (NWFSC) gave a presentation on the application of generalized linear mixed model (GLMM) with spatial autocorrelation to survey data. The geostatistical GLMM approach is similar to what has been used during several assessment cycles for the analysis of bottom trawl survey data series. Predicted fish biomass density is derived as the product of a "delta" portion for the probability of a non-zero catch and a second portion for the magnitude of the non-zero catches. Further, the geostatistical GLMM framework can accommodate spatial autocorrelation. Additional information about the approach and the software package it is implemented in are available from www.fishstats.org. Dr. Thorson indicated that he plans to phase out the single-species version of the software in favor of a multispecies version called VAST (vector autoregressive spatial temporal model, where the single species version remains as a special case of the multispecies version).

Dr. Thorson's software package makes use of special purpose software that implements the integrated nested Laplace approximation (INLA) approach, which he described as the ADMB for spatial correlation models. INLA uses a simplification for representing the variance of multivariate normal distributions to reduce complexity and speed up computer processing. A triangulated mesh is used to represent the relationships between points in space. There was discussion regarding why triangulation would be a better approach than a gridding approach, and on what basis a user would choose the number of "knots" to use for the triangulated mesh.

Dr. Thorson raised the problem of "the garden of forked paths" in reference to how an analyst could predetermine the outcome of an analysis by their selection of how many knots they include in an analysis. He cautioned that the SSC should be suspicious of analyses based on a small number of knots. He suggested that a solution would be for the SSC to pre-specify the minimum number of knots used in any analysis that develops indices for assessments. Having too many knots is costly in terms of the amount of computer time needed to complete an analysis.

There was discussion about using depth (or some other auxiliary data) to influence the placement of the knots or as a covariate and whether aspects of the sampling design can be ignored in geostatistical models (because they have littler influence on the results). Dr. Thorson identified the problem of preferential sampling, as likely occurs in fishery-dependent data, versus design-based sampling. Whether or not depth should be included in a geostatistical analysis of survey data remains a topic of research. The geostatistical GLMMs conducted in the last assessment cycle

for the canary rockfish and darkblotched assessments did not directly include depth information (but depth was used to define stratum boundaries).

There was discussion about including vessel as a random effect in the analysis of survey data given that the same vessels have been contracted for the survey for many years. It was noted that although the vessels have not changed much there have been changes in skippers and the vessel gear such as winches. Dr. Cadigan recommended that assessment analysts and reviewers confirm there are no temporal trends or other unusual patterns in effects that should be random, such as the vessel.

With regard to model diagnostics Dr. Thorson provided examples of residual plots by year and over space that are now produced by his software package. There was discussion of how residual plots or other diagnostics should be interpreted as indicating possible problems in the model. Large spatial areas having large numbers of large positive or negative residuals, or temporal patterns in clumps of residuals might be interpreted as indications that the model is missing some key spatial feature. Dr. Thorson suggested Q/Q plots are not always a very informative diagnostic but whether or not the Hessian has converged is a key diagnostic.

Dr. Thorson presented results from a simulation study that showed that the geostatistical GLMM approach can capture upward, downward and stable trends in biomass. It was noted that geometric anisotropy is important on our coast, but the effect varies depending on whether a species is southerly or northerly distributed. There was discussion about whether analyses of survey data should use an optional feature in the software that corrects for bias associated with nonlinear functions that have random effects. The bias-correction feature is memory-intensive. Tests of the bias-correction have shown it to produce results that are consistent with even more computationally intensive MCMC sampling.

The Groundfish Subcommittee recommends that the geostatistical GLMM software developed and maintained by Dr. Jim Thorson should be considered as the first choice for developing biomass indices from bottom trawl survey data, though exploration of other methods is encouraged. Dr. Thorson will provide a document describing recommended defaults and practices for using the software.

D. Application of the Generalized Linear Mixed Model with Spatial Autocorrelation to Fishery CPUE Data

Dr. Jim Thorson gave a presentation on the application of the geostatistical GLMM approach to fishery CPUE data, based on the VAST software package that he has developed. As in the application to fishery independent (survey) data, the model combines a component for the probability of a zero density with a component for spatio-temporal variability in density to predict total density across space and time. In the example applications presented, years were treated as being independent (not autocorrelated). Temporal autocorrelation can be included in the models but this feature is not recommended for use at present. One particularly novel aspect of the package is that it can accommodate multispecies applications, in which model estimates of covariance among species provide information about the expectation of a given species in a given observation. In the example provided, Atlantic cod and haddock were shown to have positive covariation with respect to habitat preferences (spatial variation) and in their annual response to environmental signals (spatio-temporal variation), such that the catch rates of one species helped inform the

expected catch rates for the other species. Dr. Thorson suggested that the approach might also be applied in the future for standardizing compositional data, with cohorts being treated as "species".

Dr. Thorson's suggested that the software package could be applied to the analysis of fisheries dependent data, particularly for the exploration of multispecies data sets that include detailed spatial information. The assessments planned for California Scorpionfish and blue/deacon rockfish might benefit from an exploration with the software of the CDFW onboard CPFV observer data; the assessment for yellowtail rockfish might benefit from an exploration of the bycatch CPUE data from the at-sea whiting fishery. There was discussion of the challenges and merits associated with the analysis of CPUE data from commercial logbooks, such as accounting for the effects of regulations, vessels, skippers and gear. After some debate there was general agreement that the VAST software would likely not replace the Stephens-MacCall approach that has been used in several Council assessments to filter dockside intercept data and identify trips that could plausibly have caught the species of interest. The issue with applying the VAST software to the dockside intercept data is that these are trip-level data that do not have spatial information associated with them.

A number of additional features of the VAST software relevant to the analysis of fishery dependent data were also discussed, such as the decomposition of the covariance in catchability into portions thought to be controllable (vessel behavior) and those that are not controllable (e.g., gradual changes in the fleet). Many of these features in the software and the statistical approach it implements have not been fully developed but are areas of active exploration. One point of discussion was that if an analyst wants to apply the VAST software to fisheries dependent data, the analyst should first evaluate the spatial and temporal extent of the data to understand if there are large gaps in coverage. Most of the features in the VAST software and approach are fairly consistent with methods developed and applied in the past (e.g., the underlying geostatistical GLMM has been used for index development in the past). However, some aspects are novel and untested (e.g., modeling the targeting behavior of fishers) and will require building a foundation of models of growing complexity in the review process. There are some non-trivial impediments in using fishery dependent data to develop indices (e.g., accounting for changes in fishing power).

The Groundfish Subcommittee does not recommend at the present time use of the VAST software for developing abundance or biomass indices based on fishery logbook data series or dockside interviews. However, the software could be a useful tool for analysis and standardization of data series based on information from at-sea observers.

E. Revised Set of Priors for Natural Mortality

Dr. Owen Hamel (NWFSC) gave a presentation of a revised prior for natural mortality (*M*). The new prior is a revision to a prior developed and described in Hamel (2015), based on an approach and information from Then et al. (2015). The presentation considered five published meta-analyses that examined relationships between *M* and life history correlates such as maximum age, the von Bertalanffy growth coefficient and asymptotic size, water temperature and a gonadosomatic index.

The approach recommended by Dr. Hamel is a simplification of the model for *M* as a non-linear function of maximum age derived by Then et al. (2015). The Hamel prior, which takes a different approach than Then et al. to account for variability and provides a much better fit to the underlying data, is based on the relationship $M = 5.4 / A_{max}$, where A_{max} is the maximum age.

There was discussion of how the original studies (on which the meta-analyses were based) derived their estimates of natural mortality and the life history correlates. For example, one would expect that observations of maximum age would depend on how many fish were sampled and would be influenced by the properties of the sampling gear and ageing error. It was pointed out that estimates of *M* based on growth parameters could be biased from distortion of the growth curve due to size-based selection (e.g., smaller fish for a given length are under-represented). There was also discussion of whether the maximum ages used to derive *M* from the prior should be restricted to samples from the region of the assessment and whether derivations of *M* should consider differences in maximum age by gender.

The Groundfish Subcommittee considers it important that different assessments use consistent approaches for deriving values of *M* because this parameter is difficult to estimate but often has high influence on assessment results. The Subcommittee recommends that (a) groundfish assessments during the 2017 assessment cycle report the prior probability distribution for natural mortality based maximum ages as updated by Dr. Owen Hamel and (b) that STATs explore using the prior to inform the assessment models. Further, the maximum age values on which *M* priors are based should be from fish caught within the area of the assessment (e.g., not from Alaskan catches of the same species). If a prior for *M* is used to provide a fixed value for *M*, the fixed value should be set equal to the mean value of the prior.

F. Revised Prior for Steepness

Dr. Jim Thorson (NWFSC) gave a presentation on a revised prior for rockfish steepness for use in this year's groundfish assessment cycle. This is the sixth iteration of specifying a prior for steepness based on likelihood profiles from previous rockfish assessments. Providing recommendations to assessment authors on a prior for steepness is helpful to ensure (a) that assessments use a consistent approach for specifying this important parameter and (b) that the approach is based on a synthesis of available information. Seven of the 12 likelihood profiles used in the revised meta-analysis were from new or revised assessments. The re-run of the meta-analysis was straightforward and encountered no technical issues. The resulting mean of the prior was 0.72, which is decline from the mean steepness of 0.77 of the distribution in 2015, but still higher than when the meta-analysis was first done for the 2007 assessment cycle. The standard deviation of the prior decreased very slightly from 0.16 to 0.15. The Groundfish Subcommittee endorses the use of the updated prior for steepness in this year's rockfish stock assessments.

There are several possible ways that the prior for steepness could be used in the 2017 stock assessments. The Groundfish Subcommittee recommends the following procedures be followed:

1. If the stock assessment is not in the set of stocks used to estimate the steepness prior and you chose not to estimate steepness, then fix steepness at the mean of the predictive distribution.
2. If the stock assessment is not in the set of stocks used to estimate the steepness prior and you chose to estimate steepness, then use the mean and standard deviation of the predictive distribution as the mean and standard deviation of your prior on steepness.
3. If the stock assessment is in the set of stocks used to estimate the steepness prior and you chose not to estimate steepness, then fix steepness at the mean of the predictive distribution.
4. If the stock assessment is in the set of stocks used to estimate the steepness prior and you chose to estimate steepness, use a "Type-C" value that is recalculated while excluding that stock (for

2017 assessments, this will apply to Pacific Ocean Perch and Yellowtail). This ensures that the prior distribution does not "double count" data for that stock when estimating steepness (Minte-Vera et al. 2005). For Type-C priors, assessment authors should contact James Thorson with at least one month lead prior to when the value is needed.

The Groundfish Subcommittee also requests that Dr. Thorson report values of steepness at each quantile from the predictive distribution from 0.025 to 0.975 (separated by 0.05) as well as the value of steepness at the following set of quantiles of the predictive distribution {0.05, 0.25, 0.75, and 0.95}. Quantiles may be used by STAT teams to define values of steepness used in decision tables, or they could be used to integrate over the distribution of steepness to more fully characterize assessment uncertainty. To gauge the utility of the approach the Groundfish Subcommittee is interested in reviewing several examples where this approach has been explored, but the Subcommittee does not request that it be done for all assessments in the upcoming cycle.

The Groundfish Subcommittee notes that concerns have been raised previously (and at the methodology review) about the reliability of the meta-analysis approach used to develop the steepness prior. One concern, that ignoring autocorrelation in recruitment within stocks is causing bias in steepness estimates, was addressed by a paper discussed by Dr. Thorson at the productivity workshop. His work indicated that biases in steepness caused by autocorrelation tend to be relatively minor; this finding helps to alleviate this particular concern.

Other concerns include potential correlation in recruitment across stocks due to similar environmental forcing, and potential bias in the estimation of steepness and the steepness profile. The Groundfish Subcommittee encourages research to address these issues, some of which is underway. In particular, the Groundfish Subcommittee recommends continuation of the research being done at the SWFSC to evaluate the conditions under which stock assessment models produce reliable estimates for steepness and the steepness profile.

G. New Features in the Revised Stock Synthesis Software

Drs. Chantel Wetzel and Teresa A'mar (NWFSC) presented information on the new version (3.30) of the Stock Synthesis (SS) software that is now available. Documentation and the software can be found at the secure website https://vlab.ncep.noaa.gov/home. Individuals who are not part of NOAA need to request access to the website by sending their email address, name, phone number, and organization to nmfs.stock.synthesis@noaa.gov.

The new SS version has many features that will make it easier to develop input files, such as providing more flexibility in how fleets are specified and list-oriented inputs that use an end-of-data indicator rather than requiring specification of the number of data rows. New modeling features of version 3.30 include the ability to specify one to many recruitment events within a year, a catch multiplier that can use time-blocks or any other time-varying approach to scale catches (e.g., to explore the effects of uncertainty in historical catch series), an option to use the Shepherd stock-recruit function, time-varying stock-recruitment parameters that could be used to model regime shifts, an option for dome-shaped retention functions (as an alternative to the logistic form), the ability to include autocorrelation in parameters that have deviations, and an option to use the Dirichlet multinomial for representing sampling variability in compositional data. The SS 3.30 User Manual, which is available from the website, describes all of the changes and new features.

A translation routine is available that will convert files constructed for use with SS version 3.24 to formats that will run with version 3.30. Some aspects of the automatic conversion may require the analyst to make additional changes.

The new version of Stock Synthesis has undergone extensive testing. Model comparisons between SS 3.30 and SS 3.24 were successfully produced for sixteen assessments. Some features of these models required manual conversion (e.g. time-varying selectivity bounds for retention, time-varying *Q* setup). The testing conducted so far has found no more than 5% differences in results for depletion, SB_0, and SB_{final}. Outside of the assessment for Pacific hake, the largest differences have been less than 2%. Differences of this small magnitude are not totally unexpected. The two versions of SS do not use identical internal calculations. One important change is in how the two versions do age-length-key calculations. Another difference is in the transformation of bounds of time-varying parameters.

Drs. Wetzel and A'Mar recommended the following approach be used for bridging an existing SS assessment model from version 3.24 to version 3.30. The file format conversions should be done before any new data are added, then step from the old SS version to the new SS version, and then add new data. Finally, add new features, parameters, or options, step by step in any order.

There is no requirement to show perfect agreement between results when converting to the new version. This is especially the case for very old assessments (e.g., yellowtail rockfish, blue rockfish, and California scorpionfish). However, it is important for analysts who are bridging to the new version to try and understand the source(s) of the differences.

During discussion there was a question about whether the new version has fixed a problem identified during the last round of assessment that the minimum effective sample size for composition data could not be reduced below one, but it was unclear whether this had been taken care of yet. There was also a question about whether there was an option available in the new version for the Ricker stock-recruitment relationship with a power parameter.

H. Review of the Draft "Accepted Practices Guidelines for Groundfish Stock Assessments

During the final hours of the meeting the group reviewed the draft Accepted Practices Guidelines document and made some changes to the text. The proposed changes are flagged in a revised version of the Guidelines that has been included in the Briefing Book for the March 2017 Council meeting.

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2017 SSC Review of Recommendations from Science Workshops and Assessment Methodology Reviews; Agenda Item I.2.a, REVISED Supplemental SSC Report, March 2017

The Scientific and Statistical Committee (SSC) discussed reports and recommendations from two workshops and one methodology review, conducted in the fall and winter of 2016-2017, to support groundfish stock assessment data, science and analytical methods. The SSC also discussed reports from the Oregon Department of Fish and Wildlife (ODFW) and the Groundfish management Team (GMT).

I.2, Attachment 1: Report of the Groundfish Historical Catch Reconstruction Workshop

Dr. David Sampson (SSC Groundfish Subcommittee Chair) provided an overview of the Groundfish Historical Catch Reconstruction Workshop. The focus of the workshop was on understanding and improving analytical approaches for estimating total catches at the species level prior to 1981 (the PacFIN and RecFIN era), although some presentations discussed potential improvements for the analysis of more recent data (including uncertainty estimates).

Presentations on catch reconstructions for all three West Coast states were included, and potential improvements to all of these efforts were identified. There was greater emphasis on the Washington catch reconstruction, which is less developed than those in California and Oregon. The workshop included an attempt to recreate catch reconstructions used in recent assessments with data queries and analyses conducted on site. This revealed inconsistencies for some species, including historical catches of darkblotched rockfish, which will be revised for the 2017 stock assessment update.

Dr. Theresa Tsou (WDFW) provided the SSC with an update regarding Washington catch history reconstruction efforts conducted since the workshop, focused on lingcod and rockfish, to support upcoming assessments. There was uncertainty as to whether the Washington reconstruction will include complete or partial historical tribal landings.

The SSC is in agreement with the recommendations in the workshop report, noting that several of the recommendations address issues relevant to upcoming stock assessments. The SSC is supportive of a methodology review for the Bayesian methodology for model-based catch estimation as an off-year science activity in 2018. Finally, it was noted that there is still much

more work to be conducted in improving catch reconstructions in all three states, and ongoing or anticipated future efforts should be reviewed at future catch reconstruction workshops.

I.2, Attachment 2: Groundfish Productivity Workshop Report

Dr. Martin Dorn (AFSC) provided an overview of the report of the Groundfish Productivity workshop. The format of the meeting was presentations by scientists in academia and management agencies. Most talks focused on the challenges associated with estimating spawner-recruit relationships, including the functional shape of such relationships and the resulting uncertainties associated with subsequent estimates of productivity and potential yield.

The report includes extended abstracts, highlights of panel discussions, and a series of recommendations and conclusions. The SSC recommends adopting the ten recommendations and conclusions listed in the workshop report, with the following caveats:

The SSC clarifies that recommendation 5b ("Evaluation of different three-parameter models and alternative leading parameters for incorporation into Stock Synthesis") reflects the desire to include a wider range of alternative stock recruit relationship functional forms in the Stock Synthesis modeling platform. Similarly, recommendation 5d refers to the need to continue to perform meta-analyses that assume nonparametric shapes.

With respect to point 7 (regarding the gradual increase of steepness estimates for rockfish from ~0.6 to ~0.8 since the initial productivity workshop in 2002), the SSC notes that the most recent estimate of the steepness prior suggests a decline in the steepness point estimate from ~0.78 to ~0.72. This would lead to less of a difference between inferred productivity (yield) from the steepness prior estimate and the lower yield associated with the SPR-based reference points used by management. The SSC recommends that a workshop that includes specific analyses exploring the consistency among reference points be scheduled for the next non-assessment year in 2018.

I.2, Supplemental SSC Groundfish Subcommittee Report on the Review of Assessment Methodologies Proposed for Use in 2017 Assessments

Dr. David Sampson presented an overview of the results of the Groundfish Subcommittee Report on the Review of Assessment Methodologies. The SSC recommends adopting the recommendations in the workshop report, and will revise the Accepted Practices Guidelines for Groundfish Stock Assessment document accordingly, with the following modifications:

The SSC discussed the geostatistical GLMM software developed and maintained by Dr. Jim Thorson (VAST, vector autoregressive spatial temporal model, www.fishstats.org). For fisheries-independent survey data, the software includes a range of options that can either replicate previously recommended model complexity levels or use more advanced analytical methods. The SSC recommends that analysts have the latitude to use this software, and strongly encourages analysts to compare model results with and without autoregressive features. Analysts need to provide appropriate diagnostic statistics if they intend to use the geostatistical features of the model.

With respect to the revised set of priors for natural mortality (M), the recommendation should be to set the fixed value equal to the median rather than the mean value of the prior.

I.2.a, ODFW Report: Regarding Speciation of Unspecified Rockfish Landings in Oregon for Inclusion in Stock Assessment Time Series of Removals

Mr. Patrick Mirick (ODFW/GMT), discussed results of this analysis with the SSC. He noted that for species that had their own market categories (such as Pacific ocean perch), catches do not change much, but total landings of other species do undergo substantive changes (such as darkblotched and yelloweye). This document should be consulted in the development of rockfish catch histories from Oregon.

Agenda Item I.2.a, GMT Report 2: Groundfish Management Team (GMT) Report 1: Discard Mortality Rates Applicable to the Nearshore Fishery

The SSC discussed the GMT report on discard mortality rates applicable to the nearshore fishery. The SSC concurred that if fishing practices in the nearshore sectors are comparable, then it would be reasonable to apply the previously endorsed recreational mortality rates to the commercial nearshore fishery using "sport-like" jig and pole gears for the 20 to 30 fathom depth bin. However, the SSC did not review a complete comparison of fishing practices between the two sectors.

With respect to the mortality rates applied with the use of a descending device, the GMT report expressed a diversity of opinions regarding whether recreational rates should be applicable to the nearshore commercial fishery. Given these concerns, the SSC would recommend a more formal analysis be conducted prior to considering a change in these rates.

SSC Notes:

Re: Productivity workshop report- Relative to revisiting inconsistencies between steepness and adopted SPR targets, interest was expressed in replicating analyses presented at the first productivity workshop by Robin Cook regarding replacement values for recruits per spawner under a range of harvest rates.

Re: Subcommittee Report on the Review of Assessment Methodologies- The SSC concurs with the workshop report recommendation to endorse the Francis method (TA1.8) for weighting age, length- and conditional age-at-length compositional data. Assessment documents should include sensitivity runs that use (a) the MI harmonic mean weighting approach as well as (b) the Dirichlet multinomial likelihood approach, as a means to gauge the uncertainty associated with the choice of methodology.

Another revision included a change to the guidelines for using maximum age estimates from within assessment areas, to add the term "generally" to that recommendation.

One issue in developing the natural mortality prior was what is the correct way to estimate the variability of the relationship between maximum age and M. Don Gunderson estimated this using a confidence interval in one paper, essentially assuming all observed variation was due to

estimation error in the values of M used on the meta-analysis. This approach would to the same median estimate, given M, but a very different mean.

Add language to the accepted practices document to the effect that CA historical catch reconstruction might not include some CA landings caught in OR, lingcod catches can be easily developed, but rockfish will not be assigned to species level prior to assessment cycle.

Re- ODFW report on unspecified rockfish landings- It was noted that there are still unidentified rockfish species codes (URCK) in Washington landings as well. The SSC also noted that the term "speciation" typically refers to the formation of new and distinct species in the course of evolution, and the term "species assignments of unspecified rockfish landings" would be a more accurate reflection of the content of this report.

Re: GMT Report 1: Groundfish Management Team informational report on sablefish and lingcod discard mortality rates. It was noted that WCGOP includes discard mortality credits for sablefish and lingcod that were not applied to the shorebased IFQ program. The SSC was not asked to review this document, and did not review or discuss the document in detail.

RE: GMT Report 2: T Groundfish Management Team report on discard mortality rates applicable to the nearshore fishery- the report indicates that the SSC has in the past concurred that that mortality rates applied to the charter vessel fleet could be extended to private boats and commercial nearshore catches, essentially removing the mortality buffer in waters deeper than 20 fathoms for the commercial nearshore fishery. However, a clear record of this endorsement could not be readily located, although a recommendation that "additional research should be pursued" was found.

2017 Arrowtooth Flounder Update Assessment; Sampson et al. 2017

Addressing the following research and data needs could improve future assessments of arrowtooth flounder.

1) *Reevaluation and reconstruction of historical flatfish removals, including arrowtooth flounder*. Historical estimates of discards are a large contributor to total removals. The current modelling exercise of using co-occurring flatfish species as predictors of discard could use further exploration. The arrowtooth flounder catch history for Washington should be reconstructed using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical landings needs to be done comprehensively (i.e., with other species) to ensure efficiency and consistency.
2) *Reevaluation of the value of stock-recruitment steepness for arrowtooth*. In the base case model, steepness was set at 0.902 based on Dorn's meta-analysis (personal communication). While model results are not sensitive to the value of steepness, it would have an effect on MSY calculations and OFL and ABC values at lower stock sizes.
3) *Research to provide information on survey catchability*. The absolute scale of the stock is still quite uncertain. The calculated catchability associated with the NWFSC trawl survey ranges from 0.2 to 0.8 across the three states of nature.

4) *Evaluation of stock boundaries and the feasibility of a bilateral assessment with Canadian scientists*. This could perhaps be accomplished through the Technical Subcommittee (TSC) of the US Canada groundfish working group.
5) *Evaluation of maturity and fecundity relationships*. New studies on both the maturity and fecundity relationships for arrowtooth flounder would be beneficial. The maturity versus length relationship used in this update and the 2007 assessment is based on a study done in 1993.
6) *Age-reading of otoliths from the fishery off California*. A collection of unread arrowtooth flounder otoliths that is available for fish landed in California should be read to provide possibly more representative age-at-length compositions for the fishery. The fishery age-at-length compositions in this update assessment were based entirely on fish landed in Oregon and Washington.
7) *Evaluation of the spatial variability of productivity processes*. The extent of spatial variability on productivity processes such as growth, recruitment, and maturity is currently unknown and would benefit from further research. This stock shows clear evidence of a latitudinal gradation in abundance and other traits.

2017 Blackgill Rockfish Update Assessment; Field and He 2017

Age estimates are highly uncertain and this species has proven very difficult to age, which is not uncommon for deepwater species that inhabit environments where seasonal variability is muted. There is some indication of aging bias between ages developed for the 2011 assessment and for this update, despite the fact that they were aged by the same reader, using the same age determination criteria. Conducting cross reads with other laboratories, as well as consideration of alternative age validation and bias evaluation methods, are important factors for future efforts.

Both the previous assessment and a subsequent publication indicate differences in size-at- maturity over space, with fish maturing at larger sizes (older ages) further north. Although recent histological studies have shown that this species is slow to mature and often undergoes abortive maturation (particularly at younger ages), additional investigations into spatial and potentially temporal variability in reproductive parameters would be optimal.

There also appear to be latitudinal clines in growth and potentially other life history parameters that are not accounted for in the model, greater exploration of possible differences in age structure and growth, as well as maturity, throughout the range of this stock are desirable. As this species occupies a wide range of depths, some investigation of the potential effects of depth on growth variability may also be desirable.

Recent efforts to analyze spatially explicit historical catch data have indicated that fisheries for this and other rockfish species tended to fish deeper waters, further offshore, in more inclement weather over time, suggesting that historical catches of this deeply distributed species may be overestimated. In general, historical catches remain very uncertain for this (and other) rockfish stocks. The potential for the fishery to sequentially deplete regions of abundance for this species could also bias estimates of stock status and productivity if length composition data do not reflect a constant mortality rate exhibited on the whole of the stock biomass.

A large fraction of blackgill habitat is currently closed to both fishing and survey effort in the Cowcod Conservation Areas (CCAs), complicating efforts to interpret both catch and survey data. Alternative means of exploring relative or absolute abundance in this region is a key research priority. Submersible or other survey methods could potentially provide additional habitat and abundance information for this species as they have for others.

Greater investigation into the likely or plausible consequences of a shoaling of the oxygen minimum zone (OMZ) on blackgill habitat will aid in evaluating threats to this species that may be posed by global climate change.

As the slope environment is dominated by a relatively small number of species, for which respectable abundance and food habits information exists on key predators (such as sablefish and shortspine thornyheads), this environment could be an ideal one for exploring the consequences of fishing on trophic interactions and altered predator abundance levels.

2017 Blue and Deacon Rockfishes Assessment; Dick et al. 2017

Draft Research Recommendations – Subject to Change:

1. There appears to be no routine sampling procedures in place to sample the catch for ageing structures or biological data in the California fishery. Collection of representative ageing data is important for stock assessment and should be instituted for California.

2. A fishery independent survey should be developed for nearshore species off California and Oregon. Several possibilities should be explored. For a nearshore survey to be viable over the long term, it will be important to keep the cost of the survey low and engage in a collaborative effort with the fishing industry. An effort should be made to distribute sampling sites according to a design that would allow both local and state-wide estimates of abundance, and to evaluate density both in nearshore and offshore waters. Some alternatives for a near-shore survey include:
    a. An acoustic survey for rockfish distributed in mid-water such as black rockfish and blue/deacon rockfish. Anecdotal information suggests that black rockfish and blue/deacon rockfish schools are distinguishable. Descending cameras can be used for species identification. The preliminary ODFW acoustic project to survey black and blue/deacons rockfish needs to be peer-reviewed. Acoustic surveys can produce an estimate of absolute abundance if properly calibrated and acoustic target strength is sufficiently well known.
    b. ROV surveys of rocky reef habitat. ROV surveys are usually used to survey near-bottom species, which may be a problem for species that are often found in the water column, such as black rockfish and blue/deacon rockfish. An ROV survey can produce an absolute estimate of abundance for near-bottom species if the sighting function can be estimated, such that quantitative methods are used to estimate density.
    c. A standardized hook-and-line survey such as is used by the California Collaborative Fisheries Research Program to study changes in density inside and outside MPAs, and is being developed by the Washington Department of Fish and Wildlife. This would

only provide an index of relative abundance, so a time series would be needed to inform the assessment.

3. Better characterization of habitat is needed for fishery CPUE index development. Oregon and southern California do not have the same coverage of mapping as the rest of California in nearshore waters. Other environmental descriptors in addition to rocky reef substrate and depth strata should be evaluated. Standardization of methods would allow for comparisons across larger areas (e.g. between states).

4. Ad hoc criteria are used to identify a threshold when applying the Stephens and MacCall method of selecting records for CPUE index development. Further research is needed to determine whether threshold selection criteria can be optimized.

5. Modeling discard as a separate fleet, as was done for blue/deacon rockfish, is a simple and intuitive approach, but the strengths and weaknesses of this approach are unclear. This method should be compared to the more standard approach of modeling discard with retention curves to ensure the model results are not strongly affected by the method used.

6. The Markov chain Monte Carlo (MCMC) method implemented in Stock Synthesis is not reliable in many cases. Characterizing uncertainty of the final assessment model is important, and MCMC offers advantages over asymptotic approximations using the Hessian or likelihood profiles.

7. Several alternative approaches were used this year to construct decision tables, and some approaches may be better than others. The stock assessment TOR should outline the various methods that can be used, and provide recommendations if possible on preferred approaches.

8. Additional genetic work is needed to describe the geographical distribution of blue and deacon rockfish. The SWFSC juvenile rockfish survey is a good platform for genetic samples because it is a fisheries independent survey and the survey spans the geographic area where transition occurs from predominately blue rockfish to predominately deacon rockfish. If the relatively clear break in geographic distribution at San Francisco is reinforced by additional information, consideration should be given to separate assessments north and south of this boundary. DNA sampling of historically collected otoliths should continue.

9. Evaluate the effect of MPAs creation on nearshore recreational fishery CPUE indices in California.

10. Age validation study is needed given differences in ageing criteria between the SWFSC and the Oregon age readers for blue/deacon rockfish.

11. Consider a formal process of soliciting local and traditional knowledge regarding blue/deacon rockfish behavior, seasonal and ontogenetic movement, and density by depth strata to inform the next assessment.

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11) Consider a formal process of soliciting local and traditional knowledge regarding blue/deacon rockfish behavior, seasonal and ontogenetic movement, and density by depth strata to inform the next assessment.

2017 California Scorpionfish Assessment; Monk et al. 2017

There are a number of areas of research that could improve the stock assessment for California scorpionfish. Below are issues identified by the STAT team and the STAR panel:

1) Both natural mortality and steepness were fixed in the base model. The natural mortality estimate used the assessment was based on maximum age. The collection of age data for older females may improve the ability to estimate female natural mortality in the model. The NWFSC trawl survey was the only available source of age data for this assessment, of which there were a number of age-1 fish and the data were dominated by males. It may also be possible to evaluate mortality by quantifying predation by major predators of scorpionfish, such as octopus.
2) Tagging study to estimate natural mortality for scorpionfish should be considered. This project could be designed as a cooperative research project with the charter fleet in southern California.
3) California scorpionfish has not been fished to a level where information on steepness is available. A meta-analysis for species with similar breeding strategies to California scorpionfish could be conducted if data are available. A meta-analysis of steepness should be done for species with the same reproductive strategy as scorpionfish.
4) No available information on the status of California scorpionfish in Mexico could be found. A number of emails were sent to researchers in Mexico and none were returned. It is known that a portion of the stock resides in Mexico and that boat leaving from San Diego target California scorpionfish off the Coronado Islands.

5) The sex ratio in both Love et al. (1987) and samples from the NWFSC trawl survey were skewed towards males. Data on sex ratios from the recreational or commercial fisheries would help in determining the sex ratio of the population.
6) Aggregative behavior in both spawning and non-spawning seasons of California scorpionfish is not well understood. Studies are needed to evaluate the environmental or ecological conditions that govern this behavior.
7) A reproductive biology study of California scorpionfish is needed. There are currently no estimates of fecundity for California scorpionfish. Love et al. (1987) has published the only estimates of maturity for California scorpionfish, but the original copies of the data are no long available. Some data on the spatial distribution of the eggs are available from CalCOFI, but were not keypunched to the species level.
8) California scorpionfish mature at a young age, and additional data can help inform the maturity ogive.
9) No studies have been done of the relationship between weight and reproductive output. California scorpionfish have a different reproductive strategy than rockfish, and seasonal protection of spawning areas may help maintain reproductive capacity of the stock.
10) Many scorpionfish are discarded at sea. The assessment used estimates of discard mortality of a distantly related species (lingcod) in a different ecological setting. Studies of discard mortality are needed to parametrize the assessment model.
11) The relationship between environmental conditions and recruitment for scorpionfish should be further explored. Preliminary exploration using CalCOFI temperature data suggested that a relationship existed, but other time series may correlate more strongly given that scorpionfish are a near-shore species. Scorpionfish appear to be a relatively hardy and adaptable species and may expand northward in a warming climate.
12) Ad hoc criteria are used to identify a threshold when applying the Stephens and MacCall method of selecting records for CPUE index development. Further research is needed to determine whether threshold selection criteria can be optimized.
13) Modeling discard as a separate fleet, as was done for California scorpionfish, is a simple and intuitive approach, but the strengths and weaknesses of this approach are unclear. This method should be compared to the more standard approach of modeling discard with retention curves to ensure the model results are not strongly affected by the method used.
14) The Markov chain Monte Carlo (MCMC) method implemented in Stock Synthesis is not reliable in many cases. Characterizing uncertainty of the final assessment model is important, and MCMC offers advantages over asymptotic approximations using the Hessian or likelihood profiles.
15) Several alternative approaches were used this year to construct decision tables and some approaches may be better than others. The stock assessment TOR should outline the various methods that can be used, and provide recommendations if possible on preferred approaches.
16) Additional biological information (sex, otoliths, depth distribution) should be collected for California scorpionfish during the Publicly Owned Treatment Works (POTWs) trawl survey and the Southern California Bight Regional Monitoring Project (SCCWRP) trawl survey.
17) An age validation study is needed for California scorpionfish.
18) CalCOFI ichthyoplankton surveys in southern California do not currently identify scorpionfish eggs to species, though it is possible to do this in southern California waters. Species-specific identification of scorpionfish eggs is recommended to develop spawning output index for use in the next stock assessment.

1) A reproductive biology study of California scorpionfish is needed. The maturity estimates that were used in the assessment are dated and cannot be reproduced. No studies have been done of the relationship between weight and reproductive output. Scorpionfish have a different reproductive strategy than rockfish, and seasonal protection of spawning areas may help maintain reproductive capacity of the stock.

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11) A meta-analysis of steepness should be done for species with the same reproductive strategy as scorpionfish.

12) Aggregative behavior in both spawning and non-spawning seasons of California scorpionfish is not well understood. Studies are needed to evaluate the environmental or ecological conditions that govern this behavior.

13) The natural mortality estimate used the assessment was based on maximum age. It may be possible to evaluate mortality by quantifying predation by major predators of scorpionfish, such as octopus.

14) Tagging study to estimate natural mortality for scorpionfish should be considered. This project could be designed as a cooperative research project with the charter fleet in southern California.

2017 Lingcod Assessment; Haltuch et al. 2017

Most of the research needs listed below entail investigations that need to take place outside of the routine assessment cycle and require additional resources to be completed.

1) Age validation of lingcod to quantify aging bias.
2) Development of a transboundary assessment.
3) Investigation of the proportion of fish caught in Mexico and landed in U.S. ports.
4) Consider other survey techniques (e.g., longline, combined lingcod/sablefish pot survey, trap surveys) for lingcod as they occupy untrawlable habitat.
5) Investigate environmental covariates for recruitment and time-varying growth and availability inshore.
6) Investigate the impact of male nest-guarding on reproductive output.

2017 Lingcod STAR Panel Report; Sampson et al. 2017

Specific recommendations for the next lingcod assessment

1) Prior to the next iteration of this assessment the age data available from the fishing fleets should be carefully screened to identify and possibly rectify aberrant data.
2) There should be a study to cross-validate age-readings of lingcod among the different laboratories contributing age data to the assessment. It may be necessary to develop laboratory-specific (and possibly year-specific) ageing-error vectors.
3) Available information on lingcod catches, abundance trends, and age-compositions should be acquired from Canadian and Mexican authorities to take an initial step towards a more spatially-comprehensive view of lingcod population trends and dynamics.
4) The next iteration of this assessment could be an update assessment. If a full assessment is done it should explore developing a spatial model that encompasses the northern and southern areas rather than again treating them as independent stocks, as in the current and previous assessments.

General recommendations for all assessments

1) Modify the software used to develop length- and age-compositions from PacFIN data so that unsexed fish are flagged rather than including them in compositions after the automatic application of an assumed sex-ratio (e.g., 50:50). If the analysts preparing the composition data need to develop sex-ratio coefficients to accommodate unsexed fish (e.g., by length-bin), the assessment documents should clearly state the methods and data used for this purpose and the resulting sex-ratio coefficients.

2) If assessments use marginal age-compositions the STATs should evaluate whether the raw data are consistent with random sub-sampling from the available lengths. If the ages appear to have been subsampled non-randomly (e.g., no more than 5 fish from any length-bin), the age data should be suitably expanded to reflect the variable sampling fraction.
3) A standard approach for combining conditional age-at-length sample data into annual CAAL compositions should be developed and reviewed. If age data are not selected in proportion to the available lengths, simple aggregation of the ages by length-bin may provide biased views of the overall age-composition and year-class strength.
4) Comprehensively evaluate whether the Triennial survey should be split into early and late segments and the basis for making the decision. The lingcod assessment split the Triennial survey into separate early and late surveys, whereas there was a single Triennial survey in the draft assessment for Pacific ocean perch brought to this STAR.

2017 Pacific Ocean Perch Assessment; Wetzel et al. 2017

There are many areas of research that could be improved to benefit the understanding and assessment of Pacific ocean perch. Below, are issues that are considered of importance.

1) **Natural mortality**: Uncertainty in natural mortality translates into uncertain estimates of status and sustainable fishing levels for Pacific ocean perch. The collection of additional age data, re-reading of older age samples, reading old age samples that are unread, and improved understanding of the life history of Pacific ocean perch may reduce that uncertainty.
2) **Steepness**: The amount of stock resilience, steepness, dictates the rate at which a stock can rebuild from low stock sizes. Improved understating regarding the steepness parameter for US west coast Pacific ocean perch will reduce our uncertainty regarding current stock status.
3) **Basin-wide understanding of stock structure, biology, connectivity, and distribution:** This is a stock assessment for Pacific ocean perch off of the west coast of the US and does not consider data from British Columbia or Alaska. Further investigating and comparing the data and predictions from British Columbia and Alaska to determine if there are similarities with the US west coast observations would help to define the connectivity between Pacific ocean perch north and south of the US-Canada border.

2017 Pacific Ocean Perch STAR Panel Report; Sampson et al. 2017

Specific recommendations for the next assessment of Pacific ocean perch (POP)

1) Further investigation of POP stock structure is recommended. One approach would be to look for correlations of U.S. West Coast recruitment deviations and survey biomass estimates with corresponding results from POP assessments in Canada and the Gulf of Alaska.
2) The next iteration of this assessment could be an update assessment.

General recommendations for all assessments

1) Comprehensively evaluate the appropriateness of using the Triennial survey in assessments for other rockfish species.
2) Explore the assumption that conditional age-at-length data are random samples of the age-composition.
3) A standard approach for combining conditional age-at-length sample data into annual CAAL compositions should be developed and reviewed. If age data are not selected in proportion to

the available lengths, simple aggregation of the ages by length-bin may provide biased views of the overall age-composition and year-class strength.

4) Further explore the VAST approach for constructing relative abundance indices. The upcoming workshop at the Center for the Advancement of Population Assessment Methodology (CAPAM) will address this issue.

2017 Yelloweye Rockfish Assessment; Gertseva et al. 2017

The following research could improve the ability of future stock assessments to determine the status and productivity of the yelloweye rockfish population:

A. The available data for yelloweye rockfish remains relatively sparse given the limited sampling effort available under the rebuilding plan. It is essential to continue yelloweye data collection, especially in this recent period, to provide a fuller picture of age structure and population dynamics. Further length and age collections will also refine estimate of year class strength in the late 2000s, which will improve estimates of stock status and productivity.

B. Poorly informed parameters, such as natural mortality and stock-recruit steepness will continue to benefit from meta-analytical approaches until there is enough data to estimate them internal to the model. A more thorough examination of yelloweye longevity off the West Coast of the United States is needed to get a better understanding of natural mortality.

C. The age data used in this assessment were generated by two ageing laboratories, the WFDW ageing lab and the NWFSC ageing lab. Even though growth estimates from these two labs are similar, there are still questions regarding the level of bias and precision in the ages coming from each lab. A larger, systematic comparison of age estimates between labs as well as with outside agencies could help resolve the issue of between-lab agreement. To this end, WDFW and NWFSC labs have been in correspondence and are currently seeking resolution to this issue.

D. Continue to refine historical catch estimates. Disentangling catch and biological records between Oregon and Washington would allow further spatial exploration. A better quantification of uncertainty among different periods of the catch history among all states would also be beneficial. These issues are relevant for all West Coast stock assessments.

E. Continue to evaluate the spatial structure of the assessment, including the number and placement of boundaries between areas. While this assessment took a step back from a more refined spatial resolution given data limitations, further detailed examination of yelloweye rockfish stock structure would be useful. This includes the exploration of area-specific life history characteristics and recruitment.

F. Develop and implement a comprehensive visual survey, as currently available bottom trawl surveys do not encounter yelloweye rockfish often and the hook-and-line IPHC survey targets halibut and incidentally encounters rockfish.

G. Yelloweye rockfish is a transboundary stock with Canada. However, a legal mandate and management framework for using the advice of a transboundary stock assessment does not exist. Data sharing is currently happening at a scientific level with Canadian scientists. A

transboundary (including Mexico) stock assessment and the management framework to support such assessments would be beneficial. This is relevant to many stocks off the West Coast of the United States.

Most of the research needs listed above entail investigations that need to take place outside of the routine assessment cycle and require additional resources to be completed.

2017 Yelloweye Rockfish STAR Panel Report; Field et al. 2017

Although data are available from a number of sources to inform this model, both index and compositional data to inform this stock remain relatively sparse. Efforts to increase sampling for length and age data would be very beneficial for future assessment efforts.

In evaluating the results of age determination cross-reads between WDFW and NWFSC age estimates, it has become apparent that there may be some bias in age estimation methods by one or another of these laboratories. Specifically, there is some indication that while there was strong agreement on fish up to age 32, age estimates produced by WDFW efforts for older individuals are significantly older than estimates on the same fish produced by both the NWFSC and the Alaska Department of Fish and Game (ADFG). Given the high sensitivity of the model results to the presumed values of natural mortality, which are greatly informed by age distributions, further investigation into the likely causes of these discrepancies would be a very high research priority. Additional research efforts to confirm age estimation results using age validation methods (such as bomb radiocarbon or lead 210 validation) would also be beneficial in resolving such differences.

The IPHC longline survey index is based on a delta-GLMM in which station effects represent the spatial information to inform the model. As most stations do not regularly encounter yelloweye, this approach results in exclusion of nearly half of the positive observations available from this survey to inform the index. Analysis to investigate whether a geostatistical approach, using the VAST package and/or other geostatistical methods, instead of fixed station effects, may improve the information content of this index for future assessments.

A long standing research recommendation for this (and other) stocks has been the development of appropriate surveys (such as some form of hook and line, and/or visual survey) that could lead to indices that might better inform assessments. Selectivity of the surveys was a large source of uncertainty identified in the sensitivity analysis (Figure 9). When selectivity was estimated the model the result was dome shaped for not only the recreational fisheries, but for others as well resulting in depletion of 72.8% and implausible values of spawning biomass in 2017 (2412 mt vs. 323 mt for the base case). While the degree of dome shape resulting from free estimation may not be plausible, estimation of a representative selectivity proved difficult without data to inform what size classes were present yet unobserved. Assuming selectivity is asymptotic results in more conservative estimates of scale and depletion. As the current base model estimated asymptotic selectivity for all fishery independent and fishery-dependent data sources, despite some indication that older, larger fish may be more associated with rockier habitat, greater evaluation of data from recent or ongoing visual surveys could be beneficial in helping to inform likely selectivity patterns in future assessments. A closely related observation is that this stock appears to be considerably less vulnerable to the NWFSC bottom trawl survey in California waters relative to those off of Oregon and Washington, a pattern noted for other stocks as well (e.g., yellowtail

rockfish). Understanding these possible differences in catchability, as may be associated with habitat preferences or other factors, would be beneficial.

Many historical catch estimates remain highly uncertain and would benefit from greater refinement and improvement, including the potential to develop estimates of uncertainty over time and greater precision with respect to catch versus landing locations, if feasible (note that more explicit recommendations are highlighted in the catch reconstruction workshop report from 2016).

Future work is recommended on the recruitment redistribution process for area-specific models to either support or reject the assumptions behind the spatial recruitment distribution dynamics inherent in stock synthesis. The restriction to a single value across years may be constraining- options to address this could include time blocking or revising the model structure such that it would take the ratio of spawning stock on one or the other side to help inform how recruitment is distributed over time.

As the yelloweye rockfish population at the northern end of the range likely represents a transboundary stock and resource, work towards a combined US/Canadian stock assessment would greatly aid our overall understanding of stock status.

Common documentation of data streams and sources to support fishery independent and fishery dependent indices and compositional data could reduce the burden on assessment analysts to provide details about each data source, and allow reviewers a robust source of information on the most important, common data sources for any given stock assessment cycle.

2017 Yellowtail Rockfish Assessment; Stephens et al. 2017

The following research will be valuable for future Yellowtail Rockfish assessments:

1) A hindrance to analysis of the commercial fi is the inability to distinguish between midwater and trawl gear, particularly in the 1980s-1990s. Reliable recording of gear type will ensure that this does not continue to be problematic for future assessments.
2) We recommend that the next assessment of the Northern stock be an update to this assessment, unless fi patterns change dramatically, or new sources of data are discovered.
3) For the next full assessment, we suggest the following:
    - A commercial index in the North. This is by far the largest segment of the fi y, and the introduction of the trawl rationalization program should mean that an index can be developed for the current fi when the next full assessment is performed.
    - Further analysis of growth patterns along the Northern coast. The previous full assessment subdivided the Northern stock based on research showing diff tial growth along the coast, and although data for the assessment is no longer available along the INPFC areas used in that analysis, there may be some evidence of growth variability that would be useful to include in a future assessment.
4) The Southern stock cannot be evaluated with a full statistical catch-at-age model unless more data are made available. In particular, we feel that the following are minimally required:
    - A longer time series of the juvenile rockfish CPUE in the south, which will of course only be available after several years have elapsed.
    - A time series of recent ages for the Southern model. The commercial age time series currently stops in 2002. Otoliths have been collected for all years in the Hook & Line survey, however only samples from 2004 have been aged.

The age data available for the northern model are strongly indicative of a higher natural mortality rate for female yellowtail rockfish. Yellowtail are one of several rockfish species that demonstrate this apparent difference in sex ratios at age, and historically there has been concern regarding whether differential natural mortality rates throughout the lifespans of populations are reasonable, whether these differences reflect greater mortality rates of older females, or whether these difference reflect some manifestation of dome-shaped age-based selectivity (such that older females are less vulnerable to fisheries or surveys, presumably as a result of habitat associations). These models did not explore alternative explanations for these differences at the level that has been done for other stock assessments (such as Canary and Black Rockfish, where increasing natural mortality rates for females with age, as well as both size- and age-based dome-shaped selectivity have been explored). Given the richness of age data for yellowtail rockfish in the north, additional investigations that better quantify the phenomena, and evaluate potential mechanisms for the observed discontinuities, should be pursued.

The draft northern yellowtail assessment models included indices of relative abundance based on fishery-dependent time series, including a trawl logbook CPUE index and an index of abundance based on yellowtail bycatch in the at-sea Pacific whiting fishery. Upon greater discussion of challenges associated with the development of these indices, particularly with regards to possible differences by state in the resolution of market categories in the logbook data, and how the bycatch rate information was standardized for the whiting fishery bycatch index, the STAT recommended exclusion of both indices in the final base model. However, as the indices were influential with respect to model results, greater exploration of the potential for these data to inform a relative abundance index, particularly for the trawl logbook CPUE data, would benefit future assessment efforts.

As yellowtail rockfish is a semipelagic species, it may not always be reliably sampled in bottom trawl surveys, particularly if the depth distribution is sensitive to environmental conditions (for example, for widow rockfish it has been suggested in the past that El Niño years or other periods of low productivity, individuals may have a more benthic, relative to pelagic, distribution and therefore be more vulnerable to bottom trawl surveys). Consideration of alternative survey methods (e.g., acoustic surveys, midwater trawl surveys) and/or the means to account for changes in catchability that may be associated with environmental factors, could improve the ability of survey indices to track stock abundance.

For the southern yellowtail model, the STAT and STAR Panel discussed a number of priorities. Given the importance of age and length compositional data, and the sparseness of such data available for the southern model, developing additional age data from available sources (such as the hook and line survey, and reproductive ecology studies at the SWFSC) should be a fairly high priority. The means to best ensure reasonably comprehensive sampling of commercial, and if possible recreational, fisheries catches with sex and maturity information is also a high priority for this (and other) stocks, particularly to the extent that future management changes enable greater fishing activities and landings for these populations.

Additional efforts to improve recreational and fisheries-independent indices for the southern model should also be undertaken. For example, there were conflicting trends in the onboard observer index (reflecting yellowtail catches throughout all California waters) and the NWFSC hook and line survey (reflecting catches in the northern part of the Southern California Bight). Investigating

whether this reflects a fundamental difference in signal, or whether this might reflect regional differences in catch rates, which could be evaluated by subsetting the recent onboard observer data to overlap the spatial scale of the hook and line survey, would be worth greater scrutiny in advance of any future assessment.

As both genetic studies and past assessments have indicated differences in stock structure and life history parameters, greater evaluation of region-specific life history parameters (such as growth, maturity, fecundity) would also likely benefit future assessment efforts both within and between the two assessment areas. For example, as the NWFSC hook and line survey is at the southern extent of the range of the southern stock, this might include potential differences in growth and maturity among different subregions within the southern model range, to evaluate the potential utility of indices and age data from that survey in a future southern base model. Such studies should be feasible based on the relatively rich amount of data available to inform the northern assessment.

It was ultimately not possible to fully evaluate the influence of the pelagic juvenile index on the southern model results during the panel review, however there was some concern that the index could have been overly influential in the model due to the lack of age or length compositional data in the recent time period that might conflict with the juvenile abundance signal. Greater scrutiny regarding the potential utility of this index should be given if the index is to be included in future models

As northern yellowtail presumably represents a transboundary stock and resource, work towards a combined US/Canadian stock assessment would greatly aid our overall understanding of stock status.

Common documentation of data streams and sources to support fishery independent and fishery dependent indices and compositional data could reduce the burden on assessment analysts to provide details about each data source, and allow reviewers a robust source of information on the most important, common data sources for any given stock assessment cycle.

Recommendations from the 2015 Assessment Cycle

2015 SSC Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental SSC Report, September 2015

The Scientific and Statistical Committee (SSC) reviewed possible topics for off-year science workshops related to improving groundfish stock assessments for the 2019-20 management cycle based on recommendations from recent Stock Assessment Review (STAR) panels (Agenda Item G.4a, Attachment 1). The SSC identified three priority topics for off-year science workshops. These three workshops were also recommended in 2013 (and two of them in 2011), but could not be completed for various reasons. The SSC continues to regard them as priority topics.

Successful workshops require dedicated research, careful organization before the workshop, and post-meeting development of scientific reports, all of which come at a cost of time and resources. The Council should be cognizant of the trade-off between the number of workshops that are held and amount of progress that can be made on other projects with the potential to improve data inputs and stock assessments.

1. Workshop to review historical landings time series (recommended in 2011 and 2013).
A major effort to reconstruct historical landings was initiated in 2008 in response to the Council's call to compile the best estimates of catch history early in the development of Pacific Coast groundfish fisheries. Currently, this effort has produced published estimates for most California and Oregon fisheries and species. Databases have been developed for raw landings and historical species composition data for Washington, and some analysis should be complete by summer 2016, in time for a workshop. An off-year science workshop would review reconstructions of all landings comprehensively. This review would need to be structured differently than the other proposed workshops, since the most expertise is to be found among current and former employees of state agencies, and experienced fishermen and processors. Formal uncertainty analysis for the historical catch estimates due, for example, to uncertainty in estimates of landings species compositions, would also be an important priority for this workshop.

2. Workshop on estimation of B_{MSY} proxies (recommended in 2011 and 2013).
The Council's harvest control rules depend on estimates of stock size relative to a B_{MSY} proxy, with a default B_{MSY} proxy defined as some fraction of unfished stock size, B_0. Changes in stock assessment methods or data inputs can lead to large changes in estimated B_0, and in some cases to marked changes in depletion levels, overfishing limits, acceptable biological catches, or rebuilding times. This workshop would review alternative control rules (e.g., control rules based on "Dynamic B_0" or on direct estimates of B_{MSY}) and compare their performance with current approaches using management strategy evaluation (MSE). The workshop would build on the last B_0 workshop, but would be more focused on the performance of control rules. It would also include review of stock status for a range of stocks when stock status determinations are based on "Dynamic B_0." The evaluation of control rules could be based on the MSE currently being developed to evaluate rebuilding revision rules.

3. Workshop on the shape of the stock productivity curve (Recommended in 2013).
Recent data-moderate assessment approaches such as Extended Depletion-Based Stock Reduction Analysis (XDB-SRA) are designed to have greater flexibility in how productivity changes with stock size. In contrast, nearly all full assessments of West Coast groundfish use the two parameter Beverton-Holt stock recruit relationship, which imposes strong constraints on the shape of the stock productivity curve. While the approach used in XDB-SRA has conceptual appeal, it is not clear whether such flexibility is appropriate given what is known about the growth and mortality of West Coast groundfish. The two approaches represent a fundamental difference in how stock productivity is modeled, and there are important implications to biomass and fishing mortality reference points used in Council's harvest control rules. The SSC recommends that a scientific workshop be sponsored that would evaluate the suitability of these alternative ways of modelling stock productivity in data-moderate and full assessments. Work to include XDB-SRA's approach for modeling productivity in Stock Synthesis has been conducted, making 2016 an opportune year to review productivity assumptions.

Other potential future workshops discussed include:

- Workshop on methods of data reweighting (recommended in 2013).

The Center for the Advancement of Population Assessment Methods (CAPAM) is holding a workshop on this topic in October, 2015. Depending upon the results of that workshop, there may no longer be a need for a separate west coast workshop on this topic. The issue, while technical in nature, has important consequences, since it is not unusual for assessment results to be fairly

sensitive to the weights given to composition data. These issues apply to groundfish, CPS and other assessments.

- Workshop on transboundary groundfish stocks.

This workshop would address both control rules and transboundary assessments. Current assessments that are limited by political boundaries that are not reasonable assessment boundaries biologically. Transboundary assessments without related international control rules may not result in better management. Work with scientists from Canada and/or Mexico would be helpful prior to and during this potential future workshop.

- Workshop on recreational catch per unit effort (CPUE) standardization.

Several recent stock assessments have depended upon CPUE standardization, relying on a few methods, such as that of Stephens and MacCall (2004). There has been a proliferation of methods in recent years, and a review of alternative methods would be useful to provide consistent advice prior to future assessments.

- Workshop on spatial models.

As with CPUE standardization methods, there is a fair amount of recent research and literature on spatial modeling. A workshop to review alternative methods and provide guidance for stock assessment could be useful in the future.

SSC Notes:

Workshop/SSC subcommittee meeting on management proxies (both F and B proxies).
Harvest rate and biomass target and limit proxies should be readdressed as more and better information is available over time.

2015 GMT Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental GMT Report, September 2015

The Groundfish Management Team (GMT) reviewed the materials under this agenda item and received additional information from Mr. John DeVore, during a joint discussion with the groundfish advisory (GAP) regarding these recommendations. The GMT discussed science activities in preparation for the 2017 stock assessment cycle, as well as projects to resolve significant scientific issues related to groundfish management. Overall, the GMT recognizes that the efforts of the National Marine Fisheries Service (NMFS) Science Centers provide the fundamental science used for conservation and management policies. The GMT recognizes the efforts to improve the accuracy and reliability of stock assessments as one of the most important tasks that can be done. Many of the recommendations put forth below were also recommended as part of the 2011 and 2013 cycles, but have not yet been resolved.

1. Recommendations of High Priority with Major Logistical Needs (not in order of priority)

Review and Synthesis of Stock-recruitment Parameters and Resulting Harvest Proxies

The current proxy F_{MSY} harvest rate that forms the basis for harvest control rules varies by species or species group with $F_{50\%}$ applied to rockfish and elasmobranchs, $F_{45\%}$ for roundfish like lingcod and sablefish, an $F_{40\%}$ harvest for whiting, and an $F_{30\%}$ for flatfish (http://www.pcouncil.org/wp-content/uploads/GF15_16_SpexFEISJanuary2015.pdf, Section 4.3). Generally speaking, higher proxy F_{MSY} values are associated with lower productivity stocks while lower values are associated

with higher productivity stocks, since a stock with low productivity is more vulnerable to overfishing and vice versa. Productivity is reflected by the shape of the stock-recruitment curve, e.g., steepness in the Beverton-Holt curve, used in stock assessments. The accepted steepness prior for *Sebastes* species is estimated through an update to a meta-analysis of Tier 1 stocks (Dorn/Thorson prior, Table 1).

Table 1. Mean of the steepness prior for *Sebastes* species by assessment year.

Year	2007	2009	2011	2013	2015
Steepness	0.51	0.51	0.754	0.78	0.773

Given the increase in the steepness prior from 2009 to 2011, the GMT recommends that both the shape of the productivity curve and resulting F_{MSY} proxy for groundfish be reexamined during the off year if not within the 2017-2018 regulatory specification. With a greater number of assessed stocks contributing to the meta-analysis, it may now be possible to conduct the meta-analysis independently for rockfish species with differing life histories, e.g., black rockfish maturing at ~seven years of age vs. yelloweye rockfish maturing at age 22, for which differing SPR harvest rates may be justified. For example, during the Oregon kelp greenling STAR panel, it was acknowledged that the stock is relatively productive compared to other species of roundfish (mature at two years old), which may justify an SPR harvest rate proxy closer to $F_{45\%}$. The same consideration also arose at the black rockfish STAR panel. **Therefore, the GMT recommends a synthesis of the stock-recruit productivity parameter and reconsideration of SPR harvest rates for these and other groundfish be analyzed as part of the off year science endeavors.** This is similar to the SSC's recommendation for a workshop on the shape of the stock productivity curve (also recommended in 2013).

Reconstruction of Historical Landings Time Series

Time series of historical landings are a key element for stock assessments, including the data-poor assessments, and have been a limiting factor in the ability to assess some West Coast fish stocks. California and Oregon have both produced reconstructions of historical landings time series for a number of species and fisheries. Washington projects that it will have a historical reconstruction by the summer of 2016. Once Washington completes its historical catch reconstruction, the **GMT recommends a workshop to review the historical reconstructions for all three states.** In addition to historical catch reconstruction efforts, the GMT also supports organization of a workshop focusing on the identification and utilization of historical databases (e.g., discard studies) not commonly provided for use in stock assessments. The workshop will depend heavily on the involvement of state agency representatives and those with expert knowledge of the fisheries and their histories. **The GMT also recommends the workshop review analyses available to provide estimates of uncertainty and discard in these fisheries.** Both the GMT and SSC have recommended this task since 2011.

Standardization of Recreational Fishery Data and CPUE Indices

Many of the recent stock assessments, especially for nearshore species, depend heavily on fishery-dependent recreational indices of abundance. It has been common for each STAT team and stock assessment analyst to data mine the available fishery-dependent recreational dockside data sources from each state. This results in each stock assessment treating the data in a different manner, where consistency among data sources and stock assessments is preferred.

The databases include the historical Marine Recreational Fisheries Statistics Survey (MRFSS in all three states), the California Fisheries Recreational Survey (CRFS), the Oregon Recreational

Boat Survey (ORBS), and the Washington Ocean Sampling Program (OSP). For the historic MRFSS survey, dockside interviews need to be properly aggregated to the trip level (in the current database, multiple interviews from the same trip are separated). Efforts have been made to aggregate the data to the trip-level in California and need to be reviewed, and similar efforts need to be completed for Oregon and Washington. In addition, each database should be checked for errors with changes well documented, i.e., (1) remove or flag computed biological records; (2) remove erroneous biological samples. **The GMT recommends that there be a collaborative effort between the state agencies and NMFS to develop the reconstructed databases across all fishing modes sampled (i.e., private boats, charter boats, shore mode, etc.).** All such effort should be well documented, including survey design changes, computed vs actual data. **The GMT then recommends a workshop to review the trip-level databases, which will depend heavily on state agency participation. The approved databases should be made available to all analysts for future stock assessments and incorporated into RecFIN. The GMT also recommends that the workshop provides guidelines on best practices for analyzing the data for CPUE indices, such as data filtering.**

B_{MSY} and B_0 workshop

The idea of this type of workshop has been mentioned previously, by both the GMT, GAP, and SSC. We continue to support the idea. As we understand it, the focus involves a look at the Council's harvest policies to inform several outstanding questions (e.g., the appropriateness of the Fishery Management Plan's (FMP's) B_{MSY} and F_{MSY} proxies). Also, such analysis will help explore considerations of additional flexibility and conservation objectives that are being discussed nationally (e.g., "pretty good yield" and the mixed stock exception). **The GMT recommends a B_{MSY}/B_0 workshop to advance the Council's harvest policy framework.**

Natural mortality

Natural mortality is a difficult parameter to estimate for any fish species, and is often the axis of uncertainty for decision tables. Assessments accordingly are often sensitive to the choice of life history parameters (when fixed). Some assessments incorporated an increase in natural mortality for post-maturity females (e.g., canary rockfish in 2015), and such assessments can be extremely sensitive to the choice of natural mortality parameters and the increase in female natural mortality rate. While natural mortality was incorporated as an axis of uncertainty, it is not one-dimensional in the case of these females (depending on the pre- and post- maturity values of natural mortality, the slope of the ramp between the two values, and the age at which natural mortality begins to increase). **The GMT recommends that further investigation be conducted on the effects of age-specific natural mortality and the absence of females in the data above a given age.**

2. Recommendations of Lower Priority (not in order of priority)

Workshop on transboundary stocks

The GMT recommends a workshop on transboundary stocks. We understand there is a limit to the improvement on scientific research and stock assessments that cannot be made without international cooperation. Therefore, the GMT recommends such a workshop only with participation of Canadian and/or Mexican scientists.

Research and exploratory analyses related to ecosystem considerations

We continue to support efforts by the Ecosystem Work Group to develop ecosystem analyses (e.g., integrated ecosystem assessments) that inform stock assessments. The GMT strives to connect our understanding of ecosystem impacts within the context of management decision-making, stock status, etc. This will provide greater context for the effect of various Council actions and policies on the marine environment.

3. Summary Recommendations (not in priority order)

1. **Explore data moderate assessments and methods and their applications.**

2. **A workshop on stock-recruitment relationships, including reconsideration of proxy SPR harvest rates.**

3. **A workshop to review the historical catch reconstructions for all three states. There should be analyses available that provide estimates of uncertainty in these catch estimates, including the amount of discard in these fisheries.**
4. **A collaborative effort between the state agencies and NMFS to develop recreational databases across all fishing modes sampled (i.e., private boats, charter boats, shore mode, etc.).**

5. **A workshop to review the trip-level recreational databases, which will depend heavily on state agency participation. The approved databases should be made available to all analysts for future stock assessments and incorporated into RecFIN. The GMT also recommends that the workshop provides guidelines on best practices for analyzing the data for CPUE indices, such as data filtering.**

6. **A B_{MSY}/B_0 workshop to advance the Council's harvest policy framework.**

7. **A further investigation on the effects of age-specific natural mortality.**

2015 GAP Report on Off Year Science Improvements; Agenda Item H.10.a, Supplemental GAP Report, September 2015

The Groundfish Advisory Panel (GAP) received a report from Mr. John DeVore about potential off-year science projects and improvements. We also referenced the draft Scientific and Statistical Committee (SSC) report in making our recommendations.

In both 2011 and 2013 (see: 2011 GAP report and 2013 GAP report), the GAP recommended the following:

1. A workshop on Transboundary Stocks
2. A workshop on B0 Harvest Management Framework
3. A Workshop to Review Historical Catch Reconstructions
4. A Workshop to Develop Techniques to Survey the Cowcod Conservation Areas

The GAP maintains these are important workshops and requests the Northwest Fisheries Science Center continue to keep them on the schedule. However, we also note No. 4, a workshop to develop techniques to survey the Cowcod Conservation Areas (CCAs), may be taken off as significant

work is being done in not only the CCAs, but other Rockfish Conservation Areas as well. We fully support these endeavors.

With regard to the SSC's draft recommendations, the GAP suggests the transboundary groundfish stocks workshop be retained as an important one to keep on the schedule. The other three, a workshop on methods of data reweighting, a workshop on recreational catch per unit effort (CPUE) standardization and a workshop on spatial models should also be retained and completed as time allows. The GAP suggests the workshop on recreational CPUE standardization be moved up on the priority list as well.

2015 Nearshore Assessments Workshop Report; Sampson et al. 2015

During the final hours of the workshop the group discussed various issues that had been raised. The following recommendations were developed.

Area Stratifications / Regional Assessment Models

- In developing area stratifications for their assessment models the STATs should explore available evidence in terms of genetics, life history patterns, age- or length-compositions, exploitation trends, or state-specific data (e.g., the Oregon nearshore logbook). Management history should be taken in to account in determining area stratifications.
- The STATs should explore state-specific stratifications for the assessment models. If the available data do not compel a state-specific stratification, the final assessment should nonetheless provide estimates of relative biomass by state to inform management decisions.
- The STAT for China rockfish should provide estimates of biomass north and south of the Council's management boundary at 40°10' N latitude.
- The STATs for black rockfish and China rockfish should not conduct coastwide (one-area) assessments because state-to-state differences in exploitation and management almost certainly have created spatial structure in the age-structure and abundance of these stocks.
- The STATs should minimize borrowing data from other areas to inform an assessment, although borrowing life history data may be a reasonable exception.
- The STAT for black rockfish should use port of landing of recreational catches by state for area stratifications. Further exploration of historical trawl catches is needed to apportion landings in Astoria and Ilwaco.

Methodologies

- The new methodology presented by Dr. Melissa Monk (for processing the at-sea observer data from the recreational fisheries in California and Oregon) is a substantial improvement over the methodology that was used in the last assessment cycle to produce CPUE indices for some of the data-moderate assessments. The workshop participants recommend use of this new methodology.
- There are issues that need to be explored and resolved with respect to combining habitat and CPUE data from Oregon and California. The data are not strictly compatible.
- The CPUE analysts should keep management boundaries and depth restrictions in mind when choosing spatial strata for CPUE standardization.

- Most changes in management and regulations have been documented and included in a database so they can be incorporated into CPUE standardizations. Analysts should ensure these databases are complete with respect to all management changes that may have affected recent and historical data.
- Along with gear changes, many other technological changes have occurred over the length of the CPUE time series that may have affected catchability (e.g., the introduction of depth finders and GPS). The STATs should consider the importance of these changes and how to address these potential effects (gradual change, step functions, etc.). The South Atlantic Fishery Management Council has had to deal with potential temporal changes in catchability for many of their fisheries; it might be worth exploring approaches they have developed.
- Analysts should explore ways to address the potential effects of bag limit changes on CPUE series. High resolution effort data (e.g., fishing hours) may alleviate some of this problem. East Coast fisheries have had to deal with bag limits for many of their recreational fishery CPUE indices. Analysts should explore how other assessment scientists have dealt with this issue.
- Analysts should consider differences in the effort metric between CPUE indices based on ORBS (trip duration) and MRFSS (fishing time) data.
- Changes in depth restrictions and the creation of MPAs will affect the spatial distribution of effort. CPUE indices that are based on data with spatial information may not be as affected because those changes will be tracked directly. However, if these depth and area restrictions moved effort out of hot-spots, analysts must consider how to address the loss of information from these areas.
- In the Oregon historical catch reconstruction for kelp greenling the catches prior to 1980 should ramp up from the WWII era rather than being scaled to the human population size. Also, the catch for 1979 should be based on an average catch during the early years when catch data were available rather than the estimated 1980 catch.
- The Oregon historical catch reconstruction for kelp greenling should explore alternatives to the assumption that the shore and estuary catches of kelp greenling were constant during the last 10 years.
- The STATs for black rockfish and kelp greenling should consider the sensitivity of the assessment results to uncertainty in the historical catch series.
- The STAT for black rockfish should consider using the Washington (and possibly the Oregon) tag release data of black rockfish to develop a CPUE index. A bridge model run using tagging data as an absolute abundance estimation method (e.g., the Peterson approach in the 2007 northern black rockfish assessment) may be an option to explore.
- The STATs for all three stocks should explore developing CPUE indices using the Oregon nearshore commercial fishery logbook data.
- The STATs for China rockfish and kelp greenling should attempt to explore multispecies aspects when interpreting recreational CPUE trends for China rockfish and kelp greenling (for example, comparing the CPUE for black rockfish with an aggregate CPUE for benthic target rockfish species, or comparing CPUE trends from different fishing sectors).
- Changes in market forces will change the targeting behavior of fishermen. This will be particularly evident with the rise of the live-fish fishery where smaller fish are more valuable per pound than larger fish. Such changes in market preference will affect the observed species compositions and should be accounted for in both CPUE indices and selectivity functions.

- Changes in regulations and gear (e.g., use of descending devices) may change discard patterns or discard mortality rates. Analysts should ensure discards are being appropriately accounted for (e.g., catch-per-unit-effort vs. landings- or retained-fish-per-unit-effort, incorporation of discards in historical reconstructions, etc.).

2015 Arrowtooth Flounder Data-Moderate Assessment; Agenda Item D.8, Attachment 5, June 2015

The following list contains research recommendations to further improve the application of catch and index only stock assessments for arrowtooth flounder:

- Historical estimates of discards are a large contributor to total removals. The current modelling exercise of using co-occurring flatfish species as predictors of discard could use further exploration.
- Such large difference in biomass between MLE and Bayesian results was unexpected. Further investigation into these large differences is warranted.
- Further exploration in the upper limits of $\ln R_0$ priors to exclude the unlikely scenario of the current state being at unfished conditions.

Greater understanding of the differences between the MCMC and XSSS models could help inform a better convergence criterion when using AIS.

2015 Black Rockfish Assessment; Cope et al. 2016

Recommended avenues for research to help improve future black rockfish stock assessments:

1) Further investigation into the movement and behavior of older (> age 10) females to reconcile their absence in fisheries data. If the females are currently inaccessible to fishing gear, can we find where they are?
2) Appropriate natural mortality values for females and males. This will help resolve the extent to which dome-shaped age-based selectivity may be occurring for each.
3) All states need improved historical catch reconstructions. The trawl fishery catches in particular require particular attention. Given the huge historical removals of that fleet in each state, the assessment is very sensitive to the assumed functional form of selectivity. A synoptic catch reconstruction is recommended, where states work together to resolve cross-state catch issues as well as standardize the approach to catch recommendations.
4) Identifying stanzas or periods of uncertainty in the historical catch series will aid in the exploration of catch uncertainty in future assessment sensitivity runs.
5) The ODFW tagging study off Newport should be continued and expanded to other areas. To provide better prior information on the spatial distribution of the black rockfish stock, further work should be conducted to map the extent of black rockfish habitat and the densities of black rockfish residing there.
6) An independent nearshore survey should be supported in all states to avoid the reliance on fishery-based CPUE indices.
7) Stock structure for black rockfish is a complicated topic that needs further analysis. How this is determined (e.g., exploitation history, genetics, life history variability, biogeography, etc.) and what this means for management units needs to be further refined. This is a general issue for all nearshore stocks that likely have significant and small scale stock structure among and within states, but limited data collections to support small-scale management.

2015 Black Rockfish STAR Panel Report; Cooper et al. 2015

Continued research on:

- Stock structure, including whether national/international boundaries are appropriate.
- Catch histories, including uncertainty and alternative catch streams to be used in sensitivity analysis.
- Definition and measurement of black rockfish habitat
- Preparation of composition data: post-stratification and scaling supported by a detailed analysis of the data

A specific data workshop, perhaps for all species prioritized for assessment, could examine information across a broad range of species due for assessment, and would also assist with the development of more specific documentation of protocols used to compile best available data sets for stock assessment, continue acceptance of agreed procedures for standardization of abundance indices, and also begin work on procedures for the development of alternative data series that capture uncertainty – particularly for historical catch and discards.

The outline for stock assessments (Appendix B in the 2014 Terms of Reference) includes a section for addressing previous STAR Panel recommendations. If a data workshop precedes the stock assessment, as here for black rockfish, the outline should also include a section on how the recommendations from the data workshop were addressed. A similar process should be outlined to address recommendations from previous CIE reviewers.

Consider the development of a coastwide fishery-independent survey for nearshore stocks. As the current base model structure has no direct fishery-independent measure of recent rebuilding of the adult portion of the stock, any work to commence collection of such a measure for nearshore rockfish, or use of existing data to derive such an index would greatly assist with this assessment.

For abundance indices a multi-species simulation study to test whether the Stephens-MacCall filtering may lead to a bias in abundance estimates given differences in abundance trends among species should be considered. It is the understanding of the panel that some simulation testing has been done; these results should be made generally available. A comparison of alternative filtering procedures should also be considered.

CPUE standardization protocols need improvement:

- An objective procedure for sub-model error structure (usually gamma or lognormal here) is required for delta-GLM procedures. Consistency is required for the model selection process – preferably using *a priori* candidate models rather than a stepwise selection. For Washington and California: removal of the restriction on having the same explanatory variables for the binomial and positive catch rate models. There is no reason why the presence/absence of the species should be explained by the same variables which explain the magnitude of the positive catch rates.
- The AIC tables do not appear to report the correct AIC values in some cases. In particular, models with 1 or 2 additional variables, which were likely confounded with other variables, often had the exact same AIC value as the less complex model. While this is technically possible, it is highly unlikely and its consistency is worrying.
- Better diagnostics for each CPUE analysis: plots of the binomial and positive catch rate year effects in addition to the combined year effects; plots of all estimated effects; production of year:area interactions and a comparison of the trends by area. In cases where the trend in CPUE index differs across areas, the aggregate CPUE index is affected by the method used to weight the CPUE from the areas. Evaluation of the effect

of alternative weighting methods on the aggregate standardized CPUE index should be evaluated in these cases.
- The effects of the standardization on the "nominal" or unstandardized indices should also be shown and explained (i.e., which variables have caused a shift in the trend).

SS3:

- The input interface is not user-friendly and requires considerable knowledge of formatting requirements and the meaning of some settings in relation to how the model is configured or parameterized.
- The addition of extra standard deviation for biomass indices should be correctly implemented. Standard deviations do not add arithmetically. To apply a constant process error to a time series of biomass indices requires that the variances be added (i.e., square the standard deviations, add them together, and take the square root).
- The fact that some priors are set in normal space and others are set in log space creates confusion on inputting these priors.
- Many of the problems could be solved by creating an "expert system" front end which creates the input files exactly how SS3 needs them (i.e., no erroneous white space or unprintable characters) transforms parameters from arithmetic space as needed, and checks for obvious user errors (e.g., a row of 1s being added to the standard deviations).
- Improved debugging tools are necessary to help track down sources of errors messages such as "-1.INDs"

R4SS:

- The plots showing the fits to the indices could also include useful information such as the estimated q and whether extra SD was added to the input SD (users look at the plots but they may not look at the report file). A plot to assist with comparison of all abundance indices where all indices are plotted with available biomass determined by selectivity (such a plot was developed for China rockfish during a recent STAR Panel).
- Calculation of unexploitable spawning output: the procedure developed here should be considered as a standard diagnostic for all assessments.
- The units of spawning output should be shown in the r4ss plots, as confusion was caused when spawning output is defined as egg production that may not necessarily be proportional to spawning stock biomass.
- Assistance with appropriate levels for jittering: Jason Cope has used a procedure for setting appropriate ranges for jittering that might be considered as an objective method for standard practice.

2015 Scientific and Statistical Committee's Groundfish Subcommittee Mop-up Stock Assessment Review Panel Meeting Black Rockfish Report; Field et al. 2015

There are considerable avenues of future research that should help to inform future assessments. Key among them is additional surveys, tagging studies or other research to attempt to locate older female black rockfish. The need to accommodate the data by using dome-shaped age-based selectivity suggests a behavioral cause for unavailable old females. Automated underwater vehicles, video landers and/or an acoustic or additional tagging studies might be one plausible option. Others include focused studies on locations mentioned during the meeting, when anecdotal accounts of concentrations of larger fish found in certain places were discussed. Some form of sampling to confirm the existence of a considerable biomass of older females unavailable to the ocean recreational fishery is required.

Continued investigations into both the tagging study data and the inferred or plausible estimates of catchability associated with that study should be maintained. The relative importance of this study in anchoring the model would suggest that some level of effort could be maintained

(currently the study is not ongoing) and/or expanded to other areas of the coast (an optimal study would include all available state waters). Movement patterns can and should also continue to be explored, in order to better understand the level at which regions represent open or closed populations, as there are clearly a fraction of black rockfish that undergo substantial movements at times.

Age validation is important to more accurately evaluate the age composition data. A number of historical ages were reportedly excluded from the model due to concerns over differences among age readers, historical structures from trawl and recreational fisheries in particular should be re-aged by reliable readers and included in future assessments. Another unusual pattern was the greater degree of aging error suggested for Oregon black rockfish, this issue should be resolved in concert with the previous issue by more rigorously examining ageing error across readers.

A fishery-independent nearshore survey, particularly across state boundaries, is essential to any future accurate assessments of nearshore resources, which almost exclusively rely on fishery dependent data.

Although historical catches did not appear to be a substantial axis of uncertainty in this model, the relatively low magnitude of trawl catches in the early years of the fishery (e.g., 1940s-1950s) were somewhat inconsistent with the relatively greater magnitude of trawl and fixed gear landings in California and Washington during this period. Anecdotal accounts of the relative importance of black rockfish in Oregon trawl fisheries during the 1940s (in which they were described as one of four key species in the fishery) would suggest that historical catches be reconsidered to the extent practicable in future assessments.

2015 Bocaccio Assessment; He et al. 2015

Stock structure and stock boundaries for Bocaccio rockfish on the West Coast remains an important issue to consider with respect to both future assessments and future management actions.

Since large scale area closures and other management actions were initiated in 2001, the spatial distributions of fishing effort (fishing mortality) have changed over both large and small spatial scales. This confounds the interpretation of survey indices for surveys that do not sample in the Cowcod Conservation Areas (CCAs), although the decision to begin sampling for the NWFSC hook and line survey within the CCAs should begin to address this issue with time. .

Recently updated reproductive biology data (maturity and fecundity) show some differences in length and weight specific fecundity in Bocaccio from those used in the past assessments. Regional differences (southern and northern California, as well as southern Oregon), and multiple brood spawning, are poorly understood.

As Bocaccio is one of the most abundant and important piscivorous rockfish species, and its interactions with other predator and prey species are poorly known, information regarding diet and movement patterns associated with habitat and prey abundance are key in order to further understand its roles in the ecosystem of the California waters. Northward migratory behaviors of juvenile and young adults are indicated by length frequency data, but such behaviors are also poorly understood. Studies on these behaviors and their associations with oceanographic or other ecological factors can help future assessments in defining stock structure as well as explaining high variability in stock recruitments.

2015 Bocaccio STAR Panel Report; Dorn et al. 2015

An objective procedure for evaluating the stock boundaries is needed for all rockfish (and potentially other west coast assessments). Such a procedure would more directly point to directions for future research or collaboration across national/international political boundaries.

Explore better ways to model productivity for stocks like bocaccio that exhibit large episodic recruitment patterns. Lognormal distributions are not a good way to model the recruitment variability for such stocks.

The strength of recent recruitments is a major uncertainty for bocaccio. Technical methods for capturing and propagating this uncertainty are needed in stock synthesis (especially for axes of uncertainty), perhaps by an improved procedure to fix particular recent recruitment deviations.

The relationship between stock size and spawning output is critical for interpretation of the CalCOFI index, which is perhaps the most useful index in the bocaccio assessment. Research is needed to better quantify spawning output. This research could include evaluation of environmental correlations of spawning output, and studies of both the prevalence, and the potential demographic and environmental drivers of multiple broods (multiple spawning events by an individual fish within a given spawning season).

The Panel recommends continued processing of historical CalCOFI samples from northern transects in the early 1950s through the late 1960s. These data would add to the index used in the assessment model, and improve understanding of spatial patterns in population dynamics.

A data workshop prior to STAR panel review, perhaps for all rockfish stocks due for assessment, should be scheduled to examine assessment information across a broad range of species. The workshop could document protocols used to compile data sets for stock assessment, establish agreed procedures for standardization of abundance indices, and develop alternative data series that capture uncertainty–particularly for historical catch and discards.

Several estimated selectivity patterns in the bocaccio assessment are very unusual. The NWFSC trawl survey has a curiously flat selection pattern at young ages, and triennial survey has a strongly peaked selectivity at young ages. Research into alternative ways to model the selection pattern of these surveys is needed. Possible approaches include 1) use of age-specific natural mortality, 2) splitting the surveys into separate indices for juveniles (age 0 and/or1) and older fish.

Available information indicates that the CCAs are a center of abundance for bocaccio. Surveying inside the CCA during the NMFSC hook and line surveys should be continued, though several years of data will be required before the information can be used to inform the assessment. Consideration should also be given to extending the NWFSC trawl survey into the CCAs. A simple analysis of potential catch rates of cowcod, and the impact of survey take on stock rebuilding, would allow the benefits of surveying inside CCA to be compared to potential costs.

Age data from the NWFSC hook and line survey would increase the utility of the survey for assessment of bocaccio by better defining the selectivity pattern for large fish.

2015 Canary Rockfish Assessment; Thorson and Wetzel 2015

We recommend the following research be conducted before the next benchmark assessment model:

1) The canary rockfish stock has high density near the US-Canadian border, so previous assessment authors and STAR panel reports have recommended an assessment model that incorporates landings, abundance index, and compositional data from both US and southern British Columbia regions. However, we do not believe that incorporating heterogeneous data from different sampling programs and management jurisdictions is feasible without using a spatial model (e.g., our base model), both because different jurisdictions are likely to have different exploitation histories, and because different regions are likely to have different data sources (invalidating the second-stage expansion used in coast-wide models). Given the use of a spatial model, we recommend that efforts proceed to gather, document, analyze, and evaluate Canadian data sources for a joint assessment.
2) Direct observation of canary rockfish suggests that individuals are often associated with rocky habitat, and therefore may not be available to the bottom trawl gear used to obtain coast-wide fishery-independent data in the California Current. Recent research suggests that, when (1) a portion of the population is unavailable to survey sampling gear, and (2) the proportion of the population that is unavailable varies among years (e.g., due to density- dependent habitat selection), then survey indices are likely not representative of stock-wide trends in abundance. Therefore, we highly encourage a coast-wide pilot study for an alternative sampling method (e.g., hook-and-line sampling), as well as its calibration against the existing bottom trawl survey via paired sampling methods (J. T. Thorson et al., 2013).
3) A spatial model replaces problematic assumptions in a coast-wide model (i.e., an equally mixed stock in which every individual fish and fishing operation has equal probability of encounter, no spatial variation in density or exploitation history) with other difficult assumptions (Punt et al., 2015). In particular, our base model represents the assumption that movement is negligible among strata. We therefore recommend that tag-resighting studies be initiated to estimate interannual movement rates.
4) We also note that this assessment, like many other rockfish assessments in the California Current (e.g., darkblotched rockfish) is highly sensitive to assumptions regarding life history characteristics including natural mortality rate and the steepness of the stock-recruit relationship. We therefore recommend ongoing research for these and other life history parameters that form the primary axis of uncertainty for many rockfishes. In particular, research regarding steepness could involve exploration of the impact of autocorrelation within a species, cross-correlation among species, and model mis-specification leading to bias in the reconstruction of spawning output for species included in the prior. Steepness research could also involve a management strategy evaluation to evaluate the potential impact of rapid changes in the assumed value of steepness on management performance (i.e., false positives in detecting overfished or rebuilt stocks). Research regarding natural mortality could involve continued investigations of the relationship between natural mortality and the Brody growth coefficient, as well as how to incorporate prior information regarding this relationship into Stock Synthesis.

2015 Canary Rockfish STAR Panel Report; Jagielo et al. 2015

The historical catch data ultimately used in the assessment differed from that which was given in the original draft assessment presented for review at the panel. The review process would be improved by ensuring that any such issues (i.e. disagreements about the best available historical catch) are resolved well in advance of the assessment review meeting. One possible approach might be to have an earlier step in the process intended to sign-off on the input data, analogous to the way that the STAR panel signs-off on the stock assessments. Ongoing efforts to reconstruct Washington catch data, in the way that has already been done for Oregon and California, should help to resolve these issues in the medium term, but until then, there will still be a need to work with agreed, interim catch estimates for inclusion in stock assessments.

Catch and discard history for this stock in US waters is highly uncertain. While the STAT was able to construct alternative upper and lower bounds for catch using simple multipliers on certain years of historical catch, this is arbitrary. Work to assess the uncertainty related to each individual data source would allow a better investigation of the overall combined uncertainty and its effect on stock assessments.

Improved documentation is required to clearly outline the process used to construct the historical catch and discard time series from the various data sources. Such documentation should also include the process for construction of alternative catch histories that are used to propagate such uncertainty into the stock assessment.

Additional work on the geospatial index is required to better resolve differences in abundance trends among areas.

Work towards a combined US/Canadian stock assessment would greatly aid our overall understanding of stock status.

If data permit, the trawl fleet should be divided into separate components so that bycatches in the shrimp and pelagic trawls are separated from catches in the main bottom trawl fleet. In the current assessment, composition data for the trawl fleet have a major influence on the estimated stock trends, so it would be desirable to use data that are more representative of the main fleet in order to improve estimated selectivity of the fleet.

Basic life history research may help to resolve assessment uncertainties regarding appropriate values for natural mortality and steepness, and how to best account for the apparent loss of older females in the population.

2015 Chilipepper Rockfish Assessment; Field et al. 2015

Although considerable information on the reproductive ecology of this species has been compiled, the possible significance of multiple brood production and the spatial or physical drivers of such factors is highly uncertain and should be explored. Greater exploration of methods for modeling time-varying growth are essential, there remains a need to explore a model that uses conditional age-at-length data and a need to explore other possible drivers of variable growth rates. Continued evaluation of the coastwide juvenile index should be an important element of both future research and future assessments, particularly with respect to the mechanisms that drive such strong variability in cohort strength, and the potential use of a compensatory relationship between pelagic YOY and the population at later ages.

2015 China Rockfish Assessment; Dick et al. 2016

We recommend the following research be conducted before the next assessment:

1) The number of hours fished in Washington should be recorded for each dockside sample (vessel) so that future CPUE can be measured as angler hours rather than just number of anglers per trip. This will allow for a more accurate calculation of effort.
2) The number of hours fished in Oregon should be recorded for each dockside sample (vessel), instead of the start and end times of the entire trip. This will allow for a more accurate calculation of effort.
3) Compare the habitat-based methods used to subset data for the onboard observer indices to Stephens-MacCall and other filtering methods.
4) Explore the sensitivity of Stephens-MacCall when the target species is “rare” or not common encountered in the data samples.
5) A standardized fishery independent survey sampling nearshore rockfish in all three states would provide a more reliable index of abundance than the indices developed from catch rates

in recreational and commercial fisheries. However, information value of such surveys would depend on the consistency in methods over time and space and would require many years of sampling before an informative index could be obtained.

6) A coastwide evaluation of genetic structure of China rockfish is a research priority. Genetic samples should be collected at sites spaced regularly along the coast throughout the range of the species to estimate genetic differences at multiple spatial scales (i.e., isolation by distance).
7) Difficulties were encountered when attempting to reconstruct historical recreational catches at smaller spatial scales, and in distinguishing between landings from the private and charter vessels. Improved methods are needed to allocate reconstructed recreational catches to sub-state regions within each fishing mode.
8) There was insufficient time during the STAR Panel review to fully review the abundance indices used in the China rockfish assessments. Consideration should be given to scheduling a data workshop prior to STAR Panel review for review of assessment input data and standardization procedures for indices, potentially for all species scheduled for assessment. The nearshore data workshop, held earlier this year, was a step in this direction, but that meeting did not deal with the modeling part of index development.
9) The Marine Recreational Fisheries Statistics Survey (MRFSS) index in Oregon was excluded from the assessment model because it was learned that multiple intercept interviews were done for a single trip. Evaluate whether database manipulations or some other approach can resolve this issue and allow these data to be used in the assessment.
10) Many of the indices used in the China rockfish assessment model used the Stephens- MacCall (2004) approach to subset the CPUE data. Research is need to evaluate the performance of the method when there are changes in management restrictions and in relative abundance of different species. Examination of the characteristics of trips retained/removed should be a routine part of index standardization, such as an evaluation of whether there are time trends in the proportion of discarded trips.
11) Fishery-dependent CPUE indices are likely to be the only trend information for many nearshore species for the foreseeable future. Indices from a multi-species hook-and-line fishery may be influenced by regulatory changes, such as bag limits, and by interactions with other species (e.g., black rockfish) due to hook competition. It may be possible to address many of these concerns if a multi-species approach is used to develop the indices, allowing potential interactions and common forcing to be evaluated.
12) Consider the development of a fishery-independent survey for nearshore stocks. As the current base model structure has no direct fishery-independent measure of stock trends, any work to commence collection of such a measure for nearshore rockfish, or use of existing data to derive such an index would greatly assist with this assessment.
13) Basic life history research may help to resolve assessment uncertainties regarding appropriate values for natural mortality and steepness.
14) Examine length composition data of discarded fish from recreational onboard observer programs in California and Oregon. Consider modeling discarded catch using selectivity and retention functions in Stock Synthesis rather than combining retained and discarded catch and assuming they have identical size compositions. Another option would be to model discarded recreational catch as a separate fleet, similar to the way commercial discards were treated in the southern model.
15) Ageing data were influential in the China rockfish stock assessments. Collection and ageing of China rockfish otoliths should continue. Samples from younger fish not typically selected by the fishery are needed to better define the growth curve.
16) Consider evaluating depletion estimators of abundance using within season CPUE indices. This approach would require information on total removals on a reef-by-reef basis.
17) The extensive use of habitat information in index development is a strength of the China rockfish assessment. Consideration should be given to how to further incorporate habitat data into the assessment of nearshore species. The most immediate need seems to be to increase the resolution of habitat maps for waters off Oregon and Washington, and standardization of habitat data format among states.

18) Although all the current models for China rockfish estimated implausibly large recruitment deviations when allowed to do so, particularly early in the modeled time period, further exploration of available options in stock synthesis could produce acceptable results. In addition, this work may provide guidance on any additional options that could be added to stock synthesis to better handle this situation. For example, assuming different levels autocorrelation in the stock-recruit relationship for data-moderate stocks may help curb the tendency to estimate extreme recruitment with sparse datasets.
19) Research is needed on data-weighting methods in stock assessments. In particular, a standard approach for conditional age-at-length data is needed. The Center for the Advancement of Population Assessment Methodology (CAPAM) data weighting workshop, scheduled for later this year, should make important progress on this research need.

2015 China Rockfish STAR Panel Report; Dorn et al. 2015

A coastwide evaluation of genetic structure of China rockfish is a research priority. Genetic samples should be collected at sites spaced regularly along the coast throughout the range of the species to estimate genetic differences at multiple spatial scales (i.e., isolation by distance).

Difficulties were encountered when attempting to reconstruct historical recreational catches at smaller spatial scales, and in distinguishing between landings from the private and charter vessels. Improved methods are needed to allocate reconstructed recreational catches to sub-state regions within each fishing mode.

There was insufficient time during the STAR Panel review to fully review the abundance indices used in the China rockfish assessments. Consideration should be given to scheduling a data workshop prior to STAR Panel review for review of assessment input data and standardization procedures for indices, potentially for all species scheduled for assessment. The nearshore data workshop, held earlier this year, was a step in this direction, but that meeting did not deal with the modeling part of index development.

The Marine Recreational Fisheries Statistics Survey (MRFSS) index in Oregon was excluded because it was learned that multiple intercept interviews were done for a single trip. Evaluate whether database manipulations or some other approach can resolve this issue and allow these data to be used in the assessment.

Many of the indices used in the China rockfish assessment model used the Stephens and MacCall (2004) approach to subset the CPUE data. Research is need to evaluate the performance of the method when there are changes in management restrictions and in relative abundance of different species. Examination of the characteristics of trips retained/removed should be a routine part of index standardization, such as an evaluation of whether there are time trends in the proportion of discarded trips.

Fishery-dependent CPUE indices are likely to be the only trend information for many nearshore species for the foreseeable future. Indices from a multi-species hook and line fishery may be influenced by regulatory changes, such as bag limits, and by interactions with other species (e.g. black rockfish) due to hook competition. It may be possible to address many of these concerns if a multi-species approach is used to develop the indices, allowing potential interactions and common forcing to be evaluated.

Consider the development of a fishery-independent survey for nearshore stocks. As the current base model structure has no direct fishery-independent measure of stock trends, any work to commence collection of such a measure for nearshore rockfish, or use of existing data to derive such an index would greatly assist with this assessment.

Basic life history research may help to resolve assessment uncertainties regarding appropriate values for natural mortality and steepness.

Ageing data were influential in the China rockfish stock assessments. Collection and ageing of China rockfish otoliths should continue. Samples from younger fish not typically selected by the fishery are needed to better define the growth curve.

Consider evaluating depletion estimators of abundance using within season CPUE indices. This approach would require information on total removals on a reef-by-reef basis.

The extensive use of habitat information in index development is a strength of the China rockfish assessment. Consideration should be given to how to further incorporate habitat data into the assessment of nearshore species. The most immediate need seems to be to increase the resolution of habitat maps for waters off Oregon and Washington, and standardization of habitat data format among states.

Although all the current models for China rockfish estimated implausibly large recruitment deviations when allowed to do so, particularly early in the modeled time period, further exploration of available options in stock synthesis could produce acceptable results. In addition, this work may provide guidance on any additional options that could be added to stock synthesis to better handle this situation. For example, assuming different levels autocorrelation in the stock-recruit relationship for data-moderate stocks may help curb the tendency to estimate extreme recruitment with sparse datasets.

The China rockfish models made a number of simplifying assumptions, such as asymptotic fishery selectivity, and no deviations from the stock-recruit curve. It would be worthwhile to conduct a simulation-estimation exercise to evaluate potential errors associated with the assumptions commonly made for data-moderate assessments that use length and age data.

Research is needed on data-weighting methods in stock assessments. In particular, a standard approach for conditional age-at-length data is needed. The Center for the Advancement of Population Assessment Methodology (CAPAM) data weighting workshop, scheduled for later this year, should make important progress on this research need.

2015 Darkblotched Rockfish Assessment; Gertseva et al. 2016

The following research could improve the ability of future stock assessments to determine the current status and productivity of the darkblotched rockfish population:

1) Additional population genetics research to elucidate potential spatial stock structure would be valuable for assessment and management, to ensure prevention of local depletion and preserve genetic diversity.
2) Additional research on darkblotched movement including migration patterns by latitude and depth, diurnal migration patterns through the water column, relative time spent off-bottom versus midwater, relating movements to size, age and sex would be valuable for further understanding this rockfish's ecological niche, stock structure, and lend insight to catchability and gear selectivity patterns.
3) Given that the population range extends north to the border with Canada, it is important that future research would evaluate the impact of not accounting for any Canadian portion of population abundance. Such an analysis would require evaluation of movement of darkblotched along the coast; such information is currently lacking.
4) Continuing collection of maturity and fecundity data on darkblotched rockfish would allow further research into latitudinal variability in life history parameters that again would advance understanding this species stock structure. Multi-year data would also allow evaluation of temporal changes in darkblotched maturity and fecundity.

5) Additional research into natural mortality, as it relates to length and age would be valuable to enable more realistic and accurate modeling of this parameter, which is a common source of uncertainty in assessment of this, and other rockfish species. The Councill and Harford method is an example of one approach; it models natural mortality as a decaying function of size, with assumptions that mortality rates should be constrained by lifetime mortality rate.
6) Future research could also improve existing meta-analyses for natural mortality and steepness, which both contribute to the implied yield curve. Directions for improvements could include (1) weighting methods in natural mortality prior estimates included in the Hamel meta-analysis, and (2) developing a larger database of species for estimating steepness, perhaps by including species from other regions, e.g., Canada and Alaska.
7) Research into establishing optimum methods for more precise modeling of selectivity patterns is needed. Either asymptotic or dome-shaped selectivity assumptions are frequently used in stock assessments, when neither may be the best available representation of selectivity. Assumptions of a dome shape can suggest a "cryptic" biomass, or create confounding with natural mortality assumptions, potentially inflating abundance indices (Crone et al. 2013). Assumptions of asymptotic shape may also not be realistic. Simulation studies could be performed to empirically evaluate varying degrees of intermediate selectivity shapes, and how best to effectively implement them in existing stock assessment software platforms.
8) Research assessing the effects of the unprecedented warm ocean conditions off the West Coast of the U.S. during 2014 and 2015, on rockfish populations is needed. Specifically, investigations are needed that focus on how temperature and other water conditions at depth, in rockfish habitat correspond to high sea-surface temperatures recorded throughout those years, and how the fish respond to those changing conditions. Research is needed that examines whether fish move in response to changing temperatures, where, and how they move, as well as whether the conditions influence life history parameters and aspects such as mortality, feeding, fecundity and other reproductive considerations. What oceanographic and climatic forces are responsible and how long these conditions are expected to persist are also critical pieces of knowledge.

2015 Darkblotched Rockfish STAR Panel Report; Jagielo et al. 2015

Catch and discard history for this stock in US waters is highly uncertain. While the STAT was able to construct alternative upper and lower bounds for catch using simple multipliers on certain years of historical catch, this is arbitrary. Work to assess the uncertainty related to each individual data source would allow a better investigation of the overall combined uncertainty and its effect on stock assessments.

Improved documentation is required to clearly outline the process used to construct the historical catch and discard time series from the various data sources. Such documentation should also include the process for construction of alternative catch histories that are used to propagate such uncertainty into the stock assessment.

It is highly undesirable that the lack of an abundance index for the older fish in the population most affected by fishing (particularly in recent years) forces the model to rely on composition data for information on abundance trends. Unfortunately, such an index is currently unavailable, but would have the potential to considerably improve future stock assessments if commenced in the future.

Work towards a combined US/Canadian stock assessment should be pursued.

2015 Oregon Kelp Greenling Assessment; Berger et al. 2015

There are several areas of further research or data acquisition that would have a high probability of improving the estimation of population parameters for Kelp Greenling in Oregon waters. These include, but are not limited to, the following:

1) Fishery-independent surveys of abundance for nearshore species, including Kelp Greenling, would provide information about population trends that don't rely on data collected directly from the fishery and the inherent complexities that those data entail. Surveys that result in a time series of information covering a representative spatial extent of the population would be most advantageous.
2) Improved data collection relevant to basic fishery statistics (catch/effort) for recreational shore and estuary-boat fleets, including biological sampling where possible, to monitor changes in these highly dynamic fishing modes.
3) The collection of gender-specific information is generally straightforward given the visual ease (color and markings) of identifying adult Kelp Greenling by gender and the collection of this information should be implemented for Ocean Recreational Boat Samplers (ORBS).
4) The double reading of Kelp Greenling otoliths would provide some indication into error and bias for this influential source of information.
5) Kelp Greenling stock structure needs to be studied and the results accounted for in future assessments. In particular, ontogenetic and gender-related movement according to offshore depth and spawning seems plausible for Kelp Greenling, and data to support that hypothesis would be beneficial for future assessments.
6) Research into the implications and complexities of managing a stock where both genders contribute to spawning potential (e.g., through a Management Strategy Evaluation) would help guide future assessments and management for species such as Kelp Greenling (males exhibit nest-guarding behavior).

2015 Oregon Kelp Greenling STAR Panel Report; Sampson et al. 2015

Specific recommendations for the next assessment

- Acquire estimates of reader error for kelp greenling through routine double-reading samples of otoliths rather than relying on error estimates for other species, which may not accurately reflect actual read errors for this species.
- Acquire more age-readings, particularly of younger fish caught in the shore based or estuary fisheries, and try to estimate the full set of growth parameters.
- Consider seasons or a shorter time step for the model than a year (e.g., a quarter) or request a modification to Stock Synthesis to allow non-integer growth increments to increase accuracy for the estimated growth rate and error.
- Composition data weighting should start with the number of samples as the effective sample size rather than the number of fish.
- Sample catches from the shore and estuary fisheries so that they can be estimated and characterized.
- Explore starting the model at the historical point where removals become more reliable (e.g., 1970-1980) and estimate initial conditions reflecting prior exploitation such as free numbers at age and an offset to equilibrium recruitment.
- Consider estimating recruitment deviations for the entire time-period of the assessment model.
- Density estimates from visual surveys and other methods could be used to derive a prior for unexploited biomass (perhaps transformed to R_0). This could help with the very poorly estimated scale in the current assessment.
- Future assessments should consider assessing a single stock for Washington, Oregon and California; this analysis could include explicit spatial areas and or state-based fleets as

necessary. This was also a specific recommendation of the 2005 STAR panel. Expanding the spatial scale could make the interpretation of steepness based on life history theory more straightforward.

- The next assessment should be an update, given the status and trends. There is no urgency to update the assessment, unless negative trends appear in biological or catch-rate data.

Specific suggestions for the SSC

- Given current estimates of growth and natural mortality, kelp greenling is probably much more productive than an $F_{45\%}$ policy would imply. None of the data series show any signal of depletion. The SSC may wish to consider recommending a different target SPR rate for this species.

General recommendations for nearshore species assessments

- It may be more accurate in some circumstances to consider when historical catch history is so uncertain that the model should be started in a later year with the initial depletion estimated by the model.
- Consider the development of a coastwide fishery-independent survey for nearshore stocks. Any work to commence collection of such a measure for nearshore stocks, or use of existing data to derive such an index would greatly assist with this assessment.
- MRFFS data are difficult to use properly, making quantities derived from it potentially unreliable. Broadly, the MRFSS database needs to be cleaned (e.g., removing derived estimates that are not easily identified as such and that currently appear to be observed 'data'), better documented, and made more accessible for future assessment authors. It is important that the work of cleaning and interpreting these data not have to be repeated for each assessment. No further MRFSS data will ever be collected.
- For CPUE abundance indices, further evaluation of the Stephens-MacCall method would be valuable to ensure that the filtering method is robust. For example, the Stephens-MacCall method for filtering logbook records produced anomalous inclusion of the same species as both a positive and negative indicator in similar datasets. Pooling among similar series (e.g., charter boats and private boats from the same areas) to develop the filtering criteria could make this more stable. More generally, a multi-species simulation study to test whether the Stephens-MacCall filtering may lead to a bias in abundance estimates given differences in abundance trends among species should be considered. It is the understanding of the panel that some simulation testing has been done; these results should be made generally available. A comparison of alternative filtering procedures should also be considered.
- Definition and measurement of suitable habitat for nearshore species such as kelp greenling, especially when combined with density estimates, would assist assessments, particularly as an independent indicator of plausible relative scale of modeled virgin biomass by area/region/state.

General recommendations for all assessments

- Whenever age-readings are done, some portion of the effort should routinely include double-reads for estimating ageing error.
- Consider developing an alternative likelihood formulation for compositional data (condition length on age) to make better use of ages to inform on population age structure where a significant proportion of aged fish are within one standard deviation of the asymptotic length. This would be limited to sampling that is random with respect to age or length.

2015 Petrale Sole Update Assessment; Stawitz et al. 2016

Progress on a number of research topics and data issues would substantially improve the ability of this assessment to reliably and precisely model petrale sole population dynamics in the future:

1) In the past many assessments have derived historical catches independently. The states of California and Oregon have completed comprehensive historical catch reconstructions. At the time of this assessment, a comprehensive historical catch reconstruction is not available for Washington. Completion of a Washington catch reconstruction would provide the best possible estimated catch series that accounts for all the catch and better resolves historical catch uncertainty for flatfish as a group.
2) Due to limited data, new studies on both the maturity and fecundity relationships for petrale sole would be beneficial.
3) Where possible, historical otolith samples aged using a combination of surface and break-and-burn methods should be re-aged using the break-and-burn method. Early surface read otoliths should also be re-aged using the break-and-burn method. Historical otoliths aged with a standard method will allow the further evaluation of the potential impacts of consistent under ageing using surface methods, changes in selectivity during early periods of time without any composition information, and potential changes in growth.
4) The effect of the implementation of the IFQ (catch shares) program that began during 2011 on fleet behavior, including impacts on discards, fishery selectivity, and fishing locations would benefit from further study.
5) Studies on stock structure and movement of petrale sole, particularly with regard to the winter-summer spawning migration of petrale sole and the likely seasonal trans-boundary movement of petrale sole between U.S. and Canadian waters.
6) The extent of spatial variability on productivity processes such as growth, recruitment, and maturity is currently unknown and would benefit from further research.

2015 Sablefish Assessment; Johnson et al. 2016

The following research could improve the ability of the stock assessment framework to reliably model sablefish population dynamics in the future:

Continuation of the annual NWFSC Shelf-Slope trawl survey will improve the precision of estimates of absolute stock size and productivity, which are reliant upon observing some contrast in stock trend (other than a one-way trip) with an unbroken survey index. Only a longer, more informative survey time-series will provide stock-specific and data-based information on the steepness parameter governing the sablefish stock-recruit relationship.

Update all relative survey indexes of abundance to use the latest delta-GLMM methods and investigate additional model structures.

Evaluate potential causes of residual patterns in the fit to larger cohorts in the age data (particularly the 1999 and 2000 cohorts) and to the size data (particularly for the hook-and-line fishery).

Evaluate potential causes of residual patterns in the fit to discard data, particularly for the pot fishery with respect to the early years of recorded discards.

Compared to other groundfish, age sampling of sablefish from the commercial fishery has generally been sparse. Work toward further standardization of state and federal biological sampling programs to reduce sampling variability would make the data more informative. For example, in a given year at least one state collects sexed-length observations, while at least one does not. If an increased fraction the catch was available for sampling at-sea, or in-port in

a non-dressed form, then more consistent demographic information could result.

Investigate aging methods that could prove more precise than current break-and-burn methods. More accurate age data would facilitate tracking cohorts to older ages, improving estimates of historical year-class strengths. Further studies to investigate the potential for bias in aging methods should be conducted; these results will have a strong effect on natural mortality estimates.

Explore the effect of assigning unsexed fishery composition data to males and females using a 50:50 ratio or some other justified sex ratio, versus excluding the samples as was done in the 2011 assessment.

Continue to monitor and explore differences in discard rates with the implementation of the catch share system.

Routine collection of samples to refine estimates of biological parameters, particularly maturity and fecundity, could increase the reliability of this assessment.

Continued refinement of the historical landings estimates for Washington, subsequent to the large data entry of historical fish-ticket information currently underway, will likely produce a more accurate time-series of mortality and would complement the completed efforts to reconstruct California and Oregon landings.

Given the migratory nature and broad distribution of sablefish along the Pacific Rim, it is important to continue to evaluate the spatial aspects of the assessments, including the northern boundary with Canada, and the connectivity with offshore seamounts. A joint assessment with Canadian and Alaskan scientists could be warranted, following the approach taken by the International Pacific Halibut Commission.

Continue to evaluate methods to capture information regarding environmental and ecosystem variability in stock assessments. Further, historical records of particularly large year classes (e.g., 1947 reported by sport fishermen in central California) could be investigated to better inform the historical period.

There is uncertainty in the accuracy of the dressed to whole weight conversions used in some situations to estimate fishery landings. Following Oregon's lead, this topic should be investigated, and total landed catch estimates adjusted, according to the best available conversion information.

2015 Widow Rockfish Assessment: Hicks and Wetzel 2015

There are many areas of research that could be improved to benefit the understanding and assessment of Widow Rockfish. Below, we specifically identify five topics that we believe are most important.

- **Historical landings and discards:** The historical landings and discards are uncertain for Widow Rockfish and improvements would increase the certainty that fishing removals are applied appropriately. Because landings are assumed to be known exactly in the assessment model, uncertainty in the predictions does not include uncertainty in the landings. A thorough look at historical landings, species compositions, and discarding practices would potentially account for and possibly reduce the uncertainty. More importantly, though, a measure of uncertainty on the estimated historical landings would allow for reasonable sensitivities to be investigated.

- **Natural mortality:** Uncertainty in natural mortality translates into uncertain estimates of status and sustainable fishing levels for Widow Rockfish. The collection of additional age data, re-reading of older age samples, reading old age samples that are unread, and improved understanding of the life-history of Widow Rockfish may reduce that uncertainty.

- **Maturity and fecundity:** There are few studies on the maturity of Widow Rockfish and even less recent information. There have been no studies that reported results of a histological analysis. Further research on the maturity and fecundity of Widow Rockfish, the potential differences between areas, the possibility of changes over time would greatly improve the assessment of these species.

- **Age data and error:** There is a considerable amount of error in the age data and potential for bias. Investigating the ageing error and bias would help to understand the influences that the age data have on this assessment.

- **Basin-wide understanding of stock structure, biology, connectivity, and distribution:** This is a stock assessment for Widow Rockfish off of the west coast of the U.S. and does not consider data from British Columbia or Alaska. Further investigating and comparing the data and predictions from British Columbia and Alaska to determine if there are similarities with the U.S. West Coast observations would help to define the connectivity between Widow Rockfish north and south of the U.S.-Canada border.

2015 Widow Rockfish STAR Panel Report; Sampson et al. 2015

Specific recommendations for the next widow rockfish assessment

- The next iteration of this assessment should be an update assessment.
- Minor anomalies in the weight-length data from the PacFIN Biological Data System (BDS) should be excluded or reconciled.
- A reanalysis of the foreign at-sea index that best overlaps the period of largest stock decline could be conducted before the next assessment. In particular, an analysis should consider effort measures that include search as well as towing time, given the schooling nature of this species. Other fishery indices are unlikely to have an appreciable impact on the results and may not be worth reanalyzing.
- Widow rockfish should be considered in any future discussions about trans-national stocks. Although a joint assessment with Canada may be difficult to arrange, it should be explored. It is possible that lack of information from Canada affects estimates of productivity and, in particular, steepness. Until such time as a joint assessment can be conducted, evaluation of relative catches and trend information on abundance in Canadian waters would also be helpful. Potential exchange also clouds the clear interpretation of what represents steepness for this stock.
- Updated maturity data representing the current stock distribution should be collected and analyzed, preferably using histological methods.
- Since there was so little information in the data on steepness, the informative prior might be strong enough to allow for estimation in future assessments. This should be explored.
- Based on the variability estimated for the juvenile index, it should be removed from future analyses unless it can be improved and validated. Specifically, the estimated variance is greater than the RMSE of the recruitments, so it will add more noise than signal at the end of the time-series when there are no other data to inform recruitment. This decreases the predictive ability of the model.
- Although recreational removals are low in relation to other removals for this stock, these should at least be reported in a table for comparison in future documents.

- It may improve the model if the H&L and NET fisheries are combined with other fleets, as these represent very little removals and noisy data. Removals of these data did not appreciably change the results for this assessment and their selectivity showed similar patterns to other fleets. Removing these as separate fleets would likely to make the modelling simpler with no loss of signal.

- Select one or more fleets (as run-time allows) and create conditional age at length data in order to inform growth and selectivity from more than just the most recent years where survey data are available.

General recommendations for all assessments

- A specific data workshop, perhaps for all species prioritized for assessment, could examine information across a broad range of species due for assessment, and would also assist with the development of more specific documentation of protocols used to compile best available data sets for stock assessment, continue acceptance of agreed procedures for standardization of abundance indices, and also begin work on procedures for the development of alternative data series that capture uncertainty, particularly for historical catch and discards.

- Additional work is required to further develop an objective procedure for evaluating the chosen stock boundaries across all rockfish (and potentially all other) assessments may be beneficial, and also more directly point to required directions for future research or assessment collaboration across national/international political boundaries. Further investigation is required for whether the stock boundaries assumed in the assessment are appropriate for management as well as scientific assessment.

- There is a need for more detailed examination of input data independent of the stock assessment, particularly in relation to sample size and representativeness. An examination of data sources by year and sub-area in particular may suggest appropriate methods for post-stratification of composition data. Potential stratification that should be considered should include season, latitude, depth, and boat type.

- Reports should include a section on how the recommendations from any data workshop and previous CIE reviewers were addressed. This would be an extension of the section for addressing previous STAR Panel recommendations (Appendix B in the 2014 Terms of Reference).

- Additional work is required in developing catch histories. An evaluation of the plausible range of proportions of species in the aggregated catch on the reconstructed catch time series is recommended. It would be most useful not only to provide single best estimates, but to define ranges suitable for use in bracketing uncertainties and sensitivity analyses.

- The state of Washington still needs a formal catch reconstruction to standardize approaches across assessments and ensure the best available estimates are being used.

- An objective procedure for identifying sub-model error structure (usually gamma or lognormal here) is required for delta-GLM procedures. Consistency is required for the model selection process, preferably using *a priori* candidate models rather than a stepwise selection. The standard delta-GLM procedure should allow for different factors to be considered in the binomial and sub-models. A standard set of diagnostics should be provided to review panels for each abundance index including: plots of the binomial and positive catch rate year effects in addition to the combined year effects; plots of all estimated effects; production of year:area interactions. The effects of the standardization on the "nominal" or unstandardized indices should also be shown and explained (i.e., which variables have caused a shift in the trend). It may be far more efficient to produce and review this output for groups of species together, rather than try to include it in each species-specific review.

- Reporting the extreme catch encounter probability in the ECE models would be an interesting diagnostic and additional piece of information for understanding how frequent exceptional catches are estimated to be.

- Expand and weight conditional age at length data to accurately represent both the sampling process and the numbers of fish predicted in each strata. This achieves logical consistency among data sets, choices of the number of length bins, and imparts the greatest amount of orthogonal information possible to the assessment model. Where length sampling is random, marginal length data should

be associated with conditional age at length data (by year and fleet) such that the recruitment information contained in the ages is not lost relative to what would be included if using marginal age compositions.

- An objective procedure using maximum age for a natural mortality prior needs to be developed and fully explored. Specifically, unless age samples were collected prior to significant exploitation, the oldest fish may be missing from the observed data, ageing error will tend to bias the maximum age to higher values and there may be sampling bias (e.g. domed selectivity). A percentile based method (e.g. use the 90th percentile) is likely to be more robust than using the single maximum age. Other information (e.g., GSI, growth, exploitation rates etc.) should be included, where possible in the derivation of the *M* prior.
- Where there is significant uncertainty in a very recent recruitment estimate (informed by very little data), it may be helpful to perform a likelihood profile over the strength of that year-class (running the model adjusting that deviation in the par file and using a "noest" option) to see where the primary signal was coming from.
- Aggregated residual plots (weighted and combined across all fleets would help to understand whether the model is fitting the available data adequately, even where patterns in residuals might show trade-off among fleets. This could reduce the over interpretation of residual patterns within the fit to a single fleet.
- Where there are marginal age- and length-compositional data being used from the same fish, iterative reweighting should be done first, then at the final stage an additional multiplier of 0.5 should be applied and no additional iteration performed. This retains the goals of both logically consistent reweighting and down weighting the doubly-used data.
- MCMC results are a useful tool to measure uncertainty and diagnose problems in the assessment as well as provide an alternative to MLE-based results, which can differ appreciably in terms of point estimates and uncertainty (Stewart et al. 2013). MCMC should be routinely used and reported where possible.
- Producing at least one model run with the full time-period of estimated recruitment deviations would be a very helpful diagnostic and could be a plausible base case depending on the model behavior.
- Triggering a future full assessment could be based on monitoring the most reliable indices, such as surveys with confidence bounds. In comparing observed and predicted values, values outside confidence limits may suggest a higher priority for more immediate assessment.

In addition to current R4SS and SS3 functions, the following additional features and standardized procedures should be developed:

- Procedures for examining sources of information on recruitment events is required. This could include profile over recruitment events or partition likelihood components.
- A method to examine observed and expected sex ratio by age and through time would resolve questions about the consistency of sex ratios being produced for the modeled population.
- Developing residual plots that are weighted across data sources would allow comparisons to be made that might help to identify common patterns.
- Removal of the re-scaling to 1 problem after weighting is applied to composition data.
- Development of standard procedures for the selection of the most appropriate weighting system that should be applied to input data (additional sd for indices, harmonic mean/Francis/other for length and marginal age comps, harmonic mean/Francis/other for conditional age-at-length data).\

2015 Pacific Fishery Management Council and the National Marine Fisheries Service Northwest and Southwest Fisheries Science Centers Groundfish Stock Assessment Process Review Workshop; Agenda Item F.7, Attachment 8, April 2016

Wednesday, December 9

Attendees:

Dr. Lewis Barnett, NMFS Northwest Fisheries Science Center
Dr. Aaron Berger, NMFS Northwest Fisheries Science Center, SSC
Mr. Troy Buell, Oregon Department of Fish and Wildlife
Dr. Jason Cope, NMFS Northwest Fisheries Science Center
Mr. John DeVore, Pacific Fishery Management Council
Dr. E.J. Dick, NMFS Southwest Fisheries Science Center
Dr. Martin Dorn, NMFS Alaska Fisheries Science Center, SSC
Dr. John Field, NMFS Southwest Fisheries Science Center, SSC
Dr. Vladlena Gertseva, NMFS Northwest Fisheries Science Center
Dr. Melissa Haltuch, NMFS Northwest Fisheries Science Center
Dr. Owen Hamel, NMFS Northwest Fisheries Science Center
Dr. Jim Hastie, NMFS Northwest Fisheries Science Center
Dr. André Punt, University of Washington, SSC
Ms. Heather Reed, Washington Department of Fish and Wildlife, GMT
Dr. David Sampson, Oregon State University, SSC, Groundfish Subcommittee Chair
Dr. Andi Stephens, NMFS Northwest Fisheries Science Center
Dr. Jim Thorson, NMFS Northwest Fisheries Science Center
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative, GAP
Mr. John Wallace, NMFS Northwest Fisheries Science Center
Ms. Chantel Wetzel, NMFS Northwest Fisheries Science Center

Online Attendees:

Mr. John Budrick, California Department of Fish and Wildlife, SSC
Ms. Jessi Doerpinghaus, Washington Department of Fish and Wildlife, GMT
Mr. Dan Erickson, Oregon Department of Fish and Wildlife
Mr. Craig Good, Oregon Department of Fish and Wildlife
Dr. Xi He, NMFS Southwest Fisheries Science Center
Dr. Neil Klaer, Center of Independent Experts
Dr. Melissa Monk, NMFS Southwest Fisheries Science Center
Dr. Will Satterthwaite, NMFS Southwest Fisheries Science Center, SSC
Ms. Maggie Sommer, Oregon Department of Fish and Wildlife
Dr. Theresa Tsou, Washington Department of Fish and Wildlife, SSC

David Sampson called the meeting to order and there was a round of introductions of the participants. It was agreed that public comments from folks attending online would be accepted at any time.

Discuss Past Stock Assessment Process Review Reports

One point of discussion was the concept of convening data/modeling workshops prior to developing draft assessments, as occurred in the most recent cycle (the data workshop for nearshore stocks) and has sometimes occurred in past cycles. Because the assessment review process requires significant time and resources, it is important that evaluating assessment data and modeling approaches be done as efficiently as possible. One possibility is to convene a series of webinars to discuss and resolve data, and possibly model specification issues (e.g., stock boundaries). It will also be critical to have key persons develop indices, datasets, model documentation, etc. in advance of any meeting, workshop, or webinar. It might expedite the process if the "continuity" CIE reviewer (who participates in all the STAR Panels) was also a participant in any pre-assessment meetings. It would also be helpful to the process if there was a ten-year projection of assessment priorities to support planning for collecting data and developing promising indices and modeling approaches. There are other avenues for improving assessment input data. For instance, there is an effort by the RecFIN Technical Committee to improve recreational data for use in assessments. There also needs to be a review process of

recommended indices – perhaps an SSC review. There was discussion of the Southeast Data and Assessment Review (SEDAR) process, which has separate steps for review of the input data and the assessment approach. SEDAR is not flawless and perhaps more complicated than would best fit our process. There needs to be some flexibility in developing assessment data to reflect species-specific data issues. Once the data issues are worked out through advance workshops and through other initiatives to improve source data, a meeting to review proposed indices attended by the SSC Groundfish Subcommittee and STAT leads would be beneficial. Guidance on index development and modeling approaches would be a review meeting objective. Also, it is recommended that Council staff compile and distribute past CIE reports if available on stocks proposed for assessment and that this process step be codified in the Terms of Reference for groundfish stock assessments.

SSC Perspectives on the 2015 Stock Assessment Process and Recommendations for Improvement

There was discussion of the June review of the data-moderate update assessment for arrowtooth flounder, which did not result in an approved assessment. The basic data-moderate approach resulted in extremely high biomass estimates, and subsequent modelling to address this issue was too complex and different from the standard data-moderate approaches to expeditiously review the proposed update assessment in the time allotted. One possible solution for future reviews is to convene an initial data-moderate review with the STATs and the SSC Groundfish Subcommittee with sufficient lag time to address recommendations before a more formal review by the entire SSC. Also scheduling data-moderate stock assessments for stocks using similar data would enable a more efficient review. The arrowtooth example also underscores the critical nature of the compositional data in the assessment. Without the compositional data and the ability to estimate recruitment deviations in the arrowtooth assessment, biomass was increasing beyond what the model could handle or what was believed to be plausible. Criteria for stocks proposed for data-moderate assessment should be refined.

There was also discussion on how to deal with competing assessments from within a STAT (e.g., the 2015 Oregon black rockfish assessment). For stocks that are assessed with separate regional models, there should be consistent approaches to modeling productivity, data weighting, etc. across regions. For situations where one approach does not work well in all regions, it would be helpful if the SSC could provide guidelines on a process step that could be codified in the Terms of Reference for resolving such differences.

The SSC conflict of interest criteria were briefly discussed. During SSC reviews of assessments the supervisors of STATs and STAR panel chairs are encouraged to participate in SSC debates, but they are recused from voting on an assessment in the rare cases where the SSC votes. The conclusion from the discussion was that these criteria are still sound and should be maintained to keep SSC reviews as objective as possible and to avoid the perception of a conflict of interest.

STAT Perspectives on the 2015 Stock Assessment Process and Recommendations for Improvement

Jason Cope discussed practices for developing data-moderate assessments. One issue is how to develop a prior on depletion for a stock that has previously been assessed. Should results from a past full assessment be used? Another issue is whether an MLE approach should be allowed. Although the SSC has previously approved two Bayesian approaches (XDB-SRA and XSSS) for data-moderate assessments, an MLE approach may be acceptable in some circumstances. Also, there was some discussion of whether the median or the mode was the appropriate measure of central tendency for stock status in a Bayesian analysis. A set of best practices needs to be established. However, there are many technical complications that remain to be worked out, such as rules for determining the joint prior in a Bayesian model. Although STATs could be given more flexibility on reporting MLE vs. Bayesian results, as well as recommending the mode vs. median in a Bayesian result depending on the posterior distribution, with that flexibility, it will be important for the STAT to justify their approach. Otherwise there may be a lack of consistency in approaches for determining stock status between assessments and modeling platforms. More discussion on these topics will be needed before these issues are resolved.

Jim Hastie recommended that deadlines be established in the process for providing data to STATs. When new data are provided late in the process the assessment review will not be effective or efficient. This was a common problem during the 2015 assessment process and needs to be resolved. However, if a STAT is compelled to include data provided after the deadline (e.g., the original data were found to be incorrect), the STAT should be allowed to do so if it will not compromise the STAR panel process.

Advisors' Perspectives on the 2015 Stock Assessment Process and Recommendations for Improvement

Heather Reed compiled the GMT's perspectives and provided these in a brief written report and discussed them with the group. To avoid the need for last-minute changes to assessment input data, the GMT and states should be provided adequate opportunity in advance of the STAR panel to review and comment on input data. A set of best practices should be developed for modeling historical discard data. A standard protocol should be developed for deciding whether the triennial trawl survey data are used as a single series or split in two. The GMT wants to hear further discussion on best practices for data-moderate assessments. The GMT also strongly recommends convening a productivity workshop this year and sees merit in a webinar to educate the public regarding data, methods, and improved understanding of the values of steepness currently used for rockfish species. The GMT recommends a more consistent format in assessments for reporting discard rates used by year and more consistency between assessments in the assumptions underlying projections.

The workshop participants recommended adding an appendix to the Terms of Reference for groundfish assessments with SSC-recommended best practices on data and modeling approaches.

Dan Waldeck agreed that working out data issues during a STAR panel is inefficient and that there should be earlier open communication between the STAT, industry representatives, and data managers to properly review input data. A deadline for providing data to the STATs is needed. A webinar with PacFIN database managers and STATs could be convened to understand the best way to access these data. The same process is recommended for the RecFIN database.

John DeVore addressed the issue of missing deadlines for submitting draft assessments for internal review, which was a problem this past cycle. John also recommended a convention of providing all the input and r4SS files be provided in the process so that the STAR panel members have full access.

CIE Perspective on the 2015 Stock Assessment Process and Recommendations for Improvement

Neil Klaer, who was the CIE reviewer for all the 2015 STAR Panels, provided a composite report of the recommendations he made for the STAR Panels. He underscored John DeVore's recommendation to provide all the input, control, and r4SS files to STAR panel members. Neil commented that the STAR Terms of Reference worked fairly well but suggested we reconsider the idea that a STAR panel should not become a workshop. A STAR panel can evolve into a productive workshop if the STAT agrees and assessment problems can be resolved that way. The STAR process of collectively capturing requests and rationale for requests worked well. There is a need to have an advanced evaluation of data before it comes to a STAR panel. Standardizing assessment methodologies is a good idea. More work should be done on establishing best practices for projection methodologies. We should consider better ways to develop decision tables. Most assessment uncertainty is multi-dimensional and a single decision table is overly simplistic. MSEs and other risk assessments should become more standard in the process. Work should be done to improve some of the Stock Synthess problems encountered during this year's STAR panel process (e.g. implausible trends in early recruitment deviations, lower limit on data-weighting).

Martin Dorn asked about the Australian process and Neil and André Punt explained that process. David Sampson asked how the STAR process compares to SEDAR and Neil commented that the SEDAR process did a better job of vetting data and modeling issues prior to the formal assessment review. This is done in a three-meeting process with separate evaluations of data, modeling and methodologies, and then the formal review. Martin asked for more information on Appendix 3 of Neil's document with respect to "breakout rules". Neil explained the Australian process of tracking CPUE and survey trends to understand whether the stock is likely trending the way the assessment projection trajectory predicts. This helps decide whether a stock needs to be reassessed. The other useful application of this process is recognizing whether an assessment has strong retrospective patterns. In such a case an assessment should not rely on longer term projections and such stocks need to be assessed more frequently. Jim Hastie added it may be helpful to include other metrics in such an evaluation. Changes in expectation of mean lengths in the fishery, for instance, may also be needed, especially for a stock not well sampled in surveys.

David Sampson asked whether the CAPAM data-weighting workshop was useful in determining best practices. The overall recommendation is that Francis and harmonic mean weighting works, although the latter approach weights age data too much. Francis weighting is a better approach for weighting age data provided the model is correctly specified. The group recommended a default data weighting approach be decided.

EJ Dick asked if new versions of approved software (e.g. Stock Synthesis, XDB-SRA, XSSS) need a formal methodology review. Perhaps the beta testing report of new versions could be part of an SSC methodology review. At the least, there should be clear guidance from the SSC on how much change from a previously reviewed methodology would trigger a new methodology review.

Recommended Improvements for the Stock Assessment Process and Reviews

Recommendations:

- Explore a series of webinars or a data/modeling workshop to critically review proposed data and methods for index development that will be used in assessments. Bring the SSC Groundfish Subcommittee in when there are proposed indices available for evaluation. This would occur after the STATs and data experts agree on the appropriate data to be used (e.g., data filtering, interpretation of the historical data, etc.).
- Develop a 10-year stock assessment prioritization to allow state agencies and science centers to better plan data collection and analysis (e.g., ageing priorities, etc.).
- Facilitate training webinars with PacFIN and RecFIN database managers and STATs to learn how to best access these data. PacFIN webinars could happen now, but such a training webinar for accessing RecFIN data will have to wait for the database to be migrated to the new SQL framework.
- Once assessment priorities are decided, Council staff should compile past CIE reports and post them on the web site. SSC reports on their assessment reviews should also be housed on the Council assessment web pages.
- Data-moderate assessments are appropriate for improving a data-poor assessment of a stock, but may not be appropriate for a stock previously assessed using a full assessment. A STAR Panel should be dedicated for reviewing data-moderate assessments.
- A simple comparison of historical catches relative to estimated biomass should be done to decide whether any new stock assessment should be prioritized. For example, it was probably not worth conducting an assessment for stripetail rockfish, where the historical catch was a very small percentage of the estimated OFL.
- Refine the language in the Terms of Reference on how best to resolve competing models in an assessment.
- More clearly describe the nature of the STAR panel in the Terms of Reference as primarily a review body, with a limited capacity to investigate identified and agreed (STAR panel and STAT) major problems. If agreed solutions to major problems can be readily identified, sufficient time must still be allowed for full review of the resulting model(s) if they substantially differ from the original drafts presented.
- Establish a deadline (e.g., at least one month prior to the internal document review deadline) for providing data to STATs. This should be consistent with any data review process and codified in the Terms of Reference.
- Establish best practices for modeling and reporting discard data in an assessment. John Wallace has analyzed historical discard data using standardize approaches. This analysis should be evaluated by the SSC and the GMT to formalize best practices.

Thursday, December 10

Attendees:

Dr. Lewis Barnett, NMFS Northwest Fisheries Science Center
Dr. Aaron Berger, NMFS Northwest Fisheries Science Center, SSC
Dr. Jason Cope, NMFS Northwest Fisheries Science Center
Mr. John DeVore, Pacific Fishery Management Council
Dr. E.J. Dick, NMFS Southwest Fisheries Science Center
Dr. Martin Dorn, NMFS Alaska Fisheries Science Center, SSC
Dr. John Field, NMFS Southwest Fisheries Science Center, SSC
Dr. Vladlena Gertseva, NMFS Northwest Fisheries Science Center
Dr. Melissa Haltuch, NMFS Northwest Fisheries Science Center
Dr. Owen Hamel, NMFS Northwest Fisheries Science Center
Dr. Jim Hastie, NMFS Northwest Fisheries Science Center
Dr. André Punt, University of Washington, SSC
Ms. Heather Reed, Washington Department of Fish and Wildlife, GMT
Dr. David Sampson, Oregon State University, SSC, Groundfish Subcommittee Chair

Dr. Andi Stephens, NMFS Northwest Fisheries Science Center
Dr. Jim Thorson, NMFS Northwest Fisheries Science Center
Mr. Dan Waldeck, Pacific Whiting Conservation Cooperative, GAP
Mr. John Wallace, NMFS Northwest Fisheries Science Center
Ms. Chantel Wetzel, NMFS Northwest Fisheries Science Center

Modeling Productivity / Productivity Workshop Planning

The question of whether, and when, a workshop on productivity could be scheduled was discussed, including consideration of the extent to which participants could reliably be expected to conduct background work and present results at the workshop. It was acknowledged that best practices for modeling steepness are still a somewhat open question, and that improvements could be made to current methods. Another topic of discussion was the idea of using a three-parameter Spawner-Recruit (S/R) curve in Stock Synthesis to provide more flexibility in the relationship between F_{MSY} and the ratio B_{MSY}/B_0. This relationship is determined by the value of the steepness parameter in the standard Synthesis model setup with a Beverton-Holt S/R curve.

A primary motivation for these concerns is that steepness is often estimated to be very high for many rockfish and other groundfish stocks, often approaching or hitting the parameter boundary at 1. This could potentially be a consequence of mis-specified S/R relationships. The drawback of using a three parameter S/R function is that there are rarely sufficient data to estimate two parameter S/R relationships, let alone more complex ones. The trade-offs associated with adopting more complex S/R functions should be considered carefully. An evaluation of how the results of a generalized Ricker or Shepherd relationship would map to the more traditional Beverton-Holt relationship would be a helpful simulation for a workshop, in which additional relationships among derived parameters (such as F/F_{MSY} against B/B_{MSY}) could be evaluated. André Punt and Jason Cope have already done some work on this topic. Other studies that would be relevant to explore and/or expand on during a workshop include studies of B_{MSY}/B_0 initiated by Thorson, F_{MSY}/M developed by Zhou et al. (2012), and advantages of 3-parameter S/R functions by Mangel et al. (2013). Of high importance in any consideration of simulation studies to evaluate production functions is to ensure that a wide and appropriate range of functions is represented in any operating models (e.g., assuming a Beverton-Holt for simulating data is not likely to indicate that a generalized Ricker function is optimal in a simulation model). Thus, any good study will consider such factors carefully.

Also mentioned with respect to a productivity workshop was the need to address conflicts among proxy reference points. For example, if the best estimates of steepness for many rockfish are values at or approaching 1, then the current proxies for target spawning output levels could be overly constraining. However, it was also noted that any change in the current proxy reference points should have a robust rationale, and that many evaluations have indicated that the relative difference in potential yield across a moderate range of stock sizes and productivity functions is modest (e.g., Hilborn 2010). Additional MSE studies could integrate various harvest control rules and thresholds currently used by management with simulation studies of alternative S/R relationships or productivity functions within assessment models, to best evaluate the potential trade-offs between yield and the risk of overfishing.

More tractable questions to be addressed at the productivity workshop include best practices for developing steepness priors. Specifically highlighted was the need to revisit how the current steepness priors have been developed with respect to the question of whether steepness estimates (distributions) from previous assessments should be included in a meta-analysis that informs the same species in a future assessment. It is generally (but perhaps not entirely) acknowledged that this practice (including the distribution from the previous assessment) is acceptable if the parameter is included in the assessment as "fixed," but not if the parameter is being estimated with an informative prior from the meta-analysis. In extreme cases, the

consequences are nontrivial, as stocks that are inferred by their profiles on steepness to have the lowest productivity would end up with priors that counterintuitively inferred a higher productivity. Another technical issue that could be addressed at the productivity workshop is incorporating autocorrelation in the methodology used to generate the prior on steepness.

To conclude the discussion of a potential productivity workshop, numerous questions regarding both the focus and the organization were discussed. The group was not entirely clear whether the SSC had explicitly been asked to take the lead on organizing a workshop, nor were there obvious volunteers to organize or host a workshop. It was noted that a catch reconstruction workshop had tentatively been planned for July of 2016, and that there is a pending request for a CIE reviewer from the NWFSC for a productivity workshop. Moreover, there could be disadvantages in scheduling a productivity workshop too early because analysts will need time to develop and run simulations, but there is also a need to hold a workshop early enough that the results could be informative to the next stock assessment cycle. This is particularly true if the intent of the workshop is to include documentation of best practices for modeling productivity or deriving productivity parameters and priors. The larger, overarching question regarding whether there was sufficient human capital (analytical power) and financial (travel, other) support to hold two workshops in 2016 was discussed but not entirely resolved. Suggestions to streamline costs and reduce travel obligations included holding a productivity workshop before the September PFMC meeting in Boise. Three days was discussed as a necessary length of time to effectively complete a workshop that included a formal process to develop recommendations for best practices (which could potentially be added to the Terms of Reference for stock assessments).

Updating the Stock Assessment and Rebuilding Analysis Terms of Reference

During discussion of how to revise the Terms of Reference for stock assessments the following points were raised:

- If a stock was previously assessed and CIE reviewer reports for that assessment are available, the Council staff should provide those CIE reports to the STAT and the STAR as part of the background material.
- The language about competing assessments should be written in a more general way, to indicate that the STAR will accommodate competing models that may arise. There are likely to be many different mechanisms that could result in competing models within and among STATs.
- The Terms of Reference should include an appendix with any SSC recommended “best practices”, to the extent that best practices have been developed and agreed.
- The STATs should be instructed to provide all SS files as separate, stand-alone csv files in the package that goes to a STAR panel for review so that reviewers can both examine and run draft/final models. These files do not also need to be incorporated into the actual assessment document. The “numbers at age” table (required under the 2015 Terms of Reference and in previous versions) should be provided as a stand-alone csv file, but does not need to be in the final assessment document.
- It is important that all of the assessment materials be archived, including all input files, different SS executable versions and R4SS code, model outputs, and assessment document word files plus pdf versions. NMFS has been doing this for many years. Currently the Council keeps pdf versions of final assessment documents on the Council website, plus the corresponding STAR Panel reports. Should other pieces of the assessment package also be included on the Council website? Should the Council website include standard sets of figures and tables in an output package (such as the pdf or html viewer)?
- The Terms of Reference should specify a standard format for citing assessment documents, which will be included as boiler plate in the Executive Summary of each assessment document (e.g., “please cite this document as …”.

- The text in the Terms of Reference describing the process for referring an assessment to the mop-up panel needs to be revised to allow enough time for public notice of the mop-up panel meeting. One possibility is to include a webinar following the last round of assessments to recommend referral to the mop-up. The recommended process needs to be explicit in the next Terms of Reference.
- The list of responsibilities for the GMT should include providing the STATs with the information needed to conduct default projections, including the default harvest control rules, sigma and p-star values for default forward projections, as well as additional GMT projection requests. If done in coordination with Council staff and early in the process it should lead to more consistent treatment across assessments regarding what is assumed about removals.
- The Terms of Reference should include examples or explicit templates of the information needed for projection runs (removals, spawning biomass and depletion projections as well as OFL and ACL values for the current and next year). The projections start in the current year; not the year in the future that the management based on this assessment will go into effect. Also, the text needs to be very clear that for non-overfished stocks, the OFL and ACL values for the current and next year are from the last assessment, whereas for overfished stocks, the projections for the current and next year are from the rebuilding analysis.
- The Terms of Reference should include examples or explicit templates of the information needed for the Species Information System (SIS)

There was discussion of how to provide better guidance in the Terms of Reference on constructing decision tables, but with recognition that there is no single, best approach for representing multiple dimensions of uncertainty in a single table. The revised Terms of Reference could point to examples of assessments that have used different approaches for constructing decisions tables, such as the 2015 assessment for canary rockfish, which provided two sets of decision tables, or the assessment for widow rockfish, which incorporated three aspects of uncertainty into a single decision table. It was noted that the 2015 Pacific hake assessment, conducted in a Bayesian framework using MCMC, provided useful metrics related to the probability of biomass falling below a prescribed threshold. However, analyses based on MCMC are not feasible for most of the Council's full assessments because they take too long to run. The potential for ensemble modeling was also discussed. Such an approach would provide a mechanism for considering model structure uncertainty, whereas current decision tables mostly consider parameter uncertainty.

There is a need to formalize the process of updating projections from old assessments given that management is based on a number of assessments that do not provide projections beyond the current management cycle. A closely related issue is how old an assessment can be before it no longer can be used to provide projections for management. Adjustments to the current ten-year projection rule may be appropriate for some stocks, depending on the stock's dynamics and the level of removals. The issue could be considered as part of the Council's stock assessment prioritization process.

A substantive topic of discussion was with respect to data weighting, and the question of whether there should be a recommended best practice. Even if the recommendation is only guidance, it was noted that the term "best practice" implies that the SSC had thoroughly evaluated the issue. In reality, research is ongoing and there is not yet broad consensus.

David Sampson and Martin Dorn have volunteered to implement these changes to the Terms of Reference in advance of the April meeting; John DeVore will offer some additional suggestions.

Data weighting

There was discussion of results presented at the recent workshop on data weighting hosted by the Center for the Advancement of Population Assessment Methodology (CAPAM) in La Jolla, CA in October of 2015. Some general consensus was that considerable progress was made at the workshop, but that an overall set of "best practices" for data weighting remained somewhat elusive and context dependent. For example, one participant noted that data weighting problems are minimal if the likelihood functions and model structure are correctly specified. It was noted that if a model is correctly specified, the harmonic mean weighting method works well for marginal age- and length-composition data. If the model is not correctly specified (diagnostics should indicate this), the Francis weighting method is likely more appropriate, as this method takes into account the autocorrelation among the compositional data. However, it was noted that the Francis approach is unlikely to address all the problems that a mis-specified model might create. Similar general rules may apply to conditional age-at-length composition data. The need to improve diagnostic plots in order to evaluate these factors was highlighted.

There was some discussion whether the best practices guide should recommend conducting sensitivity runs that contrast the Francis weighting versus harmonic mean weighting approaches, but it was not clear if there was consensus on this point. Jim Thorson noted that the Dirichlet multinomial has similar properties to the harmonic mean weighting (Thorson 2014), and if this distribution could be implemented in Stock Synthesis for the next assessment cycle, using the Dirichlet multinomial likelihood for compositional data might resolve many of these issues. This new approach will also merit discussion and likely review. With respect to changes to Stock Synthesis, there was discussion of the issue of minimum compositional sample sizes reverting to 1 during iterative weighting exercises. Apparently this problem will be addressed in the next version of Stock Synthesis. Additionally, the appropriateness of applying a single scalar to an entire time series of compositional data was questioned given that the fisheries and sampling procedures may have changed. It was agreed that this remains an important area of investigation that does not appear to be the focus of much research effort. Finally, issues regarding recreational fisheries and sample sizes were recognized, such as the challenges of identifying what constitutes a "trip" in the data.

Stock assessment prioritization

Jim Hastie addressed the group regarding ongoing efforts to develop a formal stock assessment prioritization approach. The current plan is to assemble prioritization information between Nov.-Jan. and distribute this information to the Council and Advisory Bodies in February for discussion at the March Council meeting. Currently, landings are the primary metric for recreational groundfish; there is a need to consider metrics that might be more appropriate. Information on subsistence value to the tribes would also be helpful, and some information may be available. The overarching goal is to strike a balance between the overall contributions of a stock to the fishery as a whole as well as to ensure that reasonable consideration is given to stocks that may be particularly important to specific elements of the fishery.

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Recommendations from the 2013 Assessment Cycle

2013 SSC Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental SSC Report, September 2013

The Scientific and Statistical Committee (SSC) reviewed possible topics for off-year science workshops related to improving groundfish stock assessments for the 2017-18 management cycle based on recommendations from recent Stock Assessment Review (STAR) panels (Agenda Item G.4a, Attachment 1). Dr. Owen Hamel gave a presentation on assessment-related "off-year" research priorities for the FRAM division at the NWFSC. The NWFSC priorities are grouped into a) inputs to assessment models, b) model improvements and c) management and agency priorities. Many of these activities are best regarded as research projects for individual scientists or small teams, and would not necessarily be appropriate for Council-sponsored workshops. There may be a need for the SSC to review refinements to existing methods or data inputs prior to their use for stock assessment, and this should be possible during regular SSC meetings, or during 1-day meetings of the SSC Groundfish Subcommittee scheduled before or after meetings of the full SSC.

The SSC identified four priority topics for off-year science workshops. Two of these workshops were also recommended in 2011, but could not be completed for various reasons. The SSC continues to regard them as priority topics.

Workshops related to stock assessments (in priority order):

1. **Workshop to review historical landings time series (recommended in 2011)**. A major effort to reconstruct historical landings was initiated in 2008 in response to the Council's call to compile the best estimates of catch history early in the development of Pacific Coast groundfish fisheries. Currently, this effort has produced published estimates for California fisheries, and more recently, estimates for Oregon fisheries. Data bases have been developed for raw landings and historical species composition data for Washington, but the analysis has not yet been done. An off-year science workshop would review reconstructions of all landings comprehensively, ideally when the Washington estimates are available. This review would need to be structured differently than the other proposed workshops, since the most expertise is to be found among current and former employees of state agencies and experienced fishermen and processors. Estimation of the extent of uncertainty of the historical catch estimates due, for example, to uncertainty in estimates of landings species compositions, would also be a priority for this workshop.

2. **Workshop on methods of data reweighting.** Most West Coast assessments use effective sample size to weight the composition data by fleet. During the aurora and rougheye rockfish STAR panel, CIE reviewer Dr. Chris Francis provided compelling evidence that this standard approach resulted in implausible residual patterns. An alternative approach proposed by Dr. Francis for the most part eliminated these "bad" residual patterns. However, it remains to be determined whether this approach is the "best" general approach for deriving reweighting factors. The issue, while technical in nature, has important consequences, since it is not unusual for assessment results to be

fairly sensitive to the weights given to composition data. The SSC recommends that a scientific workshop be sponsored to review the state of the art for reweighting stock assessment data, with the aim of preparing a guide to good practices for future assessments. This workshop would also benefit CPS stock assessments.

3. **Workshop on the shape of the stock productivity curve.** Recent data-moderate assessment approaches such as Extended Depletion-Based Stock Reduction Analysis (XDB-SRA) are designed to have greater flexibility in how productivity changes with stock size. In contrast, nearly all full assessments of West Coast groundfish use the two-parameter Beverton-Holt stock recruit relationship, which imposes strong constraints on the shape of the stock productivity curve. While the approach used in DB-SRA has conceptual appeal, it is not clear whether such flexibility is appropriate given what is known about the growth and mortality of West Coast groundfish. The two approaches represent a fundamental difference in how stock productivity is modeled, and there are important implications to biomass and fishing mortality reference points used in Council's harvest control rules. The SSC recommends that a scientific workshop be sponsored that would evaluate the suitability of these alternative ways of modelling stock productivity in data-moderate and full assessments.

4. **Workshop on estimation of B_{MSY} proxies (recommended in 2011).** The Council's harvest control rules depend on estimates of stock size relative to a B_{MSY} proxy, with a default B_{MSY} proxy defined as some fraction of unfished stock size, B_0. Changes in stock assessment methods or data inputs can lead to large changes in estimated B_0 and in some cases to marked changes in depletion levels, overfishing limits, acceptable biological catches, or rebuilding times. This workshop would review alternative control rules (e.g., control rules based on "Dynamic B_0" or on direct estimates of B_{MSY}) and compare their performance with current approaches using management strategy evaluation (MSE). The workshop would build on the last B_0 workshop, but would be more focused on the performance of control rules. It would also include review of stock status for a range of stocks when stock status determinations are based on "Dynamic B_0." The evaluation of control rules could be based on the MSE currently being developed to evaluate rebuilding revision rules.

Successful workshops require dedicated research, careful organization before the workshop, and post-meeting development of scientific reports, all of which come at a cost of time and resources. The Council should be cognizant of the trade-off between the number of workshops that are held and amount of progress that can be made on other projects with the potential to improve data inputs and stock assessments.

With the adoption of the Council's Fishery Ecosystem Plan, the SSC anticipates a greater workload next year reviewing ecosystem-related documents, including annual reports of ecosystem status and technical documents to support the Council's ecosystem initiatives. Depending on the nature of the document and its intended use by the Council, these reviews could range from short, focused reviews (1 or 2-day) by SSC Ecosystem Subcommittee, to more extensive reviews similar to the methodology review process used for CPS and Groundfish. For example, the Ecosystem Workgroup is proposing a science workshop to evaluate information on the food habits of Council-managed species with the goal of refining criteria for identifying forage fish species. This workshop would benefit from SSC Ecosystem Subcommittee participation as reviewers of the scientific information developed for the workshop.

2013 GMT Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental GMT Report, September 2013

The Groundfish Management Team (GMT) reviewed the materials under this agenda item and had a discussion with Dr. Michelle McClure of the National Marine Fisheries Service (NMFS) Northwest Fisheries Science Center (NWFSC). The GMT thanks Dr. McClure for her time and patience in working around the GMT's schedule. Overall, the GMT recognizes that the efforts of the NMFS Science Centers provide the fundamental science used for conservation and management policies.

Additionally, the GMT has the following items that we would like to have considered for the "off-year" science improvements. Choosing off-year science improvements involves prioritizing staff and other resources and consideration of how well certain questions can be addressed with the existing data and methods. Given time and other constraints, we were not able to get into specifics about how issues would be best addressed or to consider matters of timing. Mainly we attempt to flag issues the team sees as important. The following are in no particular order of priority.

Spatial analysis of exploitation, fishing effort, and trends in abundance

An analysis of catch per unit effort and removals by port, county, or district or other appropriate stratification using the methods similar to Cope and Punt (2009) should be conducted to identify regions with differential depletion (e.g. for rockfish species) that should be considered in stock assessments similar to explorations of population structure. Such analyses may be conducted across a number of species belonging to various groundfish complexes to examine patterns of differential depletion as a result of exploitation by differing sectors. The analysis would likely be focused on species that are sedentary (and possibly those that co-occur) and the results compared to test for the presence of regional trends in abundance. Such analysis would support the requirement in the Stock Assessment Terms of Reference to include, "Species/area, including an evaluation of any potential biological basis for regional management." Differential exploitation may provide a justification for regional management beyond a strictly biological or stock structure basis. Any additional research that would aid the process of determining stratification used in assessments or allocations across management boundaries would be welcomed by the GMT.

Transboundary Stocks

In their report under this agenda item, the Groundfish Advisory Subpanel (GAP) is reiterating a recommendation for attention to the transboundary stock issue. We agree that it is a very key issue for many groundfish stocks. It comes up frequently in our discussions. For instance, at this meeting, it has been mentioned in the context of at least three other agenda items. For example, in consideration of the "in the fishery" classification and stock complex evaluation, and just on the northern border, at this meeting alone we have discussed questions about the management of dusky rockfish, Pacific cod, walleye pollock, shortraker rockfish, tiger rockfish, and more. Similar issues are present on the southern border with Mexico as well. We understand there is concern that not much can be done on the research/science or stock assessment side of things

without international cooperation. Not weighing in on that question, we emphasis that there are scientific questions about the stock unit of conservation. The questions related to this may be similar to the discussion above on spatial analysis and regional variations in abundance and depletion history. If not an off-year activity, some discussion about the scientific realities of managing these stocks and how it fits within the Magnuson-Stevens Act National Standard 3 and other requirements could be beneficial.

Data-Moderate Stock Assessments

The recent data-moderate sock assessments for nearshore species were largely dependent on data from the party and charter fleet. Data for this sector are sparse in some parts of the coast. In addition, some species are predominantly distributed in shallower depths than party and charter vessels typically fish, but where private and rental vessels regularly access. Such data is available for a long time series and provide a substantial number of angler interviews. Thus the data from the private recreational fishery may provide valuable data to inform indices of abundance for future assessments. The GMT would like to see an evaluation of methods to derive catch per unit effort indices from the private and rental boat mode of the recreational fishery for use in future data-rich and data-moderate stock assessments of nearshore and/or shelf species.

Catch Reconstructions and Discards

The GMT supports the continuation of the historic catch reconstruction process, including holding an independent review of the work completed to date. This may be supplemented by a workshop on modeling discards for periods prior to the West Coast Groundfish Observer Program (WCGOP). The WCGOP data have enabled stock assessments to represent discarded catch in a more complex and accurate way for recent years. However, the accurate representation of discards during earlier periods has been more difficult. Just as the catch reconstructions have brought more consistency to treatment of landed catch, further research on methods for modeling discards could increase consistency among assessments and may reveal better ways to account for the full history of changes in fishing practices.

B_0 Workshop

We understand that the SSC will recommend this workshop. We support the idea as well. As we understand it, the focus would involve a look at the Council's harvest policies and potentially inform several outstanding questions (e.g. the appropriateness of the fishery management plan's (FMP's) B_{msy} and F_{msy} proxies). Also, like we mention in Agenda Item H.1, such analysis will help explore considerations of additional flexibility and conservation objectives that are being discussed nationally (e.g. pretty good yield and the mixed stock exception). We understand the Management Strategy Evaluation (MSE) being prepared for Amendment 24 could be adapted for this analysis to explore some of these questions.

Ecosystem-related Analysis

We continue to support exploration of the connections between the ecosystem analyses (e.g. integrated ecosystem assessments) and related activities and the groundfish analyses, for example, the Tier 1 environmental impact statement (EIS) and the analysis that will follow it, stock assessments, and more. Connecting our understanding of ecosystem impacts with cumulative impacts of management, stock status, etc. will provide greater context for the effect of various Council actions and policies on the marine environment. The Council has already requested that time be spent on certain activities and we point out that the Science Centers and

the Scientific and Statistical Committee (SSC) will likely be allocating time this year and next to these effort.

Ongoing Socioeconomic Discussion with the SSC - Possible Workshop and SSC recommendations

We support a joint GMT and SSC workshop to continue identifying and discussing groundfish-related socioeconomic needs and priorities. Though we appreciate the model reviews that the SSC's Economics and Groundfish Subcommittees have engaged in so far, the recommended priorities that the SSC identified and the socioeconomic-related priorities of the team may differ. We would like an opportunity to discuss these differences with the SSC and a workshop would be helpful for clarifying the GMT's socioeconomic needs and concerns relative to the SSC's recommendations.

Regarding the SSC's recommendations identified in their report (Agenda Item F.7.b, Supplemental SSC Report, June 2013), the GMT provided a complete list of items that we are addressing during this 2015-16 biennial process, and will begin to address after this process is complete. This list can be found in Agenda Item G.7.b, Supplemental GMT Report, September 2013. The GMT would like further discussion with the SSC on some of these items and will work with Council staff to facilitate these discussions.

2013 GAP Report on Off Year Science Improvements; Agenda Item G.4.c, Supplemental GAP Report, September 2013

The Groundfish Advisory Subpanel (GAP) received a presentation from Dr. Michelle McClure on science improvements for the next groundfish management cycle. The GAP also reviewed the STAR Panels' recommendations under this agenda item.

Generally, the GAP understands the Council has to prioritize science needs and improvements, taking into consideration the recommendations by the STAR Panels, science centers and Scientific and Statistical Subcommittee, but request the Council concentrate on changes and suggestions that have the most benefit to the industry.

Thus, our recommendation in September 2011 (Agenda Item G.10.b, Supplemental GAP Report) still stands. Briefly, we requested four workshops: 1) A workshop on transboundary stocks; 2) one on the B_0 harvest management framework; 3) one to review historical catch reconstructions; and 4) one to develop techniques (non-extractive) to survey Cowcod Conservation Areas. That statement is attached for your review.

We understand there are budgetary concerns at all levels of government (including Canada, in the case of transboundary stocks), but fiscal concerns also affect every harvester, processor and community when it comes to operating small businesses. The GAP supports these improvements and believes they will be the most productive at making the industry and management process more efficient.

It is also the GAP's understanding that a workshop will be held to review stock assessments and the stock assessment process. We request industry members also be included in this workshop, as we reiterate the collective knowledge of the fishing industry will certainly aid conveners and participants of these workshops.

2013 Aurora Rockfish Assessment; Hamel et al. 2013

The following research could improve the ability of future stock assessments to determine the current status and productivity of the aurora rockfish population:

1) This was the first year in which aurora rockfish otoliths were read to develop age data. There was insufficient time to read all of the otoliths or even cover all of the years for which aurora rockfish otoliths were collected from the fisheries or surveys. Additional age data could provide additional information for the model to estimate such parameters as natural mortality and recruitment deviations. Additionally, validation methods, such as the bomb radiocarbon chronometer, could be used to validate the ages and ageing method for aurora rockfish.
2) The base model does not use newly available information of female maturity collected within the NWFSC shelf-slope survey in 2012. This new information includes data on mass atresia (a form of skipped spawning), at far greater numbers than that reported in Thompson and Hannah (2010). More data on aurora rockfish maturity will be collected this year on the NWFSC shelf-slope survey, which could confirm the information on mass atresia or indicate variability between years. This information could better inform the maturity curves used in the assessment.
3) The base model assumes spawning output is proportional to spawning biomass. For many rockfish species, fecundity has been shown to have a non-linear relationship with female weight. Determining this relationship for aurora rockfish would improve the estimation of spawning output and depletion.
4) Improve the meta-analysis for steepness. This would include consideration of fixed and estimated parameters, assumptions, and the quality of the information on maturity and fecundity in the component assessments, as well as correlations in recruitments among assessments due to environmental drivers.
5) The application of the GLMM software elicited many unresolved questions. Continued research and articulation of that statistical approach and the options available (e.g. extreme catch events) will greatly benefit both STAT application and STAR Panel understanding of the model and its advantages.
6) Further research on the most appropriate method for data-weighting is greatly needed. Simulation testing and comparison of standard and new (Francis 2011) methods would benefit future assessments of this and other stocks.
7) Development of information on the spatial structure of the stock is needed, including genetic analysis, investigation of differences in and size at maturity, and information on aurora rockfish off of Canada and Mexico.
8) The development of additional indices could provide further information to anchor the assessment. While direct adult biomass indices are unlikely to surface, there may be some possibility to develop a larval abundance index from the CalCOFI data set. This index reflects a measure of spawning biomass.

2013 Aurora Rockfish STAR Panel Report; Sampson et al. 2013

General (affecting more than one assessment)

1) A workshop should be held to evaluate (a) methods for the iterative reweighting of composition data (e.g., current approach based on SS3 calculation of effective N versus Francis approach) and (b) methods for developing initial weightings (the initial input N values).

2) A workshop should be held to evaluate methods for constructing survey GLMM estimates. Topics that should be explored include: (a) the effect of treating vessels as random when in fact the vessels hardly vary from one year to the next; (b) possible aliasing of the index

values with the *Vessel* x *Year* interactions; and (c) using information from the GLMM for combining length composition data collected by different vessels. One goal for the workshop should be to provide adequate documentation of the GLMM methods that will be used to produce survey biomass indices for future assessments and guidelines on how the analyses, including diagnostics, should be presented in stock assessment reports.

3) Port sampling programs should continue their routine collection of otoliths of slope rockfish species. A catalog of historical collections that have not been aged should be developed.

4) The series of historical catches of individual rockfish species, which are important sources of uncertainty in stock assessments of rockfish, should be explored in more detail. The STAR Panel agrees with the statement in the draft assessment document for rougheye rockfish that "*A thorough look at historical landings, species compositions, and discarding practices would reduce the potential uncertainty that is not entirely accounted for"*.

5) Furthermore, catch reconstructions should not just develop best estimates of rockfish catch by species, but should also characterize the uncertainty of historical catch estimates by identifying periods of greater and lesser uncertainty. For example, rockfish species compositions taken during early years when there were limited slope fisheries should be very different from species compositions taken during later years when fisheries on the slope were more prevalent.

6) The SSC should develop detailed technical guidance on how to construct decision tables, including a summary of lessons learned from a review of approaches applied in past stock assessments.

7) Investigate better fishery-independent data collection methods for slope rockfish and other species living in untrawlable habitats (e.g., surveys using submersibles or remotely operated vehicles).

8) To lessen the potential for confusion in assessment documents and presentations, STATS in the future should be encouraged to develop and use consistent nomenclature for identifying standard data sets. For example, during the Review the "AFSC triennial shelf survey" was also described as the "triennial survey" and as "AKSHLF".

Specific to aurora rockfish

1) The STAR Panel agrees with the STAT regarding the importance of (a) producing additional age-reading data for use in the next assessment of aurora rockfish and (b) validating the ageing method and age readings.
2) The STAR Panel agrees with the STAT regarding the importance of collecting additional information on reproductive biology (maturity, fecundity, and mass atresia) in aurora rockfish. This will allow analyses that better establish the relationship between effective fecundity and length, and between effective fecundity and weight.
3) The STAR Panel agrees with the STAT regarding the need for further development of the meta-analysis for steepness, including "*consideration of fixed and estimated parameters, assumptions, and the quality of the information on maturity and fecundity in the component assessments, as well as correlations in recruitments among assessments due to environmental drivers*".
4) The STAR Panel agrees with the STAT regarding the need for information on the stock structure of aurora rockfish with the aim of evaluating the assumption that the US West Coast stock is isolated from aurora rockfish off Canada and Mexico.
5) The STAR Panel agrees with the STAT that there should be exploration of developing an index of larval abundance of aurora rockfish from the CalCOFI surveys.

2013 Cowcod Assessment; Dick and MacCall 2014

Annual Catch Limits for the area south of Cape Mendocino are currently defined as twice the ACL set for the SCB. A reliable estimate of absolute abundance and/or a time series of relative abundance is needed to assess the status of cowcod in waters between Point Conception and Cape Mendocino.

Fishery-independent (extractive) surveys are not currently sampling inside the Cowcod Conservation Areas, which likely contain a large fraction of the population. To better understand rebuilding progress, this policy could be reconsidered given the more optimistic results of the assessment.

Additional information is needed on cowcod stock structure and life history traits, including but not limited to dispersal between U.S. and Mexican waters, and potential differences in life history characteristics (e.g. growth, maturity, fecundity, longevity) among the recently identified genetic lineages.

Consider regular, but not necessarily annual, visual surveys of absolute cowcod abundance in the SCB (inside & outside the CCAs) and central California.

2013 Cowcod STAR Panel Report; Jagielo et al. 2013

1) Investigate the stock structure of cowcod in adjacent areas, especially the population in waters off Mexico.
2) Re-investigate the CPFV data to attempt to produce a CPUE time series to be used as an index of relative abundance. The CPFV data have a historical basis for inclusion and produce a time-series that has a smaller interannual variability than other indices.
3) Age-at-maturity and other life history parameters are inherently uncertain for cowcod and require further investigation. Future assessments should consider incorporating the uncertainty associated with age at 50% maturity.
4) Investigate methods to include uncertainty in historical catches in the modeling.
5) Evaluate the methods used to reconstruct historical catches of cowcod and other rockfish.
6) The STAT team expressed the most confidence in the NWFSC Hook-and-Line and visual surveys. The STAT team and STAR Panel recommend continuing these indices into the future and extending the NWFSC Hook-and-Line survey into the CCAs.
7) Priors for model parameters, based on rockfish, should be developed.

2013 Data-Moderate Assessments: Cope et al. 2015

The following list contains research recommendations to further improve the application of catch and index only stock assessments:

1) Continued research on the uncertainty in the catch histories of all groundfishes. Catch is a critical component of these and all stock assessments, especially when attempting to define population scale. Reconstructions of historical catches are still needed for certain areas, time periods, and fisheries. Currently, reconstructed catches are available for California's commercial and recreational fisheries extending back to 1916 and 1928, respectively (Ralston et al. 2010). Oregon has completed a reconstruction for its commercial catch since 1876 (V. Gertseva, NMFS; pers. comm.), but recreational catch prior to 1980 is assumed to be zero in this analysis. Recreational catch in Washington was reconstructed to 1975 for these assessments, and interpolated back to 1960. A thorough reconstruction of historical commercial catches (prior to 1981) is urgently needed for Washington. Estimates of uncertainty in historical catch reconstructions are needed for all states. Reconstructed

catches tend to be most precise for common species, and progressively less precise as species become uncommon. Because data-poor and data-moderate assessments focus on the less common species, quantification of the precision of catch reconstructions is especially important to these assessments.

2) Model selection criteria for the GLMM model, including insight when to consider the ECE models. The lognormal model frequently showed different time series behavior than the gamma and ECE models, the latter of which usually gave consistent results. The ability to determine whether lognormal or gamma is most appropriate, as well as understanding when the ECE approach should be considered will help formulate the best index treatment.
3) Further consideration as to when it is appropriate to split or maintain the full time series for the Triennial survey. While this proved of little sensitivity in these examples, it could be important in some instances.
4) The NWFSC survey showed poor behavior or limited information for all stocks. Understanding why this may be (including the residual patterns) will help diagnose its use as a data input for catch and index only models.
5) Further understanding of reasonable or probable catchability (q) values will enhance the interpretation of scale, a generally weakly informed output of these catch and index-only models that are dependent on trawl surveys. We already have an extensive collection of estimated q values from data-rich assessments, assuring feasibility. Priors on q would be useful in several respects:
6) Priors could be used to link the time series of triennial and NWFSC survey abundance estimates, greatly enhancing their information content.
7) For lightly-fished species such as stripetail rockfish, a prior distribution of q would allow quantitative estimation of ABC and OFL so that management can make informed decisions regarding fishery development and conservation. Values of ABC and OFL should not require experience from an intense historical fishery to be quantitatively acceptable.
8) Improved understanding of multispecies patterns in survey q could be useful for evaluating survey performance and diagnosis (see recommendation #4).
9) More direct attempts to compare XDB-SRA and exSSS models to understand why they may give different results. Reconciling the use of different productivity assumptions (i.e., priors) in XDB-SRA and exSSS is a major part of this work. Progress was made during the STAR panel, but much more work is needed.
10) Given the success of the efforts reported herein, more attempts at data-moderate assessment are anticipated. Further development of exSSS and XDB-SRA capabilities and speed of execution would be beneficial. One useful area of development is quantitative treatment of historical catch imprecision (see recommendation #1). Further technical details are not described here.
11) Single-species stock assessment models are still unable to address systematic changes in productivity due to external factors such as inter-species relationships and low-frequency aspects of climate change. Relatively simple data-moderate models may provide tractable linkages to ecosystem models, and are relatively easy to modify to reflect ecosystem forces.
12) Exploration of trans-boundary assessments with Canada should be initiated, and would benefit all parties. This also requires development of data inputs including historical catch reconstructions. Due to their transparency, data-moderate assessments may play an especially useful role in promoting trans-boundary fishery science.

2013 Data-Moderate STAR Panel Report; Dorn et al. 2013

Data input recommendations

1) The Panel strongly emphasizes the value of conducting a data workshop during which catches, indices, biology, and other data inputs are reviewed.

2) Consider developing GLMM models in which latitude and depth are treated as continuous covariates rather than as factors.
3) The historical CPFV drift-specific data should be keypunched, which should allow the algorithm for developing CPFV-based data indices to be improved.
4) Habitat maps should be developed so that structural rather than true zeros are designated using data which are independent from the data used to determine the indices.
5) Revisit the approach used to select among error models and whether to include ECE components when conducting the GLMM analyses.
6) Consider including a vessel factor (as a random effect) when developing indices for the Triennial survey.
7) Splitting the triennial survey into early and last periods became established practice without looking at the issue comprehensively or considering the loss of information from breaking a time series. A comprehensive evaluation of the issues and trade-offs is still needed.
8) Consistent residual patterns in NWFSC surveys for a number of assessments suggests there may be some unknown factor affecting survey catchability, or that some factor is affecting the productivity of multiple stocks in the same way.

Future reviews of data-moderate assessments

1) Nine stocks proved to be too many assessments to review at this STAR Panel. Reviewing a smaller number of assessments (4-8) may be more feasible goal for STAR Panel review, depending on the level of pre-STAR panel review of data inputs. If area-specific models are considered in addition to coast-wide models, additional time or fewer stocks should be scheduled. However, the first time that any assessment method or stock assessment is reviewed is always the most challenging, and future STAR Panels may find that the review goes much smoother.
2) The Panel recommends that data-moderate assessments continue to be reviewed at full STAR panels for at least for the next assessment cycle. As methods become standardized and the review process becomes more routine, it should be anticipated that review process can be streamlined somewhat.
3) Objective criteria should be developed to specify minimum standards for model outputs to be considered "acceptable" and "preferred" and included in the Terms of Reference for stock assessments. Such criteria might include minimum goodness-of-fit criteria and acceptable limits on posterior distributions.
4) While the Panel made some progress in comparing XDB-SRA and exSSS, our strategy of attempting to isolate the sources of difference between the two models ultimately proved unsuccessful, and resulted in complex requests to the STAT that were difficult to accomplish in the available time. The Panel suggests that some of the model comparison work is more appropriate outside the STAR panel review process, particularly as it involves fundamental differences in how stock productivity is modeled.
5) A standardized set of sensitivity runs, diagnostic plots, and performance statistics, such as runs tests on the residuals, should be developed to rapidly evaluate the performance of data-moderate assessments. Some pre-STAR panel planning involving the STAT and SSC to develop an analysis "package" could be helpful.
6) As with any assessment and review process, there is a trade-off between the number of data-moderate assessments and quality of the assessment and review. This trade-off should be taken into account when planning for future STAR panel reviews of data-moderate assessments.

Other Prioritized recommendations for future research and data collection

1) The MSE should be further explored to evaluate to performance of exSSS and XDB-SRA. Other potential topics include error in the catch time series, uninformative indices of

abundance, and time-varying productivity. The MSE could also be used to test whether more constrained models, such as fixing steepness or B_{MSY}/B_0, results in improved model performance.

2013 Longspine Thornyhead Assessment; Stephens and Taylor 2014

Research and data needs for future assessments include the following:

1) Age and growth information are needed for future stock assessments. Otoliths have been collected in good quantities from the NWFSC survey, but at this time the ageing methods are not believed to be reliable. Additional research on ageing methods for thornyheads would be valuable.

   This could involve investigation of biochemical aging methods, for example an analysis of telomere length in relation to body length.

2) A survey using a towed camera to assess the abundance in deeper water. The proportion of the stock and its size range in deeper water is unknown. Further exploration of perceived differences in catchability (q) between towed cameras and trawl nets should also be explored.
3) More tows or visual surveys south of 34.5 deg. N. latitude. Because the southern Conception Area is a large potential habitat for thornyheads, more effort should be directed to describing their distribution in this area, for inclusion in future assessments.
4) An investigation of the possible discontinuity in the reconstructed thornyhead historical catches would be useful for future assessments.

2013 Longspine Thornyhead STAR Panel Report; Key et al. 2013

1) Investigate historical catch reconstruction for thornyheads. Potentially have a workshop to sort out the catch histories for longspine and shortspine thornyheads. Washington also needs to complete their historical catch reconstruction so there is a move in a forward direction for formally reviewing all of the west coast estimates.
2) Evaluate the influence of the fixed parameters by providing likelihood profiles for these parameters for different values, or release some of the fixed parameters step by step to investigate the influence of each.
3) Ageing method validation and further otolith reading.
4) Use simpler methods of providing management advice based on the estimated biomass from the NWFSC combo survey.

2013 Pacific Sanddab Assessment; He et al. 2013

1) The proportion of the total catch of Pacific sanddab were discarded is uncertain. Discard rates varied among fisheries and states. The WCGOP has provided important information on discard rates, as well as length composition of discards in recent years. It will be important to continue to collect these data in future years. In addition, it will be helpful to record the catch of Pacific sanddab separately from other sanddab species. This is particularly informative when length composition data for both retained and discarded catches are available for the species.
2) Continue estimating catch and collecting length compositions of Pacific sanddabs in the recreational fishery. An increased sample size of length data from both retained and discarded catches from the fishery will provide more accurate information on estimates of fishery selectivity.
3) A coastwide juvenile groundfish survey data is available for most years since 2001, and has been used in assessments of other groundfish. However, sanddabs were not identified

to the species level in the northern survey areas, and thus truly coast-wide data is not available for this species. Data from a more limited geographic range does not indicate a strong correlation between juvenile abundance and subsequent recruitment to the adult population, however species level data in recent years may provide useful information on the annual recruit strength and may help in estimating the stock recruitment relationship.

4) Continuations of collecting data on reproductive biology of Pacific sanddabs will provide more comprehensive data for future assessments. This is particularly important that data are to be collected from the northern area (i.e. Oregon and Washington) and from the southern California. More data from other seasons (i.e. winter months) will also provide more complete information on spawning frequencies and spawning seasons. Consideration of the potential causes, and consequent influence on model results and dynamics, of the apparent shift in the maturity curve from maturity estimates in the 1950s would also be beneficial.
5) Stock and catch data from both Mexico and Canada have not been used in this assessment. Although there are some data and samples from the Canadian catches on Pacific sanddab, there is no information from Mexican fisheries on the species. Data gathering on the Pacific sanddab catches from Mexican waters will be useful to estimate potential impacts on the U.S. stock.
6) Pacific sanddab along the U.S. coast have been treated as a single stock in this assessment, as there is no genetic study on the stock structure of this species. Although this assumption is likely reasonable given the extended larval duration (200 to 250 days) of pelagic young-of-the-year sanddabs, genetic studies on the stock structure of Pacific sanddab could help to determine potential stock structure in future assessments.
7) The discrepancy between the survey biomass estimates and the model estimates of total biomass suggest either that the survey is dramatically overestimating total biomass for some unknown reason, or that the model us unreasonably constrained to estimating a lower biomass. Alternative sources of information, or alternative types of analyses, may shed light on both the factors that appear to drive variability in catchability for small flatfish in bottom trawl surveys would be beneficial. Alternative means of analyzing trawl survey data, or of conducting more focused surveys that could shed light on catchability issues and relative abundance and density of this species in the ecosystem, may also be beneficial.
8) Pacific sanddabs play an important role in the ecosystem, and likely experience high natural mortality rates, rates which are likely to vary both with size and age, and over space and time. A greater understanding of the appropriate mortality functions and the extent to which ecosystem changes may have altered natural mortality rates in either space or time would benefit future assessments.

2013 Pacific Sanddab STAR Panel Report; Jagielo et al. 2013

1) Exploration of the biomass estimates derived from trawl surveys, especially the NWFSC shelf/slope survey to address the discrepancy between survey- and model-based estimates of biomass.
2) Evaluate historical reconstructions of landings and discards.
3) Explore the possibility of time-varying life history parameters (e.g., regime shifts that potentially affect maturity, M, and growth).
4) Further explore the influence of the individual data sources on model results.
5) Explore ways to index the abundance of sanddabs in nearshore areas (i.e., waters shallower than 55 m) where the trawl surveys were not conducted.
6) Explore potential stock structure of this population, including the population in waters off Mexico and Canada.

2013 Rougheye and Blackspotted Rockfishes Assessment; Hicks et al. 2014

There are many areas of research that could be improved to benefit the understanding and assessment of rougheye and blackspotted rockfishes. Below, we specifically identify five topics that we believe are most important.

- **Historical landings and discards:** The historical landings and discards are uncertain for rougheye rockfish and improvements would increase the certainty that fishing removals are applied appropriately. Because landings are assumed to be known exactly in the assessment model, uncertainty in the predictions does not include uncertainty in the landings. A thorough look at historical landings, species compositions, and discarding practices would reduce the potential uncertainty that is not entirely accounted for.

- **Natural mortality:** Uncertainty in natural mortality translates into uncertain estimates of status and sustainable fishing levels for rougheye rockfish. The collection of additional age data and improved understanding of the life-history of rougheye rockfish may reduce that uncertainty.

- **Maturity and fecundity:** There are few studies on the maturity of rougheye rockfish and only one has reported the results of a histological analysis. Further research on the maturity and fecundity of rougheye rockfish, the potential differences between areas, the possibility of changes over time, and differences between rougheye rockfish and blackspotted rockfish would greatly improve the assessment of these species.

- **Age data and error:** There is a considerable amount of error in the age data and the ageing of rougheye rockfish has not been validated. Investigating the ageing error and bias would help to understand the influences that the age data have on this assessment.

- **Understanding the stock structure and biology of rougheye and blackspotted rockfishes:** This assessment reports the status of rougheye and blackspotted rockfish as a pooled complex because it is extremely difficult to separate the catches of each species even in recent data, and attempting to do so would greatly increase the uncertainty in the predictions. Because little is known about the respective biology and catch histories of the two species, it is unclear whether managing them as a complex may place one species at disproportionate risk of overfishing relative to the other. We recommend additional research that will provide insight into the distribution, life history, biological characteristics, and catch and discard profiles of the two species. Such an endeavor would like require the efforts of at sea observers in all fleets, biologists aboard fishery-independent surveys, and port samplers along the entire West Coast requiring broad, inter-agency collaboration.

- **Basin-wide understanding of stock structure, connectivity, and distribution:** This is a stock assessment for rougheye rockfish off of the west coast of the U.S. and does not consider data from British Columbia or Alaska. Further investigating and comparing the data and predictions from British Columbia and Alaska to determine if there are similarities with the U.S. West Coast observations would help to define the connectivity between rougheye rockfish north of the U.S.-Canada border.

2013 Rougheye and Blackspotted Rockfishes STAR Panel Report; Sampson et al. 2013

General (affecting more than one assessment)

1) A workshop should be held to evaluate (a) methods for the iterative reweighting of composition data (e.g., current approach based on SS3 calculation of effective N versus the Francis approach) and (b) methods for developing initial weightings (the initial input N values).
2) A workshop should be held to evaluate methods for constructing survey GLMM estimates. Topics that should be explored include: (a) the effect of treating vessels as random when in fact the vessels hardly vary from one year to the next; (b) possible aliasing of the index values with the *Vessel* x *Year* interactions; and (c) the using information from the GLMM for combining length composition data collected by different vessels. One goal for the workshop should be to provide adequate documentation of the GLMM methods that will be used to produce survey biomass indices for future assessments and guidelines on how the analyses, including diagnostics, should be presented in stock assessment reports.
3) Port sampling programs should continue their routine collection of otoliths of slope rockfish species. A catalog of historical collections that have not been aged should be developed.
4) The series of historical catches of individual rockfish species, which are important sources of uncertainty in stock assessments of rockfish, should be explored in more detail. The STAR Panel agrees with the statement in the draft assessment document that "*A thorough look at historical landings, species compositions, and discarding practices would reduce the potential uncertainty that is not entirely accounted for*".
5) Furthermore, catch reconstructions should not just develop best estimates of rockfish catch by species, but should also characterize the uncertainty of historical catch estimates by identifying periods of greater and lesser uncertainty. For example, rockfish species compositions taken during early years when there limited slope fisheries should be very different from species compositions taken during later years when fisheries on the slope were more prevalent.
6) The SSC should develop detailed technical guidance on how to construct decision tables, including a summary of lessons learned from a review of approaches applied in past stock assessments.
7) Investigate better fishery-independent data collection methods for slope rockfish and other species living in untrawlable habitats (e.g., surveys using submersibles or remotely operated vehicles).

Specific to rougheye rockfish

8) The STAR Panel agrees with the STAT regarding the importance of collecting additional age data and other information that will improve our understanding of the life-history characteristics of rougheye and blackspotted rockfish, with the aim of reducing the uncertainty regarding natural mortality.
9) The survey and port sampling efforts should collect genetic material in association with otolith sampling to provide a clear basis for distinguishing between rougheye and blackspotted rockfish. Also, researchers in the PFMC arena should collaborate with ongoing AFSC and Department of Fisheries and Oceans Canada genetic studies of rougheye and blackspotted rockfish.
10) Prior to the next assessment of either rougheye or blackspotted rockfish (or their complex), there should be targeted studies or analyses to investigate what caused the lack 30-44 cm fish caught in the 250-300 m depth zone by the NWFSC shelf/slope survey.

11) The STAR Panel agrees with the STAT regarding the importance of additional studies of the maturity and fecundity of rougheye and blackspotted rockfish. Further, any fish used for maturity and fecundity studies should be subjected to genetic analysis to definitively identify what species it is.

12) The STAR Panel agrees with the STAT regarding the importance of validating the ageing method for rougheye and blackspotted rockfish. Further, any fish used for age-validation studies should be subjected to genetic analysis to definitively identify what species it is.

13) The STAR Panel agrees with the STAT regarding the importance of "*understanding the stock structure and biology of rougheye and blackspotted rockfishes*" and their recommendation for "*… additional research that will provide insight into the distribution, life history, biological characteristics, and catch and discard profiles of the two species*".

14) The STAR Panel agrees with the STAT regarding the importance of "*basin-wide understanding of stock structure, connectivity, and distribution*" for rougheye and blackspotted rockfish, with the aim of defining "*the connectivity between rougheye* [and blackspotted] *rockfish north of the U.S.-Canada border*".

2013 Shortspine Thornyhead Assessment; Taylor and Stephens 2014

Research and data needs for future assessments include the following:

1) More investigation into maturity of shortspine is necessary to understand the patterns in maturity observed in the samples collected in 2011 and 2012.
2) Information on possible migration of shortspine thornyheads would be valuable for understanding stock dynamics. Analysis of trace elements and stable isotopes in shortspine otoliths may provide valuable information on the extent of potential migrations. Possible connections between migration and maturity could likewise be explored.
3) A greater understanding of catchability of thornyheads would help define the scale of the populations. This could include a survey using a towed camera to assess the abundance in water beyond the 1280 m range of the trawl surveys. Further exploration of perceived differences in catchability between towed cameras and trawl nets could also be explored. Understanding the relative catchability of shortspine and longspine thornyhead, which are difficult to distinguish in camera observations, would have to be a component of such investigations. Differences in selectivity between the AFSC Slope survey and the NWFSC surveys may be the result of behavioral interactions with different footropes. Understanding these interactions would also improve understanding of catchability.
4) Age data would be valuable for future stock assessments. Otoliths have been collected in good quantities from the NWFSC survey, but at this time the ageing methods are not believed to be reliable. Additional research on ageing methods for thornyheads would be valuable.
5) A greater understanding of the connection between thornyheads and bottom type could be used to refine the indices of abundance. Thornyheads are very well sampled in trawlable habitat, but the extrapolation of density to a survey stratum could be improved by accounting for the proportion of different bottom types within a stratum and the relative density of thornyheads within each bottom type.
6) A comprehensive catch reconstruction for shortspine and longspine thornyheads should be completed to estimate landings for each species prior to 1981 in each of the three states.
7) Exploration of simpler assessment methods for thornyheads and evaluation of whether such methods would provide a more robust management strategy than the current approach. It is likely that any significant reduction in the size of the shortspine thornyhead population would be apparent in the NWFSC Combo Survey index. A method for setting and/or adjusting catch limits based on either absolute values or trends in the survey has the potential to be much less labor intensive than the current assessment approach.
8) More tows or visual surveys south of 34.5 deg. N. lat. including the large Cowcod Conservation Area. Because the southern Conception Area is a large potential habitat for

thornyheads, more sampling effort would help refine the estimations of their abundance in this area.

2013 Shortspine Thornyhead STAR Panel Report; Key et al. 2013

1) Ageing to help estimate pertinent parameters in the model (e.g. M, growth), perhaps including new methods such as tagging. Tagging studies would also further investigate the assumption of an ontogenetic movement pattern seen for this species.
2) Maturity ogive to evaluate the pattern seen in the most recent data collected.
3) More efforts to reconstruct historical catches for thornyheads.
4) Investigate alternative, simpler methods that may be more robust.

Recommendations from the 2012 Assessment Cycle

2012 Data-Moderate Assessments Methodology Review Meeting Report; Dorn et al. 2012

Enhancements to catch-only methods

- Use binned PSA vulnerability scores for assessed stocks to obtain a prior for delta for use in data-poor and data-moderate assessments. Because this approach relies on a PSA analysis that was not developed for this purpose, scoring for the PSA analysis should be re-evaluated to ensure consistent time periods are used for all stocks. The year in which delta is assumed to apply should be consistent with the scoring period.
- Further develop meta-analysis methods for the ratios B_{MSY}/B_0 and F_{MSY}/M. While large-scale meta-analysis provides valuable information, synthesis of assessment results on a regional scale is likely to be more useful in determining priors. This is because the quality of the assessments going into the meta-analysis can be ascertained and consistent definitions for these quantities are used regionally. A comparison of regional results with global results would also be valuable.
- Compare the new 3-parameter stock-recruit relationship implemented in SS (Taylor et al. 2012) with the hybrid production function in DB-SRA and XDB-SRA.
- The prior for natural mortality developed by Dr. Owen Hamel, and used extensively in the previous assessment cycle, should be adequately documented and reviewed.

Extended DB-SRA and SSS

- XDB-SRA and exSSS are endorsed for use in data-moderate assessments in the next assessment cycle (see table 2 for distinguishing characteristics of the two approaches). The management strategy evaluation described in Section 2.2.3 may be informative about relative merits of the two approaches. A WebEx seminar for interested scientists should be conducted in Spring 2013 to present results from simulation testing comparing XDB-SRA and exSSS.
- The Sample Importance Resample (SIR) algorithm (perhaps implemented using Adaptive Importance Sampling) should be used to quantify uncertainty for exSSS-based assessments, should measures of uncertainty be required.
- The ability to incorporate a prior on depletion may be useful feature of data-moderate assessment that adds robustness to results. exSSS does not currently have this capability. A variant of exSSS should be developed that incorporates a prior for depletion (delta). This variant may be useful bridge between SSS and exSSS as they are currently implemented.
- The uncertainty associated with OFL estimates should be computed using the approach applied by Ralston *et al*. (2011) to evaluate uncertainty in biomass estimates. This will

provide guidance regarding the extent of error in OFL estimates which is already present even for Tier 1 assessments. Systematic comparison of OFL estimates from data-moderate and data-poor assessments with estimates from full assessments may allow estimation of the additional uncertainty due to the use of these methods.

Development of abundance indices for use in data moderate assessment

- Consider alternative ways of developing abundance indices for surveys, such as post-stratification to more closely match the species presence and distribution, or developing indices based on presence/absence or stock distribution.
- It is not necessary to omit all recreational fishery data after 2000 due to regulatory changes. Instead an attempt should be made to account for management changes such as changes to area and bag limits to the extent possible in index development. Conduct a literature review to determine best practices in developing indices from recreational fishery catch and effort data, with particular attention on methods for dealing with potential sources of bias due to regulatory changes, such as closed areas and bag limits. Focus on regions where this expertise is most advanced, such as the Southeast US.

Recommendations for the assessment and peer-review of data-moderate assessments

- The NMFS Science Centers should develop a list of stocks for which the indices of abundance can be justified as likely to be related to abundance.
- The Panel had extensive discussion regarding the number of stocks that should be reviewed during a STAR panel. Arguments for keeping the number low focused on the concern that these assessments are based on new approaches, and there will be some learning involved both in developing the assessment and reviewing it. Arguments for a higher number of assessments included that more assessments are likely to be rejected or not even carried forward for review due to insurmountable difficulties. In addition, there would be more opportunity in learning from more assessments with contrasting features. Perhaps the best way to deal with this issue is to identify 6-12 stocks from the list developed by the NMFS science centers, but plan to drop the most dubious assessments before the STAR panel review.
- The assessments to be presented to the 2013 data-moderate assessment STAR panel should include stocks whose assessments would be based on the NMFS bottom trawl survey, and those for which the primary index of abundance would be a CPUE index derived from recreational catch and effort data. Carrying forward two groups of stocks with similar habitat and fishery characteristics provides both contrast and potential efficiency, since similar analytical approaches are likely to be applicable within each group.
- A data workshop should be held to focus on development of suitable indices for data-moderate assessments. Alternatively (and perhaps preferably), a concerted effort should be made to establish good communication among the core group conducting the data-moderate assessments to share ways of filtering and analyzing data, and promote adoption of consistent modeling approaches.
- The assessments presented to the 2013 data-moderate assessment STAR panel should not use age- or length-data. Assessments which use such data are likely to require more extensive review that is possible during the data-moderate STAR panel.
- Data-moderate stock assessments should follow the template in Appendix 3.
- The first review of data-moderate assessments should be conducted during a STAR Panel, but future reviews could be conducted by the SSC or its groundfish sub-committee. For this cycle, modeling approaches other than XDB-SRA and exSSS should not be used due to lack of time to conduct an adequate review of the method during a STAR Panel (however refinements to XDB-SRA and exSSS are permissible). The independent panelists at the

data-moderate panel should be selected to provide expertise on survey design and analysis of recreational CPUE data.

- At present, both modeling approaches (XDB-SRA and exSSS) are considered appropriate for data-moderate assessments. Comparison of alternative models (both XDB-SRA and exSSS) is encouraged. It is acceptable to present an assessment using a single modeling approach, but the choice of modeling approach should be justified. The STAR Panel will make requests of the STATs, but will not impose an alternative method on the STAT if they believe this is not appropriate for the stock concerned. The STAT may change their best model, but the Panel's job is to review what is presented by the STAT. The Panel will recommend adoption / rejection of the "best model." The STAR Panel will be charged with identifying a preferred approach in the event that both models are presented.
- Data moderate assessments should be used for deriving OFLs, ABCs, and ACLs. In addition, data-moderate assessments should provide estimates of the probability the stock is in each of three categories: less than $B_{25\%}$, between $B_{25\%}$ and $B_{40\%}$, and greater than $B_{40\%}$. The Panel recommends that these results not be used for status determination, but rather to identify whether there is potential concern with stock status, and to prioritize stocks for a full assessment in which all available information is considered.
- The SSC will review the assessment and the STAR Panel report. The key output from this exercise is an OFL and ABC, which addresses possible overfishing. If there is a sizeable probability the stock is in an overfished state (higher than 40%, for example), the SSC will recommend that a full assessment be conducted at the earliest opportunity. The Council may wish to implement management changes in pro-actively.
- The Panel was informed that the NWFSC has a 'stock assessment handbook' which includes a summary of key common assumptions when making assessments and recommended that it be made available to all assessment authors.

Recommendations from the 2011 Assessment Cycle

2011 SSC Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental SSC Report, September 2011

The Scientific and Statistical Committee (SSC) reviewed possible topics for off-year workshops related to improving groundfish stock assessments for the 2015-16 management cycle based on recommendations from 2011 Stock Assessment Review (STAR) panels (Agenda Item G.10, Attachment 1), and suggestions to the SSC from Dr. Jim Hastie (Northwest Fisheries Science Center, NWFSC) and Dr. Russ Vetter (Southwest Fisheries Science Center, SWFSC). The SSC notes that many important recommendations for data collection and work to be conducted were made during the STAR panel meetings. However, most of these issues are best dealt with through individual research projects and not Council-sponsored workshops. They will be included in the next version of the Council's research and data needs document as appropriate.

Workshops related to stock assessments (in priority order):

1. **A 'post-mortem' workshop on the 2011 assessment process**. A post-mortem workshop was held following the 2007 assessment round to discuss how the process could be modified to overcome concerns identified by participants and the Committee of Independent Experts reviewer who attended all the panels. No such workshop took place following the 2009 assessment round. A number of general issues emerged during the STAR panels, such as the use of age data and priors, which should ideally be discussed during a workshop, with the aim of modifying the Terms of Reference for groundfish stock assessments to reflect best practices. Such a workshop should take place early in 2012.

2. **A workshop to continue development of data-poor assessment methods**. The panel which took place during April 2011 made considerable progress towards identifying assessment methods for data-poor species, and made a number of recommendations. A follow-up workshop would review progress implementing the recommendations of the April 2011 workshop, review trial applications of the methods, and further discuss how data-poor assessments should be reviewed. This workshop would also provide an opportunity to further evaluate methods for determining sigma for stocks in each of the three categories of stock assessment uncertainty.
3. **A workshop to review historical landings time series**. A major effort to reconstruct historical landings was initiated in 2008 in response to the Council's call to compile the best estimates of catch history early in the development of Pacific coast groundfish fisheries. Currently, this effort has produced published estimates for California fisheries, and more recently, estimates for Oregon fisheries, but landings are still being compiled for Washington. An off-year science workshop would review reconstructions of all landings comprehensively, ideally when the Washington information is available. This review would need to be structured differently than the other proposed workshops, since the most expertise is to be found among current and former employees of state agencies. Estimation of the extent of uncertainty of the historical catch estimates due, for example, to uncertainty in estimates of landings species compositions, would also be a focus of this workshop. A future research project, but not a focus of the proposed workshop, would be to determine how uncertainty in catches can be integrated into stock assessments.
4. **A workshop on B_0 and harvest control rules.** The Council's harvest control rules depend on estimates of stock size relative to B_0. Changes in stock assessment methods or

data inputs can lead to large changes in estimated B_0 (e.g. Pacific ocean perch and Dover sole this year) and in some cases to marked changes in depletion levels, overfishing limits, acceptable biological catches, or rebuilding times. This workshop would review alternative control rules (e.g., control rules based on "Dynamic B_0" or on direct estimates of B_{MSY}) and compare their performance with current approaches using management strategy evaluation (MSE). The workshop would build on the last B_0 workshop, but would be more focused on the performance of control rules. It would also include review of stock status for a range of stocks when stock status determinations are based on "Dynamic $B_{0.}$"

5. **A workshop to evaluate an acoustic-ROV (remotely operated vehicle) survey for rockfishes**. There is a need for estimates of abundance for areas which are currently unsurveyed (e.g. the Cowcod Conservation Area, CCA). This workshop would evaluate a proposal for a combined acoustic-ROV sampling technique whereby acoustic methods are used to determine biomass, and ROVs (or autonomous underwater vehicles, AUVs) are used to estimate species- and length-compositions. Although the workshop would focus on the work in the CCA for cowcod and boccacio, the terms of reference for the workshop would include evaluating the extent to which the recommendations and suggestions of the workshop panel could be applied generally along the west coast. The SWFSC will be sponsoring an independent review of this approach irrespective of Council involvement, but Council involvement will help to facilitate use of the results of this methodology in Council stock assessments.
6. **A workshop on transboundary stocks.** Several Council stocks are shared with Mexico and/or Canada. This workshop would consider the implications of assessing and managing only a component of a stock. Ideally, Canadian and Mexican scientists would be invited to participate in the workshop, with a view towards conducting assessments which cover the full range of Council-managed stocks.

Review activities that could take place outside of a workshop:

The SSC also discussed the value of a workshop on discard estimation and discard reconstruction. The SSC considers review of West Coast Groundfish Observer Program (WCGOP) methods for estimating discard rates as a high priority issue. Such a review could be accomplished during an SSC meeting rather than as part of a workshop. Review of discard reconstructions could only occur once sufficient preparatory work has been undertaken.

The SSC will conduct a review of information on productivity for teleosts and elasmobranches with a view to making recommendations regarding an F_{MSY} proxy for elasmobranches once appropriate information becomes available.

Workshops related to socio-economics:

In relation to socio-economics, the top priority is a workshop to further review the models that contribute to the socio-economic analysis of groundfish harvest specifications. It is not feasible to review all of the models used in socio-economic analyses, so it is necessary prioritize the review process. Based on discussions with some Groundfish Management Team (GMT) members, four models with the highest priority for review over the next two years have been identified: the California recreational model, the nearshore fixed gear model, the non-nearshore fixed gear model, and revisions to the IO-PAC model. Future model reviews would cover other models: (a) the Oregon recreational model; (b) the Washington recreational model; (c) the limited entry fixed gear sablefish daily trip limit model north of 36^0 N. latitude (d) the open access daily trip limit (DTL)

sablefish north and south of 36^0 N. latitude; (e) the commercial harvest projections to port regions; (f) the trawl rationalization model (which will be developed this year by the GMT); (g) the community vulnerability analysis; (h) the NWFSC's new vessel financial profile model; and (i) the economic data collection program for catch shares.

The SSC was advised of a motion during the June 2011 Council meeting that the GMT was requested to prepare a list of questions related to clarification on the conservation performance of the Council's rebuilding plans. The SSC, through its Groundfish and Economics subcommittees, is willing to work with the GMT on identifying these questions. Should a list be developed, a workshop or a joint meeting of the SSC Groundfish and Economics subcommittees may be an ideal way to assemble the responses to the questions.

Logistics
The SSC is willing to help organize the workshops by developing terms of reference and objectives, and nominating members of its Groundfish and Economics subcommittees to participate as reviewers and chairs of the meetings. The SSC notes that the success of any workshop depends on appropriate background work being conducted. The SSC is willing to work with the science centers regarding work plans, but recognizes that the ability of the science centers to conduct all of the desired work will be limited by available resources and conflicting commitments.

2011 GMT Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental GMT Report, September 2011

The Groundfish Management Team (GMT) discussed science activities related to preparation for the 2013 stock assessment cycle as well as possible projects to resolve scientific issues that play a significant role in groundfish decision-making. The GMT identified several key issues for off-year science improvement that will help management application, yet limited resources obviously make accomplishing all of them over this next year unrealistic. The team offers the following comments, organizing them into activities that we saw as involving either major and minor logistical needs. Major activities are those that we saw as requiring relatively more time and resource commitments and more coordination among agencies. Whether major or minor, the team agrees that all are legitimate and important needs. We did not have time to arrive at a list of GMT priorities, unlike the GAP and SSC.

1. RECOMMENDATIONS WITH MAJOR LOGISTICAL NEEDS (not in order of priority)

The GMT supports the Scientific and Statistical Committee (SSC) recommendation (#2) for on-going development of data-limited assessment techniques. Specific to the catch only methods reviewed in the data-limited stock assessment review (STAR) panel, several needed improvements to the approaches were noted. The current catch only methods show promise to be extended by adding indices of abundance to qualify stocks as Category 2. **The GMT recommends priority should be placed on development of methods for integrating indices of abundance into catch only methods to bring as many Category 3 assessments to Category 2 status as possible. The GMT also recommends data review workshops be held before or immediately after Council meetings in the off year, prior to use of these data-limited methods, to include input from fishermen regarding refinements to historical catch data used in data poor assessments. In addition, the priors used in the assessments could also be the subject of review by the SSC or these review panels.** In particular, improving the assumption of the current

change in biomass (Δ=1-depletion) input was desirable. The predictive relationship between vulnerability from the Productivity and Susceptibility Analysis (PSA) and depletion (*D)* for Category 1 assessed stocks was presented at the data-limited STAR Panel and shown to be worth pursuing to decrease the bias of estimates of OFLs from catch only methods. **The GMT recommends that the Council request further development of the correlation between PSA vulnerability or susceptibility and *D* for assessed stocks for application to non-assessed stocks.**

The GMT follows the SSC recommendation (#4) of recommending a harvest policy workshop to evaluate a range of harvest control rules and to develop a management strategy evaluation (MSE). One area of interest is establishment of a tiered system of control rules based on data quantity and quality. A suite of MSEs prepared for the recommended workshop should also help to critically evaluate current harvest policies and decide refinements tailored to the diverse stocks managed under the groundfish FMP.

The GMT supports the SSC recommendation (#6) of a workshop on dealing with the treatment of transboundary stocks. Several stocks assessed in this and in previous cycles would benefit from attention to this subject.

The GMT supports the general recommendation for a workshop on non-extractive survey methods SSC (recommendation #5). A number of stocks, several of which are designated as overfished, are poorly sampled with trawl survey gear. Non-extractive surveys are needed to provide fisheries-independent indices for their assessment.

The GMT encourages the Council adopt SSC recommendation (#1) for a 2011 assessment post-mortem workshop. Additional off-year science improvements may arise from such a meeting. This meeting will also allow for improvement to the current stock assessments Terms of Reference. Members of this workshop would include all participants from this years

The GMT recommends review and completion of catch reconstruction efforts (SSC recommendation #3). Oregon and California have completed in catch reconstruction efforts in recent years, and Washington has been preparing for a similar effort. Many assessments would benefit from this information. In addition to historical catch reconstruction efforts, the GMT also supports organization of a workshop focusing on the identification and utilization of historical databases (e.g. discard studies) not already commonly provided for use in stock assessments. We understand that the Technical Subcommittee (TSC) of the Canada/U.S. Groundfish Committee has proposed a similar interest in reviewing catch reconstruction that would also involve the Canada Department of Fisheries and Oceans.

SSC Economics Subcommittee Review and prioritization of GMT models and projections for future review

The SSC Economics Subcommittee conducted a review of the Commercial Fishery Landings Distribution Model (LDM) in conjunction with this meeting (Agenda Item G.5.b, Supplemental SSC Report, September 2011). The LDM incorporates landings estimates from five, routinely used GMT models and projections (listed within the "Commercial Module" in Figure 1 of the Supplemental SSC Report). The GMT supports the efforts of the Economics Subcommittee in reviewing this model, providing guidance on evaluating its performance, and clarifying what level of documentation is expected prior to conducting future reviews of other GMT models and

projections. The team also recognizes that the review of the LDM was an important initial step towards establishing a more formal, regular review of GMT models and projections that contribute to the regular evaluation of social and economic impacts.

Also, the GMT would like to clarify that the list of models in Figure 1 in the Supplemental SSC Report would more appropriately be characterized as "models and projections." For example, a "Tribal Fisheries Model" is listed as part of the "Commercial Module" that provides inputs for the LDM. However, there is no single "model" to estimate total catch in all tribal fisheries. It, like other fisheries or sector estimates, is therefore better characterized as a "projection," as also noted in discussion at the Economics Subcommittee and SSC meetings this week.

Regarding prioritization of GMT models and projections for future review, the team acknowledges that the majority of them are routinely used in the SPEX process but have not undergone a formal review by the SSC. **The GMT supports the SSC's prioritization of and plans to review the California recreational model, the nearshore fixed gear model, the non-nearshore fixed gear model, and revisions to the I-O PAC model.**

2. RECOMMENDATIONS WITH RELATIVELY MINOR LOGISTICAL NEEDS (not in order of priority)

The GMT supports the SSC recommendation for a West Coast Groundfish Observer Program (WCGOP) review of discard estimation. Such a review may also lead to discussion on how best to extrapolate and estimate historical discards for use in stock assessments, and connects to the SSC's suggested review of the non-nearshore and nearshore bycatch projection models.

Regarding the subsequent determination of ABCs from stock assessment derived OFLs, the GMT's stock assessment statement (Agenda Item G.4.b) explicitly demonstrated why current overfishing proxy reference points should be revisited. **The GMT recommends revising F_{MSY} proxies, especially for elasmobranch species.**

The GMT recommends the following issues to improve catch tracking and projection:

- **Update of depth dependent mortality rates.** The current matrix uses data from 2003-2007, thus several years could be added to the update. This new matrix would also include the addition of cowcod.

- **Review of the use of descending devices in reduction accounting of discard mortality. This would apply to recreationally-caught and rod and reel commercially-caught rockfishes.** Some studies suggest that a substantial number of rockfish will survive if released using descending devices. Successful implementation and enforcement of such recompression techniques could bring major changes to management of recreation fisheries.

- Methods to allocate the Rockfish Complex OFLs North and South of 40° 10' N. Lat.
  The current allocation of the OFL/annual catch limits (ACL) of complexes north and south of 40°10' N. latitude is based on historical catch. **We recommend that the Council prioritize development of alternative apportionment methods by the GMT as part of the off year science research in preparation for the 2015-16 management cycle.** This was part of the original impetus for the STAR Panel meeting. Habitat area multiplied by catch per unit of effort (CPUE) indices from the trawl survey could alternatively be used to allocate slope and

shelf complexes, while habitat area multiplied by appropriately stratified recreational CPUE indices could be used to allocate nearshore complexes. **In the interim, the GMT recommends that historical catch continue to be used to apportion the OFL/ACL of rockfish complexes until other methods can be developed.**

This round of stock assessments highlighted the further need to understand how scientific uncertainty is applied to derive OFLs and calculate ABCs. The determination of a risk neutral base case is often defined by the construction of a decision table, with the high and low states of nature specifically derived so the base case is by definition risk neutral. This is especially important when unknown removal histories or retrospective patterns are significant. The current management framework of defining scientific uncertainty does not typically use the uncertainty captured in the decision table. **The GMT recommends further efforts to revisit and define scientific uncertainty and now it relates to the decision tables in order to maintain the definition of a risk-neutral base case from which the OFL is derived.**

The work of the GMT subgroup offers a method to formulate stock complexes based on ecology and vulnerability, as prescribed by the National Standard 1 (NS1) guideline, as well as evaluating potential inclusion and exclusion of species in the FMP. The resultant stock complexes are meant to offer managers flexibility into how much resolution in ecology and vulnerability most appropriate for management needs. **The GMT recommends further support of this work to continue to support the Council in its desire to use stock complexes while complying with NS1.** The Council's direction to continue progress on this issue will require time and attention from staff during this "off year."

The GMT continues to support development of spatially explicit assessment models to support more refined spatial management.

Regarding the GMT's Clarification on a Suggested Review of the Conservation Performance of the Council's Rebuilding Plans (Agenda Item E.4.b, GMT Report, June 2011), the GMT also requests that the SSC continue to engage the team on this longer term discussion. In June, the Council directed the GMT to present a list of questions and issues for discussion on this topic either at the September or November meetings. We did not do so for this meeting but hope to have time at our October meeting to discuss and produce such a list. The SSC is recommending a workshop as the best forum for this discussion. **The GMT supports the SSC's proposed plans to conduct a workshop to address conservation performance of the Council's rebuilding plans.** As for the timing, we would request that it be scheduled sometime after our analyses to the draft Environmental Impact Statement are submitted this winter.

2011 GAP Report on Off Year Science Improvements; Agenda Item G.10.c, Supplemental GAP Report, September 2011

The Groundfish Advisory Subpanel (GAP) received a presentation from Mr. John DeVore on science improvements for the next groundfish management cycle. The GAP also reviewed the Scientific and Statistical Committee's statement under this agenda item. The GAP recommends the following activities in priority order to improve the science informing groundfish management.

1. Workshop on Transboundary Stocks

The distribution of many west coast groundfish stocks extends beyond the borders of the west coast exclusive economic zone (EEZ), yet assessments for these stocks are limited geographically

to the EEZ. Results of west coast assessments of transboundary stocks are likely compromised by not incorporating data collected comprehensively from surveys and fisheries throughout the range of these stocks. Important stocks such as sablefish, Pacific ocean perch, spiny dogfish, canary rockfish, and yelloweye rockfish are transboundary stocks and their dynamics are likely not as well understood as they could be if assessments were more geographically comprehensive. A workshop to evaluate these effects and consider new assessment protocols to address these limitations may improve assessments of transboundary stocks. The GAP notes this issue is perennially raised by the stock assessment review (STAR) panels that evaluate assessments of transboundary stocks.

2. Workshop on the B_0 Harvest Management Framework

The current biomass-based harvest management framework relies on estimates of initial, unexploited spawning stock biomass (B_0) to determine the status of stocks. Stock status, or relative depletion, is defined as the ratio of estimated current spawning stock biomass to estimated B_0. However, estimation of B_0 is extremely uncertain and such estimates tend to change dramatically from assessment to assessment as assumptions regarding historical catch and stock productivity change. This leads to fishery instability and lack of confidence in assessment results. The GAP notes that other regions do not use such a harvest management framework and assessments and management actions tend to be much more stable and much less contentious. For instance, assessments of North Pacific groundfish do not include poorly estimated historical catches prior to the mid-1970s because there is no need to estimate B_0. These assessments tend to produce more consistent and plausible results, largely because they are based less on assumptions and more on empirical data. The Council sponsored a groundfish harvest policy evaluation workshop in December 2006, which began to explore the limitations of our current framework. Many of the shortcomings of our B_0 framework were evaluated and it was concluded there may be better ways to manage many of our stocks. Workshop participants also supported another workshop to continue this evaluation. The GAP strongly recommends this second workshop be scheduled next year to evaluate an alternative framework for assessing groundfish stocks and managing west coast groundfish fisheries.

3. Workshop to Review Historical Catch Reconstructions

One of the consistent recommendations from the 2011 STAR panels was to convene a workshop to review historical catch reconstructions of west coast groundfish. To date, historical catch reconstructions have been done for California and Oregon fisheries. While there was a peer review of the California catch reconstruction effort, further refinements of methods to reconstruct historical California catches have been subsequently identified in STAR panels and no such peer review of the Oregon catch reconstruction effort has been done. The GAP understands that there are plans to reconstruct historical Washington catch reconstructions as well. Given the sensitivity of assessment results (especially estimates of B_0) to assumptions regarding historical catches, a formal workshop to review methods to reconstruct historical catches should be done. The GAP strongly recommends the participation of fishermen in any workshop designed to review catch reconstructions since their knowledge will certainly be helpful in interpreting historical catch data.

4. Workshop to Develop Techniques to Survey the Cowcod Conservation Areas

One notable limitation in stock assessments of many groundfish species that occur in the Southern California Bight is the lack of fishery-independent survey data from the Cowcod Conservation Areas (CCAs). This is a critical uncertainty in recent assessments of bocaccio, blackgill rockfish, greenspotted rockfish, and, of course, cowcod. No surveys, including the Northwest Fisheries Science Center shelf/slope trawl survey are allowed to survey the CCAs. However, development of an effective non-extractive survey technique is critically needed to better understand the distribution and relative abundance of species that reside in the CCAs. The GAP therefore recommends development of techniques to survey the CCAs and other areas that cannot be effectively accessed by our current groundfish surveys.

The GAP would also like to participate in the other workshops recommended for next year since these activities will likely affect future assessments and management actions. The collective knowledge of fishermen will certainly aid participants in each of these workshops.

2011 Data-Poor Assessments (excerpt of long term research recommendations); Dorn et al. 2011

The PFMC has been a leader in implementing methods for assessing data-poor stocks in the US. Methods first developed and applied by PFMC are being considered by other Regional Councils. To continue the progress that has been made, the Panel recommends that a similar off-year STAR Panel review be scheduled to further develop and finalize methods and to review example applications. The Panel suggests a few common data sets be used across all candidate methods. The meeting would involve participants from at least the NWFSC, the SWFSC, and various academic institutions. Methods should be sufficiently developed by the 2015-16 groundfish management cycle that it would be reasonable to bring forward a number of candidate category 2 stock assessments using simple assessment models for review at a STAR Panel in 2013. The number of assessments considered during such a review would depend on whether removal and survey data only were used or if CPUE and compositional data were incorporated.

Long term research recommendations

More comprehensive evaluation of uncertainty is needed for assessments of data-poor stocks. Conceptually, it seems preferable to obtain uncertainty estimates (σ) based on analysis of

assessment approaches used for category 1 and 2 stocks, rather than scaling up the uncertainty for data-rich stocks.

Evaluate alternative approaches to assessing and managing data-poor stocks that have been applied elsewhere such as:

- Management procedures which set catch limits based on trends in commercial CPUE or survey indices, or changes in catch at age or length compositions.

- Conducting joint assessments of a number of stocks simultaneously using the 'Robin Hood' approach (Punt et al., 2011).

2011 Blackgill Rockfish Assessment; Field and Pearson 2011

Age estimates are highly uncertain, and this species has proven very difficult to age. Conducting cross reads with other laboratories, as well as consideration of alternative age validation and bias evaluation methods, are important factors for future efforts.

Histology studies are ongoing and will help to refine both the maturity curve and the degree to which maturity may vary as a function of size, age and/or latitude.

Despite considerable investment in catch reconstruction efforts, historical catches remain uncertain for this stock due to the likely spatial patterns of fishery development for this species (a deeply distributed species generally encountered in offshore waters). Efforts to analyze spatially explicit historical catch data are ongoing.

A large fraction of blackgill habitat is currently closed to both fishing and survey effort in the Cowcod Conservation Areas (CCAs), complicating efforts to interpret both catch and survey data. Alternative means of exploring relative or absolute abundance in this region is a key research priority.

Greater investigation into the likely or plausible consequences of a shoaling of the oxygen minimum zone (OMZ) on blackgill habitat will aid in evaluating threats to this species that may be posed by global climate change. A greater appreciation for the impacts of changing abundance of predators (such as sablefish and shortspine thornyheads) will also help interpretation of long term trends for this species.

2011 Blackgill Rockfish STAR Panel Report; Gertseva et al. 2011

To address uncertainty regarding the portion of blackfish population residing in Mexico, the Panel follows the suggestions of the 2005 STAR Panel to attempt to document catches in Mexican waters by both U.S. and Mexican fishers and consider the implications of blackgill being a shared stock. The Panel also suggests exploring alternative sources of information (i.e., to investigate whether there are relevant studies conducted at Universities in Mexico), that could yield information on biology, life history and exploitation of the blackgill that could be used in the next assessment.

The Panel recommends devoting additional efforts to reconstructing historical landings. This recommendation applies to most groundfish species on the U.S. West Coast (and not only blackgill rockfish). In addition to providing the best reconstructed catch histories by species, this effort should develop alternative catch streams that would reflect differences in data quantity and quality available for different time periods. Such (more realistic) alternative catch streams would

be very useful while exploring model sensitivity to uncertainty in catch history (rather than applying a simple multiplier to entire catch time-series, which is currently the case for most groundfish assessments). Also, taking into account a spatial shift in fishing efforts to deeper waters would be a significant improvement to catch reconstruction of blackgill rockfish and other species landed in mixed-species categories.

Both the STAR Panel and the STAT agreed that alternative means of exploring relative or absolute abundance in the CCA is a key research priority. Submersible or other non-invasive survey methods could potentially provide additional information on habitat and abundance for this species. Also, it is important to develop alternative methods to monitor length and age compositions of fish inside CCA.

The STAT emphasized that blackgill rockfish has proven to be very difficult to age, and age estimates are highly uncertain. Improving age data quality (through validation studies, otolith exchange between labs) and greater exploration of possible differences in age and growth throughout the range of this stock using the data from otoliths that have not yet been processed is desirable. The STAR Panel agreed, but noted that careful consideration should be devoted to producing exactly the age data which would be of most direct benefit to the assessment, based on representative sampling, since expertise, time and funds are all limited.

Given that no changes in assessment model structure were suggested, the Panel recommends that the next blackgill rockfish assessment be an update assessment.

2011 Bocaccio Update Assessment; Field 2011

Since large scale area closures and other management actions were initiated in 2001, the spatial distribution of fishing mortality has changed over both large and small spatial scales. Not only has this effectively truncated several abundance indices (recreational CPUE), this confounds the interpretation of survey indices for surveys that do not sample in the Cowcod Conservation Areas (CCAs), as insights from larval surveys suggest that there has been a change in the distribution of bocaccio in recent years such that the greatest abundance of bocaccio is found in that area. This, in turn, infers that fishing mortality is greater on the fraction of the stock currently outside of the CCAs, which may be undergoing localized depletion at a greater rate than the coastwide total stock due to the fact that the greatest catches of bocaccio are derived from these areas.

Stock structure for bocaccio rockfish on the West Coast remains an important issue to explore and consider. Although a reanalysis of the genetic evidence done for this assessment suggests no significant differentiation among the major oceanographic provinces in the California Current, the apparent differences in growth, maturity, and longevity, are indicative of moderate demographic isolation.

The potential to develop defensible aging criteria for bocaccio in the southern area should be evaluated further, particularly if such criteria could be developed in a coordinated effort among workers along the west coast.

The application of juvenile indices to inform future recruitment remains an area in need of additional research and development, including more extensive evaluation of two indices not included in the 2009 assessment (power plant impingement data and submersible observation data). A greater appreciation of the strengths and weaknesses of these indices is an important research priority.

2011 Darkblotched Rockfish Update Assessment; Stephens et al. 2011

Future research needs include:

- Reconstruction of Washington historical catch.
- Investigation into the best available methods and data for constructing and using conditional age at length compositions from data taken across space and time within years.
- A thorough investigation of historical darkblotched rockfish mortality in the shrimp fishery.
- Mapping of "trawlable" and "untrawlable" habitat and construction of a prior on survey q.

2011 Dover Sole Assessment; Hicks and Wetzel 2011

There are 5 topics for which additional research would greatly improve the assessment of Dover sole.

1) **Age reading error:** Estimates of ageing error were simplified because minimal data and cross-validation were available. There are many within-lab rereads from the Cooperative Ageing Project laboratory in Newport, OR, and some from the California ageing lab, but there is little organized data on cross-lab reads. A workshop in 2004 resulted in some cross-lab reads, but there is little data that can be used to characterize the differences between labs. Furthermore, a bomb calibration study of Dover sole ototliths from Alaska was done by the AFSC, and they concluded that there was little bias in ageing for easy to read otoliths. However, they state that the majority of Dover sole otoliths are difficult to read and result in uncertain ages through double-reads. A ground-truthing study on the U.S. West Coast would be useful to characterize potential bias in ageing Dover sole ototliths. Further research into quantifying the uncertainty of Dover sole ageing may help clear up some of the conflicts between the age and length data and may even give insight into the estimates of natural mortality.
2) **Patterns with depth:** As discussed above, there are patterns of length and sex ratios with depth which may indicate that the stock is more complex than currently modeled. Further research into the causes of these patterns as well as differences between seasons would help with understanding the stock characteristics such that a more realistic model could be built. This may also provide further insight into migration and help determine if there are localized populations.
3) **Recruitment patterns:** Even though recruitment variability is low compared to other West Coast groundfish, this assessment model predicted periods of low and high recruitment that affect the trend in biomass. These periods may correlate with the environment and would help predict future biomass levels. It would be useful to investigate these patterns in recruitment but to also further investigate the life-history of Dover sole to determine if that can also explain the estimated patterns.
4) **Stock boundaries:** A common question in stock assessments is whether or not the entire stock is being accounted for. Dover sole live deeper than the range of the fisheries and surveys. The assessment model attempts to account for out of area biomass through catchability coefficients

and selectivity curves, but that portion of the stock is unknown and can only be guessed at. Research into abundance in deep areas would be useful to verify that the assessment adequately predicts the entire spawning stock of Dover sole.

5) **Variability of sex ratios in length and age data:** There were differences in predicted sex ratios from the length data and the age data which should be further explored. It is uncertain if this is simply an artifact of sampling or if there is a selection bias in age and/or length observations. This phenomenon may contribute to the conflict between age and length data.

2011 Dover Sole STAR Panel Report; Wespestad et al. 2011

General (affecting more than one assessment)

1) Complete and review the Washington catch reconstruction and review the California and Oregon catch reconstructions. The accuracy and wide availability of consistent basic information is essential to the development of Pacific coast assessments. In addition to the raw data, the reliability and availability of more spatially dis-aggregated forms of the data should be investigated to determine if they could be used to develop more spatially explicit models without causing sacrifices in accuracy.
2) The difficulties encountered in the Dover sole assessment and some other flatfish assessments with respect to the linkage between selectivities require addressing. Although in many instances sized based selectivity may be appropriate, when sexes separate spatially there is a requirement for models to at least be able to investigate complete independence between genders. It is important that this be implemented in an updated version of SS3.
3) The panel investigated the use of age-specific natural mortality in both assessments presented during STAR 4. In each case, one of the reasons for exploring different mortality schedules was the difficulty in fitting the imbalanced abundance at age information (as seen through residuals to fits), either in the sex ratio at older ages (Dover sole) or the ratio of young to old fish (Sablefish). The use of Lorenzen M based on a decline in natural mortality by the inverse of the growth rate implies a link with predation; however, wider use and development of some guidance on the appropriateness of the implementation in other stock assessments should be investigated.
4) Currently the only available error distribution for age information is the multinomial probability function. It appears that this may have some impact with respect to underestimating strong year-classes and it would be desirable to explore the use of alternative error assumptions in order to analyse survey information, in particular where variance estimates in catches-at-age may be less than independent on abundance.
5) There should be new studies of maturity by length and age based on more comprehensive coastwide and depth-based sampling and using histological techniques for determining maturity stage. Given that there is uncertainty regarding the temporal stability of maturity schedules, there should be periodic monitoring to explore for changes in maturity.
6) Update the STAR Terms of Reference to ensure that assessment documents include standard plots (or tables) of likelihood profiles that include likelihood components by data source and fleet. Such plots are an important diagnostic tool for displaying tensions among data sources.profiles.

Specific to Dover sole

1) Researching ageing error, particularly aging bias, is important for Dover sole given the current base models difficulty with reconciling some tensions between different data sources regarding the sex ratio at the oldest ages. In addition, the ability of the model to track cohorts accurately would be significantly disrupted if there were severe size-based bimodality in cohorts caused by vastly different times of settlement (Dover sole are thought to have a larval period of 6-18 months). Consequently, larval period should also be examined.
2) For the NWFSC combo survey, raw age and length information appeared to imply persistently different sex ratios when viewed in isolation. The concern is that there is some unrepresentative sampling occurring in the age distribution as ages are sub-sampled from length. The sampling procedure should be investigated more closely and potentially improved.
3) The conclusions of the NMFS workshop on developing priors on catchability were not available to the Panel. These should be made available and the information reconsidered specifically with respect to Dover sole, in an attempt to reconcile the relatively low catchability estimates for the surveys, particularly the NWFSC combo survey which is thought to cover the majority of the stock distribution.
4) Having simplified the model compared to previous assessments, especially with respect to uniform growth, it is important to continue investigating if this is likely to introduce undesirable levels of bias into the assessment process as more information becomes available. Spatial information on the distribution by age/size of females, particularly in the southern part of the range, particularly across the stratification boundaries of the survey as well as between stocks, should be the primary focus of this work.

2011 Greenspotted Rockfish Assessment; Dick et al. 2011

There is considerable uncertainty regarding the portion of greenspotted population residing in Mexico. It is possible that alternative sources of information (i.e. studies conducted at Universities in Mexico) could yield information on biology, life history and exploitation of greenspotted rockfish south of the U.S.-Mexico border.

Uncertainty in historical catch should be further evaluated through development of alternative historical catch streams reflecting differences in data quantity and quality available for different time periods. Existing reconstruction efforts focus entirely on historical landings, although discard has been a significant portion of removals for many species on the U.S. west coast. Coordinated reconstruction efforts for historical discard are also recommended.

Monitoring of relative or absolute abundance in the CCAs is a key research priority. Submersible or other non-invasive survey methods could potentially provide additional information on habitat and abundance for this species. Also, it is important to develop alternative methods to monitor length and age compositions of fish inside the CCAs.

The available data were limited (especially for the southern region) to reliably estimate growth, therefore, ageing the remaining available otoliths should be a priority. Careful consideration should be devoted to producing exactly the age data which would be of most direct benefit to the assessment,

since expertise, time and funds are all limited. Further development of ageing criteria for greenspotted rockfish is recommended, along with estimation of among-reader ageing error.

Further exploration of stock structure and spatial variability of life history parameters of greenspotted rockfish is recommended. Alternative assumptions about stock structure should be explored for the next assessment.

2011 Greenspotted Rockfish STAR Panel Report; Gertseva et al. 2011

To address uncertainty regarding the portion of the greenspotted rockfish population residing in Mexican waters, the Panel suggests an attempt should be made to document catches taken in Mexican waters by both U.S. and Mexican fishers, and to consider the implications of there being a single shared stock. The Panel also suggests exploring alternative sources of information (i.e. to investigate whether there are relevant studies conducted at Universities in Mexico), that could yield information on biology, life history and exploitation of greenspotted rockfish that could be used in the next assessment.

The Panel recommends devoting additional efforts to reconstructing historical landings. This recommendation applies to most groundfish species on the U.S. West Coast (and not only greenspotted rockfish). In addition to providing the best reconstructed catch histories by species, this effort should develop alternative catch streams that would reflect differences in data quantity and quality available for different time periods. Such (more realistic) alternative catch streams would be very useful while exploring model sensitivity to uncertainty in catch history (rather than applying a simple multiplier to entire catch time-series, which is currently the case for most groundfish assessments). Taking into account a spatial shift in fishing efforts to deeper waters would be a significant improvement to catch reconstruction of greenspotted rockfish and other species landed in mixed-species categories. Also, existing reconstruction efforts focus entirely on historical landings, although discard has been a significant portion of removals for many species on the U.S. west coast. The Panel recommends devoting efforts to reconstruct historical discard as well.

Both the STAR Panel and the STAT agreed that alternative means of exploring relative or absolute abundance in the CCA is a key research priority. Submersible or other non-invasive survey methods could potentially provide additional information on habitat and abundance for this species. Also, it is important to develop alternative methods to monitor length and age compositions of fish inside CCA.

The available data were limited (especially for the southern region) to reliably estimate growth, therefore, consideration of ageing available otoliths should be a priority. The Panel noted that ageing of historic samples (and future samples) would only be useful if samples were representative of the population. This needs to be examined before undertaking time-consuming and costly ageing work.

It is important to further explore stock structure and spatial variability of life history parameters of greenspotted rockfish, since currently only limited (or not species-specific) information is available. The Panel also recommends exploring alternative model structures to account for spatial pattern in

species biology, including the model with one stock assumption, model with two areas (with linkage between areas), several growth assumptions and others. Given this recommendation, the Panel suggests conducting a full assessment next time the species is assessed to allow exploration of model structure (which would be impossible in the case of an update assessment).

2011 Pacific Ocean Perch Assessment; Hamel and Ono 2011

There are a number of areas of future research, e.g.:

1) Research on the relative density of Pacific ocean perch in trawlable and untrawlable areas and difference in age and/or length compositions between those areas.
2) Estimation of climatic effects on recruitment, growth and survival.
3) Selection of an appropriate prior distribution for the survey catchability coefficients.
4) Further research on the relationship of individual female age and biomass to survival of offspring.
5) Research on the relative status of the British Columbia stock of Pacific ocean perch off of Vancouver Island and its relationship to that off of the U.S. West Coast.
6) Use of simulation models to evaluate how well one can estimate recruitment using size-composition data or biased or unbiased age-composition data, or a mix of the three.
7) Catch reconstruction for Washington State.

2011 Pacific Ocean Perch STAR Panel Report; Conser et al. 2011

- Considering transboundary stock effects should be pursued. In particular the consequences of having spawning contributions from external stock components should be evaluated relative to the steepness estimates obtained in the present assessment (see more complete discussion of this recommendation under the *Unresolved Problems and Major Uncertainties* section, above).
- The benefits of adopting the complex model used this year should be evaluated relative to simpler assumptions and models. While the transition from the simpler old model to Stock Synthesis was shown to be similar for the historical period, the depletion estimates in the most recent years were different enough to warrant further investigation.
- Discard estimates from observer programs should be presented, reviewed (similar to the catch reconstructions), and be made available to the assessment process.
- The quality of the age and length composition data, as presented, should be re- evaluated since they appear to affect model results.
- A survey that is better suited to rockfish species would be beneficial for the assessment.

- The ability to allow different "plus groups" for specific data types should be evaluated (and implemented in Stock Synthesis). For example, this would provide the ability to use the biased surface-aged data in an appropriate way.
- Historical catch reconstruction estimates should be formally reviewed prior to being used in assessments and should be coordinated so that interactions between stocks are appropriately treated. The relative reliability of the catch estimates over time could provide an axis of uncertainty in future assessments.

2011 Petrale Sole Assessment; Haltuch et al. 2011

Progress on a number of research topics and data issues would substantially improve the ability of this assessment to reliably and precisely model petrale sole population dynamics in the future:

1) The estimate of the NWFSC survey catchability in the base case model is higher than expected. Two contributing factors likely contribute to the high estimate of NWFSC catchability: 1) the herding of flatfish by the trawl bridles toward the path of the net, and 2) the use of the total area within each strata during the expansion of the survey data rather than only the trawlable areas or petrale specific habitat. Currently, the survey biomass estimates are obtained using the area swept by the net, rather than by the area swept by the trawl doors (approximately 3 times the width of the net) or some value in between the net and door areas. Therefore the current biomass estimate does not correct for the herding of fish. However, a recent video study of the NWFSC survey trawl and flatfish behavior shows that flatfish are herded by the trawl (Bryan et al. In prep). If a correction for herding was made during the calculation of the NWFSC trawl survey index the trend in the index would not change but the scale of the index would be smaller, resulting in a lower estimate of q in the stock assessment. At this time there are no area estimates for trawlable and untrawlable areas on the west coast. However the petrale sole population is most likely well surveyed by the trawl survey and expanding the survey index using areas that include untrawlable areas, and/or areas with different densities of petrale sole may not be appropriate.
2) In the past many assessments have derived historical catches independently. The states of California and Oregon have completed comprehensive historical catch reconstructions. The Oregon catch reconstruction is limited in that only annual catches based on the port of landing are available. In order to be relevant to the current petrale sole assessment the OR catch reconstruction needs to be expanded to include month or bimonthly period as well as the area of catch. At the time of this assessment, a comprehensive historical catch reconstruction is not available for Washington. Completion of a Washington catch reconstruction would provide the best possible estimated catch series that accounts for all the catch and makes sense for flatfish as a group.
3) Due to limited data, new studies on both the maturity and fecundity relationships for petrale sole would be beneficial.
4) Increased collection of commercial fishery age data from California would help reduce uncertainty. While some recent age data were made available from California sample sized could be increased and this data collection needs to continue into the future. Without age data, the ability to estimate year-class strength and the extent of variation in recruitment is compromised.
5) Where possible, historical otolith samples aged using a combination of surface and break-and-burn ages should be re-aged using the break-and-burn method.

6) The effect of fishery regulations including the impacts of trip-limits and other management approaches, such as closed areas, on discards, fishery selectivity, and fishery behavior requires further study.
7) Studies on stock structure and movement of petrale sole, particularly with regard to the winter-summer spawning migration of petrale sole.
8) Continue, and if possible increase, the recent collection of length compositions for discarded petrale sole for both the winter (Nov–Feb) and summer (Mar–Oct) fisheries.

2011 Petrale Sole STAR Panel Report; Conser et al. 2011

Expand the stock assessment area to include Canadian waters to cover the entire biological range of petrale sole (see more complete discussion of this recommendation under the *Unresolved Problems and Major Uncertainties* section, above).

Conduct a formal review of all historical catch reconstructions and if possible stratify by month and area. The mixing of U.S. and Canadian catches is of particular concern for the Washington fleet.

Discard estimates from the WCGOP should be documented, presented and, reviewed (similar to catch reconstructions) outside of the STAR panel process. The reviewed WCGOP data should then be made available to the assessment process.

Consider combining Washington and Oregon fleets in future assessments within a coastwide model.

The petrale sole maturity and fecundity information is dated and should be updated.

As noted by the previous STAR Panel, the current assessment platform (SS3) is structurally complex, making it difficult to understand how individual data elements are affecting outcomes. The Panel recommends, where possible, investigating simpler, less structured models, including statistical catch/length models, to compare and contrast results as data and assumptions are changed.

The length binning structure in the stock assessment should be evaluated, including tail compression fitting options.

The residual patterns in the age-conditioned, length compositions from the surveys should be investigated and the potential for including time-varying growth, selectivity changes, or other possible solutions should be examined.

Management strategy evaluation is recommended to examine the likely performance of new flatfish control rules.

2011 Sablefish Assessment; Stewart et al. 2011

The following research could improve the ability of this assessment to reliably model sablefish population dynamics in the future:

1) Continue the annual NWFSC shelf-slope trawl survey time-series. Future improvements in the precision of estimates of absolute stock size and productivity are reliant upon observing some contrast in stock trend (other than a one-way trip) with an unbroken survey index. Only a longer, more informative survey time-series will provide stock-specific and data-based information on the steepness parameter governing the sablefish stock and recruitment relationship.
2) Investigate aging methods that could prove more precise than current break-and-burn methods. If age data were more accurate, cohorts could be better tracked to older ages and estimates of historical year-class strengths may be improved. Further studies to investigate the potential for bias in aging methods should be conducted; these results will have a strong effect on natural mortality estimates.
3) Evaluate potential causes of residual patterns in the fit to larger cohorts in the age data (particularly the 1999 and 2000 cohorts) and for residual patterns in the fit to the size data.
4) Model results were quite sensitive to changes in the maturity schedule, yet the available information is very outdated, in addition to being variable among sources, years and regions. The routine collection of samples to refine estimates of biological parameters, particularly maturity and fecundity would greatly benefit the reliability of this assessment.
5) Age sampling from the commercial fishery has generally been sparse compared to other groundfish and relative to the importance of this stock to west coast fisheries. Work toward further standardization of state and federal biological sampling programs would make data more informative, by reducing sampling variability. For example, during most of the last 30 years at least one state has collected sexed-length observations, while at least one has not. If an increased fraction of both the catch was available for sampling at-sea, or in-port in a non-dressed form, then more consistent demographic information could result.
6) Continued refinement of the historical landings estimates for Washington, subsequent to the large data entry of historical fish-ticket information currently underway, will likely produce a more accurate time-series of mortality and would complement the completed efforts to reconstruct California and Oregon landings.
7) Given the migratory nature and broad distribution of sablefish along the Pacific Rim, it is important to continue to evaluate the spatial aspects of the assessments, including the northern boundary with Canada, and the connectivity with offshore seamounts. A joint assessment with Canadian and Alaskan scientists could be warranted, following the approach taken by the International Pacific Halibut Commission.
8) Continue to evaluate methods to capture information regarding environmental and ecosystem variability in stock assessments. Further, historical records of particularly large year classes (e.g., 1947 reported by sport fishermen in central California) could be investigated to better inform the historical period.
9) Previous assessments relied upon an independent database for collecting and analyzing biological sampling from the three states. Washington, California and Oregon have now loaded all available data into PacFIN's Biological Data System, where it can be retrieved and analyzed in a consistent and documented format. However, information is still missing from some records, and a small number of samples were unsuitable for analysis due to incomplete or jumbled records. An effort to either repair or remove any unreliable information could improve the speed and accuracy of future analyses.

10) There is uncertainty in the accuracy of the dressed to whole weight conversions used in some situations to estimate fishery landings. Following Oregon's lead, this topic should be investigated, and total landed catch estimates adjusted, according to the best available conversion information.

2011 Sablefish STAR Panel Report; Wespestad et al. 2011

The following recommendations are listed in priority order.

General recommendations affecting more than one assessment

- Complete and review the Washington catch reconstruction and review the California and Oregon catch reconstructions. The accuracy and wide availability of consistent basic information is essential to the development of Pacific coast assessments. In addition to the raw data, the reliability and availability of more spatially dis-aggregated forms of the data should be investigated to determine if they could be used to develop more spatially or temporally explicit models without causing sacrifices in accuracy.
- Include in future versions of Stock Synthesis the capability to explore alternative error distribution assumptions for compositional data. Currently the multinomial distribution is the only type of error distribution available in Stock Synthesis for length or age information. It appears that this may have some impact with respect to underestimating strong year-classes. It would be helpful to be able to explore alternative error assumptions in order to analyse composition information, in particular where the effective sample size estimates (which control the variance in the composition data) may be related to perceived stock abundance.
- Develop guidelines for use of the Lorenzen model for age-dependent natural mortality. The panel investigated the use of age dependent M in both the Dover sole and sablefish assessments. In each case one of the reasons for exploring different mortality schedules was the potential imbalance between the genders in the age- and length composition information, either in the sex ratio at older ages (Dover sole) or in the ratio of young to old fish (Sablefish). The use of the Lorenzen M model, which is based on a decline in M with age by the inverse of the growth rate, implies a link with size-based predation. However, with likely wider use of this model feature there should be development of some guidance on the appropriateness of the implementation in other stock assessments.
- Conduct new studies of maturity by length and age based on more comprehensive coastwide and depth-based sampling and using histological techniques for determining maturity stage. Given that there is uncertainty regarding the temporal stability of maturity schedules, there should be periodic monitoring to explore for changes in maturity
- Modify the Stock Synthesis code to allow changes to the plus-group age. The Panel found it very helpful to be able to modify the plus-group in the age-composition data to investigate the influence of old versus young age composition data. This feature could also be used to explore the influence of ageing errors. The current version of SS requires restructuring of the input data if the plus-group is changed.

Recommendations specific to sablefish

- Further investigate potential inaccuracy in using maximum likelihood estimates and the normal distribution to approximate confidence limits for estimates of spawning biomass. The current assessment's measures of uncertainty in spawning biomass are based on the assumption that the errors can be adequately approximated by normal distributions. The current model for sablefish is sufficiently simple that it may be feasible to conduct a full Bayesian analysis of uncertainty. There is concern that asymmetries in the error distributions, which the normal distribution cannot account for, may be creating a biased view of stock status.
- Conduct new studies on maturity and age-reading error. A major uncertainty in the sablefish assessment relates to the maturity schedule and in age determination. Better maturity and age-at-length data could reduce uncertainty and help resolve issues of cohort size.

2011 Spiny Dogfish Assessment; Gertseva and Taylor 2011

In this assessment, several critical assumptions were made based on limited supporting data and research. There are several research and data needs which, if satisfied could improve the assessment. These research and data needs include:

1) The ageing method for dogfish requires further research. Double reads indicate that the method of counting annuli on the unworn portion of dogfish dorsal spines is reasonably precise and has been validated using both oxytetracycline marking and bomb radiocarbon. However, more research is needed on the topic of unreadable annuli that are missing due to wear on the spines of older dogfish. Cheng (2011) has proposed important improvements to the statistical methods applied to these calculations, but the differences in patterns of age at length between worn and unworn spines resulting from those calculations suggests that addition research is needed. Improving estimates of the statistical uncertainty associated with the age extrapolation methods, including that proposed in Cheng (2011) would also be valuable. Tribuzio et al. (2010) explored a variety of refinements to the age estimation and growth for dogfish in Alaska that could be applied for west coast dogfish. Ideally, an alternative method of ageing dogfish that does not rely on the highly uncertainty estimation of ages missing from worn spines may be necessary before age information can be a reliable data source in dogfish stock assessments. Future assessment could also benefit from additional age readings of dogfish spines that have not yet been examined, including thousands of samples collected in the NWFSC shelf-slope survey from 2004-2009.

2) The move to full observer coverage in 2011 will improve estimate of dogfish discards for the west coast. However, there is considerable uncertainty in both the historic discard amounts, especially prior to the commencement of the West Coast Groundfish Observer Program. Even more important is the need to improve estimates of discard mortality. Studies of this topic on the east coast used shorter tow durations than those in common fishing operations in these waters, and thus are likely to produce understimates of discard mortality (NEFSC, 2006). Data on tow duration could also be incorporated into future models to better refine discard mortality estimates from the trawl fishery.

3) Ongoing research using acoustic tags on dogfish released in central Puget Sound in the summer show regular seasonal movements to coastal waters during the winter and returns to Puget Sound in the subsequent summers (Andrews, pers.com.). This suggests that biomass sampled by summertime surveys (including all those from AFSC, NWFSC, and IPHC used in this analysis) may not be representative of the population size and distribution available to the fishery in other seasons. If the movements are very regular, the surveys may still provide a reliable relative index of abundance, but any differences in movement patterns due to climate or prey availability could impact these indices. Further research into how to account for such movement patterns should be conducted to inform future dogfish stock assessments. Acoustic or satellite tagging of dogfish in coastal waters could provide valuable insight into movement patterns along the coast and benefit future assessments.

4) There are high densities of dogfish close to the U.S./Canada border, at the mouth of the Strait of Juan de Fuca which connects the outside coastal waters with the inside waters of Puget Sound and the Strait of Georgia. This distribution, combined with potential seasonal or directed movement patterns for dogfish suggest that U.S. and Canada should explore the possibility of a joint stock assessment in future years. The data used in these assessment are far more comprehensive than that used by Taylor (2008), but the spatial modeling approach used in that analysis might be considered as a starting point for spatial considerations in a future international assessment.

2011 Spiny Dogfish STAR Panel Report; Tsou et al. 2011

1) Improve age estimates and aging methods.
2) Examine the uncertainties regarding the catch data and discard mortalities. In particular bycatch estimations are very important, given that they are larger than the recorded landings over recent years
3) Research on dogfish movement. This would be informative not only in providing a better definition of the unit stock, but also aid addressing # 4 (below)
4) Linkage with fish on Canadian side of the border and exploration of a joint assessment process for this stock
5) Continuation of the commercial catch and bycatch sampling
6) Examination of catchability priors in the New Base model as well as a method for deriving future priors
7) Examination of the Beverton-Holt derivation, as it relates to dogfish, and comparison with new stock-recruitment model used in this report.

2011 Widow Rockfish Assessment; He et al. 2011

1) More studies on the feasibility of estimating stock-recruitment relationships for given model structures and data availability will be very beneficial.
2) The long-term recruitment index is a key time series in the stock assessment. Continuation of the NMFS/PWCC mid-water juvenile trawl survey should provide key information on the recruitment strength of widow rockfish.
3) Re-ageing of widow rockfish otoliths from California and possibly from Oregon and Washington fisheries in 1980's and 1990's. The conditional age-at-length data from these fisheries showed that ages-at-length were highly variable in these years. For example, fish

from the same length groups could range over 20 years in age. Re-ageing these data could improve the precision of growth estimates for assessment models. It will be useful to derive a separate ageing error vector from the re-aged data from the early years.

4) Additional research to determining the magnitude of spatial and temporal differences in biological traits (growth, maturity, fecundity, etc.).

2011 Widow Rockfish STAR Panel Report; Tsou et al. 2011

1) A thorough review of model structure and available data should be conducted, including but not limited to evaluation of one-area vs two areas models, the use of age- or length-based selectivities, evaluation of fixed model parameters (i.e. natural mortality), the use of dome-shaped or asymptotic selectivity curves, and the spatial definition of fisheries. Some of these items are discussed in detail below
2) Provide data and/or maps on spatial patterns of fishing harvest and/or effort, particularly as it relates to the split between the northern and southern areas, in order to assess whether the division at 43° N corresponds to a natural break in the fishery or whether it divides a continuous pattern.
3) Consider the theoretical basis of selectivity with regard to whether the mechanistic process is age-based or size-based, and the types of data which would provide information on this topic.
4) Obtain all length composition from the fisheries and surveys, and evaluate whether the inclusion of these data in the model improves model performance.
5) Consider multiple model-independent estimates of natural mortality in order to assess potential variation, with the possibility of developing a prior distribution for *M*.
6) Future estimates of steepness should be accompanied by comparisons to other west coast rockfish stocks, with proposed biological explanations for any large discrepancies from other rockfish stocks.
7) Apply other assessment methodologies, potentially including catch curves, surplus production models, stock reduction analysis, etc., to evaluate whether the information obtained on stock status, vital rates, and productivity are consistent with the assessment model.

2011 Yelloweye Rockfish Update Assessment; Taylor and Wetzel 2011

The available data for yelloweye rockfish are very sparse and generally weakly informative about current status. The following research topics were suggested in the 2009 assessment and are repeated here with minor modifications and additions. Progress on these points could improve the ability of this assessment to reliably model the yelloweye rockfish population dynamics in the future and provide better monitoring of progress toward rebuilding:

1) Develop and implement a comprehensive visual survey.
2) Do a scientific review of current efforts to develop and improve stock size indices for yelloweye based on IPHC (including additional stations) and make recommendations on the best approaches to develop such indices.
3) Explore a recalculation of GLMM estimates in the IPHC survey that explores station effects which allows inclusion of stations that differ over time.
4) Investigate the development of a WA recreational yelloweye CPUE based on the recreational halibut fishery. Consider a full time series and one ending in 2002, since the yelloweye RCA in waters off northern WA was implemented in 2003.

5) Encourage the collection of samples to refine the estimate biological parameters, particularly maturity and fecundity.
6) Continue to evaluate the spatial aspects of the assessments, including growth, the number and placement of boundaries between areas, as well as the northern boundary with Canada.
7) Investigate alternative ways of re-weighting. This issue is relevant for all west coast stock assessments.
8) Investigate how best to account for the variability in dates in trawl surveys through a meta-analysis. This issue is relevant for all west coast stock assessments.
9) Conduct a historical catch reconstruction for WA to match those produced for OR and CA. This issue is relevant for all west coast stock assessments.
10) Access and processing of recreational data (catch and biological sampling) currently entails differing locations and formats for data from each of the three states and RecFIN. RecFIN is difficult to use and estimates from it don't match the total mortality estimates also provided by the state agencies. A single database that holds all raw recreational data in a consistent format would reduce assessment time spent on processing these data and potential introduction of errors or alternate interpretations due to processing.
11) The IPHC data organization should be revisited. Currently biological samples cannot be linked to the station from which they were collected. Age data for 2003-2005 is disconnected from length and sex information and other unknown issues may persist in these data. A thorough evaluation of what data are reliable and a final determination of what information is lost, or can potentially be recovered, is needed.
12) Instigate discard sampling of yelloweye bycatch in the directed Pacific halibut fishery.
13) Different trends in CPUE of yelloweye in the CA recreational fishery have been identified. CPUE by port from 1980 to 2000 should be analyzed using clustering methods to identify regions with a similar demographic trajectory. This could lead to improvements in management of the stock as well as possibly inform refinements of the spatial structure of future assessment models.

2011 Groundfish and Coastal Pelagic Species Stock Assessment Review Workshop; National Marine Fisheries Service Northwest Fisheries Science Center and Pacific Fishery Management Council; Online Webinar

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Dr. Andrè Punt, University of Washington, Scientific and Statistical Committee
Dr. Dave Sampson, Oregon State University, Scientific and Statistical Committee
Mr. Rod Moore, West Coast Seafood Processors Association
Dr. Kevin Stokes, Center of Independent Experts
Ms. Sandra Krause, Pacific Fishery Management Council
Mr. Mike Burner, Pacific Fishery Management Council
Mr. John DeVore, Pacific Fishery Management Council

A. Administrative Matters

1. Roll Call, Introductions, Announcements, etc.

Dr. Hastie asked for a roll call of all participants on the line.

2. Opening Remarks and Agenda Overview

The agenda was reviewed and modified online.

B. Perspectives on 2011 Stock Assessment Process

1. Center of Independent Experts Perspective

Dr. Stokes, who was the constant Center of Independent Experts (CIE) reviewer in the 2011 groundfish stock assessment review (STAR) process, recommended a general primer on the process for new folks. A very clear Terms of Reference needs to be developed to improve understanding on what is needed at the STAR panels. Some of the assessment presentations could have been shortened. Some attention to this should be considered in the Terms of Reference. Data issues could be worked out better in advance of the STAR panel meetings. Methods should be standardized to enable more consistency in assessment approaches, although flexibility in considering new analyses should also be encouraged. There were some very good presentations and assessments at STAR panel meetings, yet some were somewhat lacking. Overall, the process was robust and the mop-up panel was a very strong part of the process.

Dr. Stokes was asked if developing a separate CIE report hampered the process and he responded that it made things difficult, but is considered important for the independent peer-review process

that is mandated in the CIE contract and in the STAR process. It was pointed out that the STAR report, and not the CIE report, is generally attended to in the west coast process.

Dr. Stokes was asked to comment on other U.S. regional reporting requirements. He provided an overview of the various reporting requirements around the U.S. It is common to have to produce a STAR-like report in addition to a CIE report. It was a relief in the North Pacific Fishery Management Council process to only have to produce a CIE report. Having reporting requirements does tend to detract from the ability of the CIE reviewer to fully engage in the assessment review.

CIE reports also comment on process as well, which may help refine these processes. Dr. Stokes also recommended a verbal debriefing by the CIE to the SSC on what and who worked well and what and who did not work as well. An informal discussion rather than a report in writing is recommended.

2. Groundfish Management Team Perspective

Mr. Niles explained there was a Groundfish Management Team (GMT) conference call to talk about the STAR process earlier this week. The GMT thought the GMT-STAR communication was generally good. The GMT would like some modification to the Terms of Reference to be more explicit about the GMT representative role in the STAR process. Timing of data/modeling issues between the stock assessment teams (STATs) and the GMT was problematic. The GMT recommends a pre-assessment data/modeling workshop to work out these issues.

Dr. Field explained there was a short pre-assessment meeting at the June Council meeting for the blackgill assessment. Mr. DeVore said he thought all the pre-assessment meetings for sablefish, Dover sole, petrale sole, greenspotted rockfish, and blackgill rockfish were helpful and improved the assessments. Otherwise, some of these issues would have to be worked out at the STAR panel meetings, which is less efficient. Dr. Field thought doing this at a Council meeting might be efficient and can be done at a marginal cost.

Mr. Niles also said the GMT wants to be able to write up the GMT perspective in the STAR report, perhaps in an appendix. This is part of making the GMT's role in the process more explicit in the Terms of Reference. Dr. Gertseva said one problem in finalizing the spiny dogfish STAR report was the late provision of GMT comments after the STAR panel was adjourned. Dr. Stokes added that part of the problem is how STAR panel meetings are conducted and perhaps the improvement could occur in how meetings are conducted.

3. Groundfish Advisory SubPanel Perspective

Gerry Richter, the Groundfish Advisory SubPanel (GAP) representative at most of the 2011 STAR panels, was not on the call. Mr. DeVore said he received an email from Mr. Richter who had to attend to a business emergency and therefore missed the call. He said he and other GAP members had no issues with the process and thought it went smoothly.

4. Scientific and Statistical Committee Perspective

Dr. Dorn, the current chair of the Council's Scientific and Statistical Committee (SSC), thought the process worked very well this year. There was a rush at the end of the season to finalize the mop-up assessments. His sense is the process needs to be tweaked but does not need wholesale revision. He agrees that advisory body input needs to be clarified in the Terms of Reference. Perhaps the GMT and GAP sections of STAR reports could be written independently, but those views should focus on the assessment and not management issues. There were some surprises between STATs and STAR panels that could be worked out. There were ideas and concepts that evolved as the STAR season progressed. There was some loss of continuity in how things, such as the use of the Hamel prior on natural mortality (M), are used in assessments. How assessment results are communicated to the Council could be refined. The evening assessment briefing sessions at Council meetings were not well attended. He noted the lower priority assessments were not given much air time or discussion, yet the STATs spent a lot of time preparing presentations.

Dr. Hastie said he thought how uncertainty is communicated to the Council could be refined. He solicited ideas for improvement of how to better communicate uncertainty. Dr. Dorn added that the widow rockfish decision table was effective at communicating the uncertainty in that assessment (e.g., sigma calculation) and could serve as a template.

Dr. Gertseva explained that the STAR chairs need to be able to review pre-STAR drafts of assessments before they are distributed.

Mr. Burner said there were some snags with respect to mandating the full SSC to review mop-up panel results. The Terms of Reference could soften up that review requirement. Mr. DeVore added that the Terms of Reference should formalize how instructions are given to STATs when there are requested revisions to an assessment that is recommended for mop-up. One potential fix is to schedule STAR panels such that there is an SSC meeting between the last STAR panel and the mop-up panel with adequate time for the SSC to discuss revisions to problematic assessments and STATs time to make the revisions. An explicit process, such as a teleconference between the STAT and the SSC Groundfish Subcommittee as happened this year to resolve the widow assessment revision request, should be added to the Terms of Reference if scheduling of STAR panels and SSC meetings cannot be changed to make this process work better.

5. Northwest Fisheries Science Center/SWFSC Perspective

Dr. Hastie said there were some problems with providing data for assessments in a timely fashion this year that the Northwest Fisheries Science Center is working to fix.

Dr. Ralston agreed with Dr. Dorn that the system works the way it is supposed to generally. He noted the challenge in resolving the bocaccio assessment. There was a final review of that assessment at the mop-up panel which made it difficult to prepare the required rebuilding analysis that was also reviewed at the mop-up panel. He thought we got wrapped around the axel a bit with bocaccio and; if there was a bit more flexibility in the update review process, it would have been easier. He recommended changes to the Terms of Reference to allow some changes in the assessment when an update doesn't make sense. Dr. Sampson says it is a slippery slope to allow

major changes to an update assessment since that requires more time to review the assessment than is allotted in the process.

Dr. Ralston thought the greenspotted and blackgill STAR panels went well.

6. Council Perspective

Mr. DeVore recommended convening a pre-assessment data/modeling workshop that all STATs attend to foster consistent data and modeling approaches in assessments. A webinar-type workshop or series of workshops could be scheduled to reduce costs relative to a face-to-face meeting. There was some thought that such workshops could occur in the off year when assessments are not conducted.

7. Coastal Pelagic Species Perspective

Dr. Punt explained that Coastal Pelagic Species (CPS) FMP only has two species that undergo assessment (i.e., Pacific sardine and jack mackerel) The 2011 CPS assessment process went fairly well and is easier than groundfish assessment reviews since only one species assessment is reviewed at a time, unlike groundfish where two assessments are reviewed at a STAR panel. CPS assessment reviews also tend to blend in a methodology review, which is somewhat different than is done at groundfish STAR panels. There are differences in how the CPS advisory panel comments on the STAR panel process and the methodology review process; however, this year's process proceeded well. Dr. Punt explained the CIE role in the CPS assessment process needs to be clarified. There is also a time crunch in the CPS process (i.e., a short time lag between the assessment review and the Council meeting) that needs to be addressed. CPS assessments need to be better reviewed and vetted internally before they go to the review panel.

Mr. Burner said there was an issue on STAR report content that came after the meeting was adjourned. Dr. Punt said he is working on making CPS STAR report contents more explicit in the Terms of Reference.

Dr. Dorn recommended a common Terms of Reference for assessment reviews and methodology reviews for groundfish and CPS.

C. Improving the Stock Assessment Process

1. Pre-Assessment Planning and Execution
    a. What Worked and What Didn't in 2011
    b. Recommended Improvements for 2013

Dr. Hastie said the timing of providing input data for assessments to STATs was difficult. For instance, there was late provision of West Coast Groundfish Observer Program (WCGOP) data for assessments. The Northwest Fisheries Science Center is working to speed up that process.

Dr. Hastie noted the pre-assessment workshop in Newport for sablefish, Dover sole, and petrale sole went well, as did the sablefish workshop at the April Council meeting. If budgets allow, they will try to repeat this.

Dr. Hastie explained the Northwest Fisheries Science Center is planning another data methods workshop for next April with the potential for another workshop after that. Therefore, the Northwest Fisheries Science Center is recommending delaying development of the Terms of Reference for doing data-limited assessments until September.

Dr. Dick recommended improvements in how ageing data are provided to STATs. He recommended earlier decisions on which stocks will be assessed to give those reading otoliths time to process the data. It takes time to determine methods/protocols for ageing a particular species and working up the data.

Dr. Dorn said there should not be a choice between a data-limited assessment review panel and an additional STAR panel that reviews two full assessments. The SSC regards data-limited assessments as a high priority. This may not be a trade-off since a data-limited assessment review panel can be scheduled such that it doesn't displace a STAR panel.

Mr. Moore said the typical Council assessment planning process occurs in March and September, but perhaps could be finalized in June. Dr. Hastie said assessments could be decided by June and the Terms of Reference finalized in September.

Dr. Hastie said summary data for historical catch reconstructions could be placed in the PacFIN database. There has been some progress in reconstructing catches off Washington back to 1981. However, a final review of historical catch reconstructions is unlikely prior to the 2013 assessment cycle due to expected delays in reconstructing the entire time series of historical catches off Washington. They are trying to establish an electronic inventory in PacFIN of all samples taken over time.

Dr. Dorn recommended consistent treatment of discard data and consistent assumptions for historical discards in assessments. There should be a workshop to establish best practices prior to the 2013 assessment cycle. Dr. Hastie said there will be an examination of the Pikitch and the Electronic Data Collection Program (EDCP) data to accomplish this. Dr. Taylor said it is worthwhile to explore historic discard data, but the issue is really how those data are modeled. For instance, assumed selectivities and other modeling assumptions have a big effect on assessment results. Dr. Hastie said it is one thing to capture the uncertainty, but the critical thing is to get the central tendency correct for the base model. Dr. Sampson thought it a mistake not to better capture the uncertainty in reconstructing historic discards at the same time.

Dr. Dorn thought it problematic in 2011 that the new methods for generalized linear mixed models (GLMMs) were not properly reviewed. Dr. Hastie said a more flexible AD Model Builder (ADMB) tool will be available for estimating GLMMs. The Northwest Fisheries Science Center will develop and publish this tool in a peer-reviewed journal. The tool can also be informally reviewed before it is published. This will happen in 2012 and they will consult with the SSC on the review process.

2. Issues Relating to "Full" Assessments and STARs
    a. What Worked and What Didn't in 2011
        I. Assessment-oriented
        II. Review-oriented
    b. Recommended Improvements for 2013

Mr. DeVore recommended that deadlines for providing pre-STAR draft assessments for review of completeness be adhered to. The STAR chairs should formally review these drafts as well. Part of this is making sure data are provided to STATs in a timely fashion so they can better meet the deadlines. Also, the pre-STAR review needs to ensure past STAR panel recommendations are addressed. Dr. Hastie said CIE reports will be readily available in the future. He recommended the Terms of Reference should also mandate that CIE recommendations be addressed in assessments. Dr. Stokes said CIE reports address all aspects of the process, not just the recommendations for assessments. He cautioned there should be some sort of filter on what CIE recommendations are addressed in assessments. He recommended the SSC review CIE recommendations before instructions are given to STATs. Dr. Dorn agreed this could be helpful and there should be consideration of adding the SSC review of CIE reports in the Terms of Reference.

Mr. Hicks thought there should be more guidance in the Terms of Reference for how to define sigma (i.e., the scientific uncertainty in estimating the overfishing limit or OFL) and how to better design decision tables to be more stochastic. It would be helpful to report the individual assessment sigma in a formal way. Dr. Dorn agreed this would be a benefit in the process and would save the SSC from having to do this in the short time they have to review an assessment. However, Dr. Dorn emphasized that evaluation of uncertainty is evolving science, and that STAT teams should not be precluded from developing new approaches. Dr. Stewart said the structuring of a decision table often takes a full day at STAR panels. Dr. Dorn thought the calculation of sigma should be done in a STAR panel with a final SSC review. Providing results to the SSC in a more informative way to make the sigma decision would be more efficient and would benefit the process. Dr. Conser said the technical aspects of determining sigma should be reviewed at a STAR panel, but STAR panels should not recommend final sigmas. Dr. Hicks said better guidance in the Terms of Reference for how to calculate uncertainty for determining sigma would be helpful. Should the biomass uncertainty or OFL uncertainty be calculated? Should this be done in log space? This type of guidance would be helpful.

Dr. Stewart recommended more consistent structures for decision tables. Mr. DeVore agreed and explained the catch streams in decision tables should be more informative and realistic. For instance, assuming an OFL catch stream is unrealistic and unhelpful. Projections using the Council's default P* decision or, in the case of overfished species, providing projections using the default spawning potential ratio (SPR) harvest rate decided in the rebuilding plan would be more realistic and informative. This would better address the bias in projecting OFLs noted by the SSC in their September statement.

Dr. Conser said the number of STAT members that come to STAR panels should be clarified. One STAT member going to a STAR panel is not enough. Dr. Field said he agreed in concept but

would not recommend mandating this in the Terms of Reference. Dr. Conser thought this should be in the Terms of Reference because it is hard to predict the issues that will come up in a STAR panel. Dr. Stokes said that having multiple STATs at a STAR panel does make it easier to handle panel requests. The widow STAR panel was a difficult one for Dr. He, especially since he was far from home and had no support. Dr. Stewart said there could be manpower issues with such a mandate since assessment authors work on multiple assessments in a cycle. Dr. Conser thought these logistics could be better worked out in the assessment planning process. Dr. Stokes thought this was a good idea but does not necessarily need to be in the Terms of Reference.

Dr. Hastie raised the issue of the role of the CIE in STAR panels and their ability to engage when asked to rapporteur the meeting. This could be problematic given the CIE report writing responsibility. Dr. Stokes said the more the duties can be divided among panel members, the better engaged individuals can be in the review. It is tough for the CIE reviewer to rapporteur but it is part of the duty. Dr. Hastie asked if it would help to have someone who is not a reviewer assigned to taking notes. Dr. Stokes said this could be helpful, but a second rapporteur is not the answer since the CIE reviewer would be taking separate notes for the CIE report anyway.

Dr. Dorn noted the difference of opinion by the widow STAT when the revised assessment was up for final SSC review was a problem and wondered if the entire STAT should have been at the mop-up panel. It is hard when these disputes come in after the STAR or mop-up panel and the SSC is asked to resolve the issue. Dr. Gertseva thought there should have been better communication among members of the STAT to avoid these types of issues. Dr. Punt thought there should be a right to address issues after the fact when new information becomes available. However, some of these problems could be addressed better by the entire STAT being at the review. Dr. Ralston said the issue was not disputing the conclusions of the mop-up panel, but providing more information for SSC consideration regarding the uncertainty in estimating widow productivity. Dr. Hamel said such issues are better evaluated in the off year in a more thoughtful way. Dr. Punt said the real question is should we change the Terms of Reference to avoid these problems. Dr. Conser said there should be a process for correcting errors that are found after a STAR panel; however, there should be a line drawn to discourage airing of disagreements between STATs and panel reviewers after the STAR panel. Dr. Ralston disagreed and said the SSC should allow external considerations before finalizing their recommendations on an assessment.

Dr. Sampson asked if there will be a “best practices” guide for 2013 assessments. He noted that issues were approached differently across assessments. Dr. Hastie said the Terms of Reference should address the biggest issues. Dr. Haltuch said there are “dos and don’ts” in how to use Stock Synthesis (SS) in the SS manual.

3. Issues Relating to Assessment "Updates" and Reviews — Martin Dorn
    a. What Worked and What Didn't in 2011
        III. Assessment-oriented
        IV. Review-oriented
    b. What is an "Update"?/ Do We Need Several Flavors?
    c. Recommended Improvements for 2013

Dr. Hastie posed the question as to whether the Terms of Reference adequately defines full and update assessments. Dr. Dorn reviewed a list he compiled regarding updates. The SSC says there is momentum to add as much into updates as possible and that should be discouraged. Dr. Hastie said there are circumstances that arise in updates where the fixed values are no longer the most compelling versions of reality. There needs to be a more prescribed method for dealing with these issues in updates. Dr. Field said he tried to provide a more realistic bocaccio assessment that adhered as close to an update as possible while providing a more realistic result. He thought an extra hour on the SSC agenda in June could have resolved the bocaccio assessment given that the model modifications were limited. Dr. Conser thought resolving such assessments would take longer than an extra hour, perhaps half a day. Dr. Field disagreed and said, if circumstances arise where an extra hour could not resolve the assessment, then send it to the mop-up panel for further review. However, in this case, an extra hour should have led to resolution. Dr. Hamel said there could be "hybrid" updates contemplated to minimize the number of assessments going to mop-up. Dr. Dorn agreed that, with some changes in the Terms of Reference and a little extra time on the SSC agenda, bocaccio could have been resolved in June. There should be some side bars on an update while allowing some modest flexibility to what comprises an update. Ms. Key agreed but cautioned that we want to guard against requests for more information going into an update. Dr. Taylor said the side bars that accomplish these objectives should be clarified. For instance, use of new versions of the modeling software that are developed to fix bugs in the modeling platform and corrections to historical catch data should be explicitly allowed in the Terms of Reference. There was some disagreement whether historical catch reconstructions should be allowed in an update. Dr. Stokes said there should be a line drawn to not allow changes in modeling assumptions, but allow reasonable changes to the input data. He did not believe there was a need to overhaul the Terms of Reference on updates. Dr. Hastie said all attempts to minimize the number of updates going to mop-up would help. Since many of the updates are for overfished species, resolving these assessments at the mop-up panel is especially onerous because a rebuilding analysis has to also be resolved then. Dr. Taylor said it would have been physically impossible to resolve a yelloweye assessment and rebuilding analysis at a mop-up panel because it takes too long to run projections. Dr. Gertseva said the update reviews would have gone smoother if there was a step-by-step documentation of all the changes in the model and results to better understand why results changed from the last full assessment to the update (e.g., darkblotched update).

D. Terms of Reference

1. Summarize issues pertaining to the changes in the "Terms of Reference for Groundfish Stock Assessment and the "Terms of Reference for Groundfish Rebuilding Analyses"

Dr. Dorn highlighted the following issues for changing the stock assessment Terms of Reference:

- scheduling of internal assessment deadlines needs to be refined;
- a more explicit definition of the roles of the GMT and the GAP and how the STAR panel report characterizing their concerns is developed,;
- clarify the role of science centers in finalizing an assessment;
- consider loosening the requirements of an update. Dr. Conser said the Terms of Reference should only allow reconstructed historical catches if they have been peer-reviewed. For example, revised historical catches from the Oregon catch reconstruction effort were routinely used in the 2011 updates despite the fact the data and methods were not formally reviewed. Dr. Stewart disagreed and said such data and methods should be evaluated by the STAT. He said the Oregon catch reconstruction was far better than the more ad hoc catch reconstructions done by STATs previously. Dr. Taylor said the Washington catch reconstruction will be a problem for 2013 updates. He recommended update STATs and the SSC should plan on reviewing these data and methods early in 2013.
- there should be step-by-step documentation of transition steps between the previous assessment and update assessment;
- determine how to accommodate a change such as occurred in the bocaccio update;
- provide guidance on appropriate levels of removals for stock projections;
- discuss the process for changing the error assumptions in GLIM analysis for survey indices;
- consider allowing the use of the latest version of SS in updates since revisions to SS are commonly done to fix coding errors;
- consider allowing the use of updated priors on steepness in updates;
- explicit inclusion of ecosystem considerations or analyses in assessments. There will need to be useful ecosystem model results that can be used in assessments. The Ecosystem Plan Development Team is targeting the 2013 assessment cycle for initiating these types of analyses. Ecosystem data and analyses need to undergo SSC review.

Dr. Dorn offered the following considerations for changing the Terms of reference for rebuilding analyses:

- reduce the number of mandated runs;
- make it clear that T_{TARGET} and SPR are Council policy choices; therefore, change the nomenclature in labeling some results;
- clarify which methods are used to determine total mortality removals in rebuilding analyses. Include greater documentation of these methods;
- clarify what rebuilding strategies are recommended by the SSC for rebuilding plans and not rely totally the default settings in the Puntalyzer (e.g., allow alternative strategies other than constant SPR);
- provide justification for how discard data are used in rebuilding analyses (e.g., use landed catch plus a modeled discard rate or the annual total catch estimates provided by the WCGOP). While the Terms of Reference should not be prescriptive on methods, it should require justification for methods used;
- include a template for summary tables in rebuilding analyses;
- provide revenue streams and economic projections in rebuilding analyses;
- compare past recruitment projections with realized interim recruitments;
- clarify levels of removals in rebuilding projections;
- add ecosystem analyses in rebuilding analyses.

E. Methodology Reviews

A combined methodology review Terms of Reference using the CPS Terms of Reference as a template is recommended for use in groundfish and CPS. This Terms of Reference will be reviewed by the SSC in March.