MINUTES
Scientific and Statistical Committee

Pacific Fishery Management Council
The Riverside Hotel
North Star Room
2900 Chinden Blvd.
Boise, ID 83714
Telephone: 208-343-1871

September 11-13, 2013

Call to Order and Scientific and Statistical Committee (SSC) Administrative Matters

The meeting was called to order at 8 a.m. on Wednesday, September 11, 2013. Council Executive Director, Dr. Donald McIsaac briefed the SSC on priority agenda items.

Members in Attendance

Mr. Robert Conrad, Northwest Indian Fisheries Commission, Olympia, WA
Dr. Martin Dorn, National Marine Fisheries Service, Seattle, WA
Dr. Owen Hamel, SSC Chair, National Marine Fisheries Service, Seattle, WA
Dr. Daniel Huppert, University of Washington, Seattle, WA
Mr. Tom Jagielo, Seattle, WA
Dr. Peter Lawson, National Marine Fisheries Service, Newport, OR
Dr. André Punt, University of Washington, Seattle, WA
Dr. David Sampson, Oregon Department of Fish and Wildlife, Newport, OR
Dr. William Satterthwaite, National Marine Fisheries Service, Santa Cruz, CA
Ms. Cindy Thomson, National Marine Fisheries Service, Santa Cruz, CA
Dr. Tien-Shui Tsou, Washington Department of Fish and Wildlife, Olympia, WA

Members Absent

Dr. Vladlena Gertseva, National Marine Fisheries Service, Seattle, WA
Ms. Meisha Key, SSC Vice-Chair, California Department of Fish and Wildlife, Santa Cruz, CA
Dr. Todd Lee, National Marine Fisheries Service, Seattle, WA
Dr. Charles Petrosky, Idaho Department of Fish and Game, Boise, ID

SSC Recusals for the September 2013 Meeting		
SSC Member	**Issue**	**Reason**
Dr. Owen Hamel	G.3 Approve Stock Assessments	Dr. Hamel was the lead author of the aurora rockfish assessment and supervises the scientists who conducted the thornyhead assessments.

Scientific and Statistical Committee Comments to the Council

The following is a compilation of September 2013 SSC reports to the Pacific Fishery Management Council (Council) in the order they were discussed by the SSC. (Related SSC discussion not included in written comment to the Council is provided in *italicized text*).

D. Pacific Halibut Management

1. Pacific Halibut Bycatch Estimate for Use in the 2014 Groundfish Fisheries

Dr. Jason Jannot of the NWFSC West Coast Groundfish Observer Program (WCGOP) met with the Scientific and Statistical Committee (SSC) and reviewed the Pacific halibut bycatch report and WCGOP Response to the SSC (Agenda Items D.1.b). The SSC had previously reviewed and commented on the estimation methodology used for the 2011 estimates and there have been relatively minor changes to that methodology for the 2012 estimates.

Dr. Jannot presented the results of analyses that addressed comments made by the SSC during its review of the halibut bycatch report in 2012. There was a relatively large decrease in the halibut total mortality estimate from 2010 to 2011 and, in its 2012 review, the SSC was concerned that some of that decrease could be due to the change in estimation methods. The analyses presented indicated that the decrease was largely due to a decrease in effort. The SSC appreciated the efforts made to address their previous concerns.

The SSC notes that there were differences between the WCGOP and Vessel Accounting System (VAS) estimates of total halibut mortality. However, both numbers were well below the quotas for 2011 and 2012. These differences may be a result of the WCGOP producing estimates by strata (across multiple vessels) while the VAS estimates are produced at the vessel level. Having two estimates, despite their similarity, could be problematic in certain situations. Based on the 2011 and 2012 estimates, both systems are producing similar estimates. If this continues, the need for the separate WCGOP estimates for the IBQ fishery should be assessed.

Dr. Jannot indicated that for the 2013 analysis, estimates for the pink shrimp fishery would be stratified by state and further investigations of the catch threshold stratification would be conducted. The SSC supports both these future analyses.

The SSC considers the bycatch estimates presented for halibut as the best scientific information available and recommends their use for 2014 management. Unless there are significant changes in the estimation methodology, the SSC does not see a need to review these estimates on an annual basis.

The SSC would like to see annual comparisons of halibut and groundfish catch rates rather than just halibut mortality totals as this could indicate whether annual changes in estimated halibut mortality are due to changes in halibut abundance or changes in groundfish catches.

G. Groundfish Management

3. Approve Stock Assessments

The Scientific and Statistical Committee (SSC) reviewed the six assessments which were reviewed at Stock Assessment Review (STAR) panels this summer, along with reports from those STAR panels. In addition, the SSC discussed the Council's request for further work on the China, brown and copper rockfish data-moderate assessments.

Aurora Rockfish

The first full assessment of aurora rockfish was conducted in 2013. The assessment estimates that the spawning stock biomass of aurora rockfish at the start of 2013 was 1673 metric tons and was depleted to 64% of its unfished level. There is little chance that the stock's spawning biomass has ever been below the Council's target level (40% of unfished). Natural mortality was used as the axis of uncertainty to bracket the states of nature in the decision table.

The SSC notes that the assessment results were very sensitive to the assumed value of natural mortality, and unresolved areas of uncertainty included: 1) an unusual pattern in the estimated recruitment deviations, and 2) unexpectedly strong dome-shaped survey selectivity, while fishery selectivity was asymptotic.

The SSC endorses the use of the 2013 aurora rockfish assessment as the best scientific information available for status determination and management in the Council process. The SSC recommends that aurora rockfish should be treated as a category 1 stock because the assessment is based on a fully developed age-structured model. The SSC recommends using the sigma value of 0.39 for aurora rockfish, and that the next stock assessment should be a full stock assessment to more fully explore model structure and data issues (e.g., the likely availability of more age composition data).

Rougheye and Blackspotted Rockfish

Rougheye rockfish and blackspotted rockfish are two closely related species of slope rockfish, which have only recently been recognized as separate species. The assessment treats them as a single complex of species (hereafter referred to as rougheye rockfish) because most data sets available for stock assessment do not distinguish between them. This is the first full assessment of rougheye rockfish. Overfishing limit (OFL) estimates for rougheye rockfish were previously obtained using catch-only methods (depletion based stock reduction analysis (DB-SRA)).

Assessment results indicate that the west coast stock is currently at 47 percent of the unexploited level, and therefore remains above the B_{MSY} proxy of $B_{40\%}$. Harvest rates of rougheye rockfish have been close to or above the F_{MSY} proxy of $F_{50\%}$ for rockfish since the mid-1980s, including four of the last 10 years, suggesting that harvest of rougheye rockfish needs to be more closely monitored in the future.

Major uncertainties in the rougheye rockfish assessment include possible differences in the life histories and abundance trends of two species in the complex, uncertainty in natural mortality, and sensitivity in model results to alternative methods of weighting composition data. Natural mortality

was used to bracket uncertainty in the states of nature in the decision table. The SSC notes that a small error was found in the decision table and that the corrected version will be included in the final document.

The SSC endorses the use of the 2013 rougheye rockfish assessment as the best scientific information available for status determination and management in the Council process. The SSC recommends that rougheye rockfish be treated as a category 1 stock because the assessment is based on a fully developed age-structured model. The SSC recommends that the next assessment be a full assessment, with the expectation that progress can be made in addressing major assessment uncertainties, such as determining the biology and distribution of rougheye rockfish and blackspotted rockfish individually, and increasing the amount of age data available for the assessment.

Shortspine Thornyhead

The previous full assessment of shortspine thornyhead was conducted in 2005. The 2005 assessment estimated the stock to be above the management threshold of $B_{40\%}$ and that overfishing had never occurred. The new assessment estimates the stock depletion (B_{2013}/B_0) to be 74% with overfishing never having occurred. The equilibrium recruitment parameter (R_0) was used to bracket uncertainty in the states of nature.

The SSC notes that 1) important fishery data (historical catches and discards) and key population vital rates (maturity, age and growth) are highly uncertain, 2) the surveys did not cover the entire depth distributions of the species, 3) key parameters (e.g., M and h) are fixed, and 4) models are sensitive to small changes in assumptions.

The SSC endorses the use of 2013 shortspine thornyhead assessment as the best scientific information available for status determination and management in the Council process. The SSC recommends that shortspine thornyhead be treated as a category 2 stock because of the lack of age data and inability to discern year class strength. The SSC recommends exploring data-moderate approaches before scheduling the next assessment.

Longspine Thornyhead

The previous full assessment of longspine thornyhead was conducted in 2005. The 2005 assessment estimated the stock to be above the management threshold of $B_{40\%}$ and that overfishing had never occurred. The new assessment estimates the stock depletion (B_{2013}/B_0) to be 75% with overfishing never having occurred. The equilibrium recruitment parameter (R_0) was used to bracket uncertainty in the states of nature.

The SSC notes that 1) important fishery data (historical catches and discards) and key population vital rates (maturity, age and growth) are highly uncertain, 2) the surveys did not cover the entire depth distributions of the species, 3) key parameters (e.g., M and h) are fixed, and 4) models are sensitive to small changes in assumptions.

The SSC endorses the use of 2013 longspine thornyhead assessment as the best scientific information available for status determination and management in the Council process. The SSC

recommends that longspine thornyhead be treated as a category 2 stock because of the lack of age data and inability to discern year class strength. The SSC recommends exploring data-moderate approaches before scheduling the next assessment.

Cowcod

Full assessments of cowcod south of Point Conception were conducted during 1999, 2005, and 2007, with the latter two assessments based on the Stock Synthesis framework. The 2009 assessment was an update to the 2007 assessment, which included revised historical recreational catch data for California, along with updated indexes. The 2013 full assessment for cowcod was based on Extended Depletion-Based Stock Reduction Analysis (XDB-SRA), unlike the earlier assessments. The 2007 and 2009 assessments used Stock Synthesis but did not include age and length data, so were similar to an XDB-SRA assessment. The 2013 assessment included data from five indices, but excluded the commercial passenger fishing vessel (CPFV) index which had been used in previous assessments. This index had suggested a more depleted stock and was excluded because of difficulties identifying effort directed towards cowcod.

The stock is estimated to be 34 percent of its unfished level at the start of 2013. However, the estimate of depletion is highly uncertain (95% credibility interval from 15 to 66 percent of the unfished level). All of the indices used in the assessment are sources of considerable uncertainty, particularly due to the spatial distribution of survey effort, the age classes sampled, and/or the high unexplained variance between the model predictions and the data. However, all indices are showing qualitatively similar increasing trends. The lack of survey information from the core area in which cowcod are located remains a key source of uncertainty.

The SSC endorses the use of the 2013 cowcod assessment as the best scientific information available for status determination and management in the Council process. The SSC recommends that cowcod be treated as a category 2 stock because the assessment is based on a data-moderate method of stock assessment. A rebuilding analysis needs to be conducted for this stock, which will be reviewed by the SSC Groundfish Subcommittee before the November Council meeting. The SSC recommends that the next assessment of cowcod be a full assessment, and ideally that the stock be assessed once an index of abundance from the remotely operated vehicle (ROV) survey of cowcod habitat in the Southern California Bight becomes available and has been reviewed. Finally, the SSC recommends that the decision not to conduct extractive surveys in the Cowcod Conservation Areas (CCAs) should be re-evaluated given the need for reliable indices of abundance for cowcod. The hook and line survey, in particular, could be conducted within the CCAs with minimal mortality impacts through the use of descending devices.

Pacific Sanddab

The first full assessment for Pacific sanddabs was conducted in 2013. Management advice for Pacific sanddabs has previously been based on application of DB-SRA.

The base model from the 2013 stock assessment predicts that the spawning biomass was 96 percent of the unfished level at the start of 2013, well above the target biomass for flatfish stocks of 25 percent. However, there are major inconsistencies between the estimates of biomass from the triennial and NWFSC surveys and the estimates of biomass from the assessment, with the

assessment inferring that catchability for the surveys is substantially larger than 1 (>19 for the NWFSC survey), which the Stock Assessment Team (STAT) and STAR panel agreed was implausible.

The SSC recommends that this assessment not be used for deciding harvest specifications. However, the information included in the assessment document is sufficient to conclude that the stock is well above the B_{MSY} proxy of 25 percent of the unfished level. Pacific sanddab should remain as a category 3 stock and the OFL be based on DB-SRA. The SSC notes that Pacific sanddab should not be a high priority for a future full assessment given the magnitude of the catch relative to survey estimates of abundance. Pacific sanddab could be considered for data-moderate assessment the next time it is assessed.

Reconsideration of data-moderate assessments for nearshore rockfish species

The SSC met with the Groundfish Management Team (GMT) to discuss the Council's request that the data-moderate assessments for three nearshore species be re-considered at a mop-up STAR Panel meeting prior to the November Council meeting (Council's June Decision Summary Document). Specifically the Council requested consideration of area stratification north and south of 42º N latitude for the data-moderate stock assessments for brown rockfish, copper rockfish, and China rockfish. Dr. E.J. Dick (SWFSC, Data-Moderate STAT member) and John DeVore were available to answer questions and contribute to the discussions.

Brown rockfish

The SSC notes that the data-moderate STAR Panel explored XDB-SRA assessment models for brown rockfish in the southern and central regions (split at Point Conception) but reverted to a combined region model because conflicting trends in the catch per unit effort (CPUE) indices produced implausible results. No model was attempted for the portion of the population north of Cape Mendocino (40º10' N latitude) because no CPUE index could be derived. Only about 1% of the coastwide landings of brown rockfish are taken north of Cape Mendocino. It is not feasible to conduct an XDB-SRA assessment for brown rockfish north of 42º N latitude.

Copper rockfish

The lack of survey or CPUE data for copper rockfish also restricts the ability to apply data-moderate assessment methods for copper rockfish north of 42º N latitude. The region north of Cape Mendocino accounts for only about 4% of the landings of copper rockfish. It is not feasible to conduct an XDB-SRA assessment for copper rockfish north of 42º N latitude.

China rockfish

China rockfish is the only of these three nearshore species for which an appreciable proportion of the landed catch is taken north of 42º N latitude. Further, a CPUE abundance index was developed for the XDB-SRA assessment for the portion of the population north of Cape Mendocino at 40º10' N latitude. However, developing a CPUE index that corresponds only to the region north of 42º N latitude is not feasible to accomplish in the near-term. The SSC recommends 1) that an XDB-SRA assessment for the portion of the population north of 42º N latitude be conducted using the existing northern CPUE abundance index, applied to catch data series restricted to north of 42º N latitude

and 2) that a separate XDB-SRA assessment for the portion of the population south of 42º N latitude be conducted using the existing southern CPUE abundance index, applied to catch data series restricted to south of 42º N latitude. The SSC's expectation is that the net result of these new assessments will be to move some of the biomass from the northern portion to the southern portion of the population.

The SSC notes that results from a set of assessments structured with a north-south boundary at 42º N latitude will require further analysis to develop OFL values corresponding to the management boundary at 40º10' N latitude.

Update of Oregon recreational catch data

The recreational catch data series used in the assessments reviewed by the Data-Moderate STAR Panel were taken directly from the Recreational Fisheries Information Network (RecFIN) database. The Oregon data in RecFIN prior to 1993 were based on catch rates (fish per angler day) obtained from angler interviews conducted by the Marine Recreational Fisheries Statistics Survey (MRFSS) and then expanded by MRFSS estimates of angler-days derived from telephone interviews. The Oregon Recreational Boat Survey (ORBS) provides more accurate estimates of recreational landings of groundfish species. The SSC recommends that the additional XDB-SRA analyses of the China rockfish (described above) be conducted using the historic (pre-1993) estimates of China rockfish landings from the ORBS program rather than the MRFSS estimates. Also, the current XDB-SRA assessment for China rockfish North of Cape Mendocino should be redone using the revised Oregon landings data.

The SSC anticipates that revisions to the Oregon catch series for copper and brown rockfish will be so small as to have inconsequential effects on the existing XDB-SRA coastwide assessment for brown rockfish and the existing XDB-SRA assessment for copper rockfish north of Point Conception. The SSC will confirm this at its November meeting.

Summary

The process for revising the data-moderate assessment for China rockfish will result in three new assessments: 1) for the population north of 40º10' N latitude; 2) for the population north of 42º N latitude; and 3) for the population south of 42º N latitude, the first two of which will be affected by the revised Oregon catch data series. The existing assessment for the population south of 40º10' N latitude is unaffected by the revised Oregon catch data (and does not involve a boundary change). The SSC will review the results of these assessments and provide recommendations to the Council regarding China rockfish at the November meeting.

SSC notes:
1. The SSC was unsure why the retrospective analysis which excluded the data after 1999 led to a median trajectory of biomass which was very similar to that for the base-case. It is likely that the trajectory of biomass is very uncertain, but this may also be a case where the prior for 2000 depletion is playing a large role given the lack of data which show an increasing trend in abundance if data after 1999 are excluded from the assessment. The depletion prior does not impact the results for the base model, as shown by sensitivity tests in which the informative prior for depletion was replaced by a uniform prior.

2. The calculation of the OFL should be based on the exploitation rate corresponding to $B_{40\%}$.

3. The next assessment should more thoroughly provide a "bridging" between the previous and current base model.

4. The OFL for cowcod off northern California should be based on applying DB-SRA, but assuming priors for the parameters of the population model from the base model for cowcod south of Point Conception.

E. Salmon Management

1. 2013 Salmon Methodology Review

At its April meeting, the Council identified the following five priority items that the Scientific and Statistical Committee (SSC) should consider for the 2013 Salmon Methodology Review.

1. Review performance of and develop alternatives to the Yaquina River marine survival rate index used in 2013 for the Oregon coastal natural (OCN) coho matrix control rule.

2. Evaluate alternative forecast methodologies for the Sacramento fall Chinook index.

3. Develop Conservation Objectives, Annual Catch Limits, and Status Determination Criteria for Willapa Bay coho.]

4. Develop Lower Columbia natural (LCN) coho matrix control rules.

5. Develop Conservation Objectives for Southern Oregon coastal Chinook.

Reports on all five of these items are expected to be available for review at the Salmon Methodology Review meeting scheduled for October.

In addition, the Model Evaluation Workgroup (MEW) identified five potential analyses and products:

6. Evaluate bias in coho mark rates in preseason forecasts and postseason estimates in mark-selective coho fisheries north of Cape Falcon.

7. Incorporate observed encounter rates of sub-legal Chinook into the Fishery Regulation Assessment Model (FRAM) for fisheries outside of Puget Sound.

8. Review the user's manual for the Visual Studio version of FRAM.

9. Develop improved base period estimates of legal and sub-legal Chinook encounter rates by incorporating more recent information from coded-wire tag and genetic sampling into Chinook FRAM.

10. Explore incorporating the coho FRAM bias-correction methods for mark-selective fisheries into Chinook FRAM.

The MEW has concentrated its efforts on improved modeling of Chinook age structure and sub-legal encounters. Items they will have ready for review in October include:

1) Development of a standardized methodology for calculating Age 2 Chinook forecasts based upon the stock specific Age 3 forecast. (related to preliminary item 9).

2) Incorporate estimates of legal and sub-legal Chinook fishery encounters from recent sampling information into FRAM's base period type data. (addresses, but does not complete, preliminary items 7 and 9).

3) Present a progress report on the development of a new Chinook FRAM base period incorporating recent year CWT recovery data, encounter rates, etc., and modifications to FRAM algorithms on assessing sublegal and legal encounters and changes in minimum size limits. (Preliminary item 9).

The SSC looks forward to reviewing reports on these topics at the November meeting. The SSC Salmon Subcommittee and Salmon Technical Team (STT) will hold a joint meeting on October 1 - 3 in Portland to review these issues. As always, the SSC requires good documentation and ample review time to make efficient use of the SSC Salmon Subcommittee's time. Materials to be reviewed should be submitted at least two weeks prior to the scheduled review. Agencies should be responsible for ensuring that materials submitted to the SSC are technically sound, comprehensive, clearly documented, and identified by author.

2. Fishery Management Plan Amendment 18 – Update of Essential Fish Habitat (EFH) for Salmon

Mr. Kerry Griffin presented a detailed review of the alternatives under consideration for essential fish habitat (EFH) in Amendment 18 to the Pacific Coast Salmon Plan (Agenda Item E.2.a Attachment 3). Alternatives are organized under thirteen subject areas. The organizational structure and the alternatives were clearly laid out. The Scientific and Statistical Committee (SSC) had previously reviewed many of these alternatives at the September 2012 Council meeting. The SSC has comments on the following specific alternatives, which are labeled as in the document:

Freshwater EFH

Chinook:

- The SSC supports adoption of Alternatives 2B, 2C, and 2D.

Coho:

- The SSC supports adoption of Alternatives 3B and 3C, but with the Pajaro HU (18060002) removed from the list of HUs added to coho EFH in 3B.

Pink:

- The SSC supports adoption of Alternative 4B.

Impassible Barriers

- The SSC supports adoption of Alternative 6B.
- Depending on the disposition of Alternative 5, the SSC supports adoption of alternative 6C (to accompany 5A) or 6D (to accompany 5B).

EFH Descriptions

- The SSC supports adoption of Alternative 8B.

Habitat Areas of Particular Concern (HAPCs)

- The SSC supports adopting the five HAPCs defined in Alternatives 9B – 9F.
- The SSC highlights the particular importance of Alternative 9E: estuaries and estuary-influenced offshore areas. These are utilized by multiple species and support a variety of ecosystem functions.

Fishing Activities

- The SSC supports adoption of Alternatives 10B and 10C.

Non-fishing Activities

- The SSC supports adoption of Alternative 11B. Dam removal should be added to the discussion of dam construction/operation in Appendix A (4.2.2.9).
- The SSC supports adoption of Alternatives 11C1 through 11C10.

Information and Research Needs

- Several data issues constrained the designation of EFH in this document. Research on these topics should be included in the data needs. Examples include: ocean distributions of Puget Sound pink salmon populations, the role of fishing activities in reducing prey availability, and ocean habitat associations.

Procedures for Changing EFH

- The SSC supports alternative 13B.

4. Science Improvements for the Next Groundfish Management Cycle

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 extremely 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 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, or 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 to refine 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.

H. Council Administrative Matters

1. Managing Our Nation's Fisheries 3 (MONF3) Conference Follow-ups and Unrelated Legislative Matters

The SSC discussed the findings of Managing Our Nation's Fisheries 3 (MONF3). The discussion focused largely on issues identified by Pacific Council staff as Council priorities (Attachment 2). SSC comments regarding the scientific merit of some of these issues are as follows.

MONF3 Session 1

- Revise rebuilding time requirements: The SSC agrees that this change to determining maximum rebuilding time will reduce the impact of uncertainty in projections and also make rebuilding time decisions depend solely on the biology of the stock
- Do not hold stocks mistakenly determined overfished to rebuilding provisions: The SSC supports this recommendation.

- Transboundary stock rebuilding exception: This is a reasonable provision that should be accompanied by a clear definition of what constitutes a "transboundary stock."
- Clarify Congressional intent regarding needs of fishing communities: It is not clear what type of clarification is needed from Congress. If clarification is needed regarding what constitutes needs of fishing communities, such details may be better addressed via guidelines rather than by legislative fiat. Such guidelines could encourage national consistency regarding how community needs are considered in rebuilding decisions, as well as provide some regional flexibility in how those needs are defined.
- Extend annual species exemption to short-lived species: This is a reasonable provision that should be accompanied by a clear definition of what constitutes a "short-lived species."
- Carryover exception: A carryover exception of this type would increase management flexibility and provide additional harvest opportunity at little biological cost.
- Use of adaptive management for data-poor species: "Adaptive management" is an operationally nebulous term. A clear definition of adaptive management and how it would be applied in this particular context is required for this provision to be considered for inclusion in the Act.

MONF3 Session 2

- Address rebuilding requirements when environmental conditions may be predominant factor in stock's decline: Distinguishing the effects of environmental versus other factors on a stock's decline can be difficult.
- Link ecosystem-based management scales to fisheries management and governance: The implementation of this would require definition of EBM scales that is currently unavailable and would require substantial research to operationalize.
- Establish national standard for adequate forage base: Determining what constitutes an "adequate forage base" would require considerable resources and time for data collection, modeling, and regulatory implementation. Any incorporation of forage base considerations in the Act should be incremental.
- Consider impact of forage fish to ecosystem and fishing communities: Considering impacts of forage fish would require considerable time and scientific and regulatory resources. The Council is already examining some of these issues for Pacific Sardine. Forage fish impacts (like adequate forage base) should be considered in the Act in terms of incremental progress toward achievable objectives.

MONF3 Session 3

- Expand cooperative research: There are many cooperative research programs on the west coast; the SSC sees the benefits of such research. However, given that cooperative research is already mandated in Section 318 of the Act, it is not clear why expanding the program would require a change to the Act. It is important that cooperative research not be mandated in a way that compromises existing comprehensive, standardized data collections that are being used for assessment and management.
- Expand public reporting of some currently confidential data: Public reporting would enable analysis by a wider community of scientists

MONF4 Session 4

- Replace term "overfished" with "depleted": "Depleted" is a more accurate and comprehensive term than "overfished," as not all incidents of depletion are due to overharvest.

G. Groundfish Management, continued

7. Initial Actions for Setting 2015-2016 Groundfish Fisheries

The Scientific and Statistical Committee (SSC) reviewed and discussed a number of topics relating to Agenda Item G.7 "Initial Actions for Setting 2015-2016 Groundfish Fisheries", including 1) the proposed 2015-16 overfishing limits (OFLs), stock categories, and sigma values for stocks and stock complexes (Agenda Item G.7.a, Attachment 1), 2) a new proxy F_{MSY} spawning potential ratio for elasmobranchs (Agenda Item G.7.b, SSC Groundfish Subcommittee Statement Regarding a Change in Target SPR Rate for West Coast Elasmobranch Species), 3) Dr. André Punt's briefing paper on Management Strategy Evaluation for Rebuilding Revision Rules: A Proof of Concept (Agenda Item G.7.a, Attachment 2), and 4) the GMT's response to the SSC Economics Subcommittee report on data and models to be used in the socioeconomic analysis for the 2015-16 groundfish biennial specifications process (Agenda Item G.7.b, Supplemental GMT Report). Mr. John DeVore was available to answer questions and contributed to the discussions.

2015-16 Overfishing Limits, Stock Categories, and Sigma Values

The SSC reviewed the draft table of OFLs for 2015-16 and with the assistance of Mr. John DeVore developed a revised table (attached) that includes changes to some of the OFL values (e.g., the revised OFL for bocaccio rockfish is from the 2013 assessment rather than the 2011 rebuilding analysis), category assignments (e.g., longspine and shortspine thornyhead are now category 2 stocks) and corrections to some subcategory designations. Information was unavailable for several stocks pending further analyses (e.g., a rebuilding analysis for cowcod and revised data-moderate assessment results for China rockfish). The information for the Other Fish stock complex will be completed following the Council's decision on restructuring this stock complex. The table shows "NA" values for canary rockfish pending a review of the 2011 rebuilding analysis, which may have had a mis-specification. With regard to buffers for scientific uncertainty, the SSC recommends calculating values for the percentage reductions in OFLs based on the information presented in Table 3 of Agenda Item G.7.a, Attachment 1, but notes that the column of values for shortspine thornyhead does not apply because the SSC has determined that this stock should be treated as a category 2 stock.

The SSC notes that several of the stocks listed in the OFL table are from assessments that are now rather dated (e.g., gopher rockfish was last assessed in 2005). Because catch projections become increasingly uncertain as the length of the projection period increases, the buffer for scientific uncertainty should also increase. During the coming year the SSC will consider different approaches for revising OFL buffers for increasing scientific uncertainty through time, which will affect harvest specifications for 2017 and beyond.

The SSC recommends the OFL values and category designations indicated in the attached table. Values that are unavailable (NA) will be provided in a revised table at the November Council meeting.

Proxy F_{MSY} Spawning Potential Ratio for Elasmobranchs

The SSC reviewed the Groundfish Subcommittee's report on a new proxy F_{MSY} spawning potential ratio for elasmobranchs and received a presentation from Dr. Martin Dorn, who conducted the analysis that informed the Subcommittee report. The SSC concurs with the Subcommittee's

recommendation that the Council adopt $F_{SPR50\%}$ as the default proxy fishing mortality rate for elasmobranch species managed by the Council. However, to inform management decisions for 2017 and beyond the SSC may recommend further revision to the default SPR for elasmobranchs based on an analysis of the maximum rate of population increase implied by the number of pups per female, which is constraining in elasmobranch species compared to rockfish or other species that produce large numbers of offspring per female.

The SSC was not presented with any information to justify changing the B_{MSY} proxy from $B_{40\%}$, the current proxy.

Management Strategy Evaluation for Rebuilding Revision Rules

The SSC received a presentation from Dr. André Punt on the software that he has developed for conducting a management strategy evaluation of possible rules for revising rebuilding plans (e.g., whether, when, and by how much to change the target SPR). The software is designed to measure how different revision rules for rebuilding plans are impacted by uncertainty in assessments and other sources of noise, and influence relative performance in terms of catch, variability in catch, and the frequency of false declarations that a stock has rebuilt. This tool will provide useful guidance to the Council, but designing an appropriate set of simulation runs will require consultation with Council staff and advisory bodies, and careful planning of a simulation experiment to evaluate a limited set of revision rules. The SSC notes that the Council currently has only one stock (cowcod) for which a new rebuilding analysis will be conducted. The SSC recommends that the process for developing revision rules for rebuilding plans be separated from the development of Amendment 24 and the 2015-16 biennial management specification process. Dr. Punt will collaborate with the GMT to further develop the analysis and will provide a summary to the Council in November.

GMT response to the SSC Economics Subcommittee report

In 2012-2013, the SSC Economics and Groundfish Subcommittees reviewed data and models used in the socioeconomic analysis for the groundfish specifications process. The report by the Groundfish Management Team (Agenda Item G.7, GMT Report) discusses how the GMT intends to incorporate some of the SSC recommendations into the 2015-16 specifications analysis, and also notes other issues raised by SSC that would require longer-term work and consultation with the SSC and various staff at NMFS and state agencies. The SSC recommends a 1-2 day meeting of the GMT and the SSC Economics Subcommittee in 2014 to address some of these longer-term issues. Priority issues to be addressed at the meeting and the materials to be prepared in advance of the meeting would be identified in consultation with the GMT.

Table 1. 2014 OFLs (mt) and SSC-recommended 2015 and 2016 OFLs (mt) for west coast groundfish stocks (overfished stocks in CAPS; stocks with new assessments in **bold**; component stocks in status quo stock complexes in *italics*).

Stock	2014 OFL	Category	2015 OFL	2016 OFL
OVERFISHED STOCKS				
BOCACCIO S. of 40°10' N. latitude	**881**	**1**	**1,444**	**1,351**
CANARY	741	1	NA	NA
COWCOD S. of 40°10' N. latitude	12		**NA**	**NA**
COWCOD (Conception)	**7**	**2**	***NA***	***NA***
COWCOD (Monterey)	5	3	***NA***	***NA***
DARKBLOTCHED	**553**	**1**	**588**	**595**
PACIFIC OCEAN PERCH	838	1	842	850
PETRALE SOLE	**2,774**	**1**	**2,946**	**3,044**
YELLOWEYE	51	2	52	52
NON-OVERFISHED STOCKS				
Arrowtooth Flounder	6,912	2	6,599	6,396
Black Rockfish (OR-CA)	1,166	1	1,176	1,183
Black Rockfish (WA)	428	1	421	423
Cabezon (CA)	165	1	161	158
Cabezon (OR)	49	1	49	49
California scorpionfish	122	1	119	117
Chilipepper S. of 40°10' N. latitude	1,722	1	1,703	1,694
Dover Sole	77,774	1	66,871	59,221
English Sole	**5,906**	**2**	**12,092**	**8,493**
Lingcod N. of 40°10' N. latitude	3,162	1	3,010	2,891
Lingcod S. of 40°10' N. latitude	1,276	2	1,205	1,136
Longnose skate	2,816	1	2,449	2,405
Longspine Thornyhead (coastwide)	**3,304**	**2**	**5,007**	**4,763**
Pacific Cod	3,200	3	3,200	3,200
Sablefish (coastwide)	7,158	1	7,857	8,526
Shortbelly	6,950	2	6,950	6,950
Shortspine Thornyhead (coastwide)	**2,310**	**2**	**3,203**	**3,169**
Splitnose S. of 40°10' N. latitude	1,747	1	1,794	1,826
Starry Flounder	1,834	2	1,841	1,847
Widow	4,435	1	4,137	3,990
Yellowtail N. of 40°10' N. latitude	**4,584**	**2**	**12,281**	**11,647**
STOCK COMPLEXES				
Minor Nearshore Rockfish North	110		NA	NA
Black and yellow	*0.01*	3	*0.01*	*0.01*
Blue (CA)	*27.4*	2	*27.4*	*27.7*
Blue (OR & WA)	*32.3*	3	*32.3*	*32.3*
Brown	***5.5***	**2**	***NA***	***NA***
Calico	-	3	-	-
China	***9.8***	**2**	***NA***	***NA***
Copper	***26.0***	**2**	***NA***	***NA***
Gopher	-	3	-	-
Grass	*0.7*	3	*0.7*	*0.7*
Kelp	*0.01*	3	*0.01*	*0.01*
Olive	*0.3*	3	*0.3*	*0.3*
Quillback	*7.4*	3	*7.4*	*7.4*
Treefish	*0.2*	3	*0.2*	*0.2*
Minor Shelf Rockfish North	2,195		2,207	2,217
Bronzespotted	-	3	-	-

Stock	2014 OFL	Category	2015 OFL	2016 OFL
Bocaccio	*284.0*	3	*284.0*	*284.0*
Chameleon	-	3	-	-
Chilipepper	*129.6*	3	*128.2*	*127.5*
Cowcod	-	3	-	-
Flag	*0.1*	3	*0.1*	*0.1*
Freckled	-	3	-	-
Greenblotched	*1.3*	3	*1.3*	*1.3*
Greenspotted 40°10' to 42° N. latitude	*9.4*	2	*9.3*	*9.3*
Greenspotted N. of 42 N. latitude (OR & WA)	*6.1*	3	*6.1*	*6.1*
Greenstriped	*1,268.3*	2	*1,281.9*	*1,292.0*
Halfbanded	-	3	-	-
Harlequin	-	3	-	-
Honeycomb	-	3	-	-
Mexican	-	3	-	-
Pink	*0.004*	3	*0.004*	*0.004*
Pinkrose	-	3	-	-
Puget Sound	-	3	-	-
Pygmy	-	3	-	-
Redstripe	*269.9*	3	*269.9*	*269.9*
Rosethorn	*12.9*	3	*12.9*	*12.9*
Rosy	*3.0*	3	*3.0*	*3.0*
Silvergray	*159.4*	3	*159.4*	*159.4*
Speckled	*0.2*	3	*0.2*	*0.2*
Squarespot	*0.2*	3	*0.2*	*0.2*
Starry	*0.004*	3	*0.004*	*0.004*
Stripetail	***40.4***	**3**	***40.4***	***40.4***
Swordspine	*0.0001*	3	*0.0001*	*0.0001*
Tiger	*1.0*	3	*1.0*	*1.0*
Vermilion	*9.7*	3	*9.7*	*9.7*
Minor Slope Rockfish North	1,553		1,804	1,817
Aurora	***15.4***	**1**	***17.4***	***17.5***
Bank	*17.2*	3	*17.2*	*17.2*
Blackgill	*4.7*	3	*4.7*	*4.7*
Redbanded	*45.3*	3	*45.3*	*45.3*
Rougheye	***71.1***	**1**	***201.9***	***205.8***
Sharpchin	***214.5***	**2**	***305.6***	***297.6***
Shortraker	*18.7*	3	*18.7*	*18.7*
Splitnose	*974.1*	1	*1,000.6*	*1,018.2*
Yellowmouth	*192.4*	3	*192.4*	*192.4*
Minor Nearshore Rockfish South	1,160		NA	NA
Shallow Nearshore Species	NA	NA	NA	NA
Black and yellow	*27.5*	3	*27.5*	*27.5*
China	***16.6***	**2**	***NA***	***NA***
Gopher (N of Pt. Conception)	*153.0*	1	*148.0*	*144.0*
Gopher (S of Pt. Conception)	*25.6*	3	*25.6*	*25.6*
Grass	*59.6*	3	*59.6*	*59.6*
Kelp	*27.7*	3	*27.7*	*27.7*
Deeper Nearshore Species	NA	NA	NA	NA
Blue (assessed area)	*187.8*	2	*188.6*	*190.3*
Blue (S of 34°27' N. latitude)	*72.9*	3	*72.9*	*72.9*
Brown	***204.6***	**2**	***NA***	***NA***
Calico	-	3	-	-
Copper	***141.5***	**2**	***NA***	***NA***

Stock	2014 OFL	Category	2015 OFL	2016 OFL
Olive	*224.6*	3	*224.6*	*224.6*
Quillback	*5.4*	3	*5.4*	*5.4*
Treefish	*13.2*	3	*13.2*	*13.2*
Minor Shelf Rockfish South	1,912.9		1,914.1	1,915.4
Bronzespotted	*3.6*	3	*3.6*	*3.6*
Chameleon	-	3	-	-
Flag	*23.4*	3	*23.4*	*23.4*
Freckled	-	3	-	-
Greenblotched	*23.1*	3	*23.1*	*23.1*
Greenspotted	*80.3*	2	*79.0*	*78.4*
Greenstriped	*232.7*	2	*235.1*	*237.0*
Halfbanded	-	3	-	-
Harlequin	-	3	-	-
Honeycomb	*9.9*	3	*9.9*	*9.9*
Mexican	*5.1*	3	*5.1*	*5.1*
Pink	*2.5*	3	*2.5*	*2.5*
Pinkrose	-	3	-	-
Pygmy	-	3	-	-
Redstripe	*0.5*	3	*0.5*	*0.5*
Rosethorn	*2.1*	3	*2.1*	*2.1*
Rosy	*44.5*	3	*44.5*	*44.5*
Silvergray	*0.5*	3	*0.5*	*0.5*
Speckled	*39.4*	3	*39.4*	*39.4*
Squarespot	*11.1*	3	*11.1*	*11.1*
Starry	*62.6*	3	*62.6*	*62.6*
Stripetail	***23.6***	**3**	***23.6***	***23.6***
Swordspine	*14.2*	3	*14.2*	*14.2*
Tiger	*0.04*	3	*0.04*	*0.04*
Vermilion	*269.3*	3	*269.3*	*269.3*
Yellowtail	*1,064.4*	3	*1,064.4*	*1,064.4*
Minor Slope Rockfish South	685		806	807
Aurora	***26.1***	**1**	***74.3***	***74.3***
Bank	*503.2*	3	*503.2*	*503.2*
Blackgill	*134.0*	2	*137.0*	*140.0*
Pacific ocean perch	-	3	-	-
Redbanded	*10.4*	3	*10.4*	*10.4*
Rougheye	***0.4***	**1**	***4.1***	***4.2***
Sharpchin	***9.8***	**2**	***76.4***	***74.4***
Shortraker	*0.1*	3	*0.1*	*0.1*
Yellowmouth	*0.8*	3	*0.8*	*0.8*
Other Flatfish	10,060		11,298	9,948
Butter sole	*4.6*	3	*4.6*	*4.6*
Curlfin sole	*8.2*	3	*8.2*	*8.2*
Flathead sole	*35.0*	3	*35.0*	*35.0*
Pacific sanddab	***4,801.0***	**3**	***4,801.0***	***4,801.0***
Rex sole	***4,371.5***	**2**	***5,609.0***	***4,259.0***
Rock sole	*66.7*	3	*66.7*	*66.7*
Sand sole	*773.2*	3	*773.2*	*773.2*
Other Fish a/	6,802	3	NA	NA
Big skate	*458.0*	3	*c/*	*c/*
Cabezon (WA)	*b/*	3	*b/*	*b/*
California skate	*86.0*	3	*c/*	*c/*
Finescale codling	*b/*	3	*b/*	*b/*

Stock	2014 OFL	Category	2015 OFL	2016 OFL
Kelp greenling (CA)	*118.9*	3	*c/*	*c/*
Kelp greenling (OR & WA)	*b/*	3	*b/*	*b/*
Leopard shark	*167.1*	3	*c/*	*c/*
Pacific grenadier	*1,519.0*	3	*c/*	*c/*
Ratfish	*1,441.0*	3	*c/*	*c/*
Soupfin shark	*61.6*	3	*c/*	*c/*
Spiny dogfish	*2,950.0*	2	*2,522.7*	*2,503.3*

a/ Values for these specifications are the sum of known contributions of component stocks.
b/ No OFL contribution for these stocks given the lack of an approved method.
c/ No OFL recommended pending decisions on restructuring this complex.

Table 2. The basis for SSC-recommended 2015 and 2016 OFLs for west coast groundfish stocks.

Stock	Comments
OVERFISHED STOCKS	
BOCACCIO S. of 40°10' N. latitude	**Projected using a 50% SPR from the 2013 update stock assessment with a 6% reduction to subtract the portion of the assessed stock north of 40°10' N. lat.**
CANARY	OFL projections not yet available pending a review of the 2011 rebuilding analysis, which may have had a mis-specification
COWCOD S. of 40°10' N. latitude	Sum of Conception and Monterey OFLs.
COWCOD (Conception)	**Projected using a 50% SPR from the 2013 stock assessment.**
COWCOD (Monterey)	Not yet available. Revised DB-SRA estimate.
DARKBLOTCHED	**Projected using a 50% SPR from the 2013 stock assessment**
PACIFIC OCEAN PERCH	Projected using a 50% SPR from the 2011 rebuilding analysis
PETRALE SOLE	**Projected using a 30% SPR from the 2013 stock assessment**
YELLOWEYE	Projected using a 50% SPR from the 2011 rebuilding analysis
NON-OVERFISHED STOCKS	
Arrowtooth Flounder	Projected using a 30% SPR from the 2007 full assessment.
Black Rockfish (OR-CA)	Projected using a 50% SPR from the 2007 full assessment with the addition of 3% of the northern OFL to account for the portion of the stock estimated between Cape Falcon and the Columbia River.
Black Rockfish (WA)	Projected using a 50% SPR from the 2007 full assessment with a 3% reduction to account for the portion of the stock estimated between Cape Falcon and the Columbia River.
Cabezon (CA)	Projected using a 45% SPR from the 2009 full assessment.
Cabezon (OR)	Projected using a 45% SPR from the 2009 full assessment.
California scorpionfish	Projected using a 45% SPR from the 2005 full assessment.
Chilipepper S. of 40°10' N. latitude	Projected using a 50% SPR from the 2007 full assessment. The portion of the coastwide stock south of 40°10' N. lat. (93%) is based on average historical landings.
Dover Sole	Projected using a 30% SPR from the 2011 full assessment.
English Sole	**Projected using a 30% SPR from the 2013 data-moderate assessment.**
Lingcod N. of 40°10' N. latitude	Projected using a 45% SPR from the 2009 full assessment with 48% of the OFL S. of 42° N. latitude added to account for line shift.
Lingcod S. of 40°10' N. latitude	Projected using a 45% SPR from the 2009 full assessment with 48% of the OFL S. of 42° N. latitude subtracted to account for line shift.
Longnose skate	Projected using a 50% SPR from the 2007 full assessment. 2015 and 2016 OFLs projected using the status quo 45% SPR rate are 2,745 and 2,686 mt, respectively.
Longspine Thornyhead (coastwide)	**Projected using a 50% SPR from the 2013 full assessment.**
Pacific Cod	Status quo OFL.
Sablefish (coastwide)	Projected using a 45% SPR from the 2011 full assessment.
Shortbelly	MSY estimated from 2007 assessment.
Shortspine Thornyhead (coastwide)	**Projected using a 50% SPR from the 2013 full assessment.**
Splitnose S. of 40°10' N. latitude	Projected using a 50% SPR from the 2009 full assessment. The portion of the coastwide stock south of 40°10' N. lat. (64.2%) is based on average historical (1916-2008) landings.

Stock	Comments
Starry Flounder	Projected using a 30% SPR from the 2005 full assessment.
Widow	Projected using a 50% SPR from the 2011 full assessment.
Yellowtail N. of 40^{0}10' N. latitude	**Projected using a 50% SPR from the 2013 data-moderate assessment.**
STOCK COMPLEXES	
Minor Nearshore Rockfish North	Sum of OFL contributions of component stocks in the complex.
Black and yellow	*DB-SRA estimate.*
Blue (CA)	*Projected using a 50% SPR from the 2007 full assessment. The portion of the assessed stock in CA north of 40°10' N. lat. (12.7%) is based on average historical landings.*
Blue (OR & WA)	*DCAC estimate.*
Brown	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Calico	*No harvest contribution (3a stock). Max. landings <2 mt, 1928-2008; mainly a discard species*
China	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Copper	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Gopher	*No harvest contribution (3a stock).*
Grass	*DB-SRA estimate.*
Kelp	*DB-SRA estimate.*
Olive	*DB-SRA estimate.*
Quillback	*DB-SRA estimate.*
Treefish	*DB-SRA estimate.*
Minor Shelf Rockfish North	Sum of OFL contributions of component stocks in the complex.
Bronzespotted	*No harvest contribution in the north (3a stock)*
Bocaccio	*DB-SRA estimate.*
Chameleon	*No harvest contribution (3a stock).*
Chilipepper	*Projected using a 50% SPR from the 2007 full assessment. The portion of the coastwide stock north of 40°10' N. lat. (7%) is based on average historical landings.*
Cowcod	*No harvest contribution (3a stock).*
Flag	*DB-SRA estimate.*
Freckled	*No harvest contribution (3a stock).*
Greenblotched	*DB-SRA estimate.*
Greenspotted 40°10' to 42° N. latitude	*Projection using a 50% SPR from the full 2011 assessment. The portion of the assessed area north of 40°10' N lat. (22.2% of OFL from northern California model) based on average historical catch.*
Greenspotted N. of 42 N. latitude (OR & WA)	*DCAC estimate*
Greenstriped	*Projected using a 50% SPR from the full 2009 assessment. The portion of the coastwide stock north of 40°10' N. lat. (84.5%) is based on the mean of the 2003-2008 swept area biomass estimates from the NMFS trawl survey.*
Halfbanded	*No harvest contribution (3a stock). Max. landings <2 mt, 1928-2008; mainly a discard species*
Harlequin	*DB-SRA estimate.*
Honeycomb	*No harvest contribution in the north (3a stock)*
Mexican	*No harvest contribution in the north (3a stock)*

Stock	Comments
Pink	*DB-SRA estimate.*
Pinkrose	*DB-SRA estimate.*
Puget Sound	*No harvest contribution (3a stock).*
Pygmy	*No harvest contribution (3a stock).*
Redstripe	*DB-SRA estimate.*
Rosethorn	*DB-SRA estimate.*
Rosy	*DB-SRA estimate.*
Silvergray	*DB-SRA estimate.*
Speckled	*DB-SRA estimate.*
Squarespot	*DB-SRA estimate.*
Starry	*DB-SRA estimate.*
Stripetail	***DB-SRA estimate. Only status determined from 2013 data-moderate assessment, so presumed to remain a cat. 3 stock.***
Swordspine	*DB-SRA estimate.*
Tiger	*DB-SRA estimate.*
Vermilion	*DB-SRA estimate.*
Minor Slope Rockfish North	Sum of OFL contributions of component stocks in the complex.
Aurora	***Projected using a 50% SPR from the 2013 full assessment. The portion of the coastwide stock north of 40°10' N lat. (19%) is based on average survey biomass.***
Bank	*DB-SRA estimate.*
Blackgill	*DCAC estimate.*
Redbanded	*DB-SRA estimate.*
Rougheye	***Projected using a 50% SPR from the 2013 full assessment. The coastwide OFLs are apportioned north (98%) and south (2%) based on average landings during 1985-2012.***
Sharpchin	***Coastwide OFLs projected using a 50% SPR from the 2013 data-moderate assessment. OFLs are apportioned north and south of 40°10' N lat. (80%N, 20%S) based on average swept area biomass estimates from the triennial survey.***
Shortraker	*DB-SRA estimate.*
Splitnose	*Projected using a 50% SPR from the 2009 full assessment. The portion of the coastwide stock north of 40°10' N. lat. (35.8%) is based on average historical (1916-2008) landings.*
Yellowmouth	*DB-SRA estimate.*
Minor Nearshore Rockfish South	Sum of OFL contributions of component stocks in the complex.
Shallow Nearshore Species	
Black and yellow	*DB-SRA estimate.*
China	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Gopher (N of Pt. Conception)	*Projected using a 50% SPR from the 2005 full assessment.*
Gopher (S of Pt. Conception)	*DCAC estimate.*
Grass	*DB-SRA estimate.*
Kelp	*DB-SRA estimate.*

Stock	Comments
Deeper Nearshore Species	
Blue (assessed area)	*Projected using a 50% SPR from the 2007 full assessment. The portion of the assessed stock in CA south of 40°10' N. lat. (87.3%) is based on average historical landings.*
Blue (S of 34°27' N. latitude)	*DCAC estimate.*
Brown	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Calico	*No harvest contribution (3a stock). Max. landings <2 mt, 1928-2008; mainly a discard species*
Copper	**Not yet available. Projected using a 50% SPR from the 2013 data-moderate assessment.**
Olive	*DB-SRA estimate.*
Quillback	*DB-SRA estimate.*
Treefish	*DB-SRA estimate.*
Minor Shelf Rockfish South	Sum of OFL contributions of component stocks in the complex.
Bronzespotted	*DB-SRA estimate.*
Chameleon	*No harvest contribution (3a stock).*
Flag	*DB-SRA estimate.*
Freckled	*No harvest contribution (3a stock).*
Greenblotched	*DB-SRA estimate.*
Greenspotted	*Projection using a 50% SPR from the full 2011 assessment. The portion of the assessed area south of 40°10' N lat. (77.8% of OFL from northern California model from average historical catch + the OFL from the southern California model)*
Greenstriped	*Projected using a 50% SPR from the full 2009 assessment. The portion of the coastwide stock south of 40°10' N. lat. (15.5%) is based on the mean of the 2003-2008 swept area biomass estimates from the NMFS trawl survey.*
Halfbanded	*No harvest contribution (3a stock).*
Harlequin	*DB-SRA estimate.*
Honeycomb	*DB-SRA estimate.*
Mexican	*DB-SRA estimate.*
Pink	*DB-SRA estimate.*
Pinkrose	*DB-SRA estimate.*
Pygmy	*No harvest contribution (3a stock).*
Redstripe	*DB-SRA estimate.*
Rosethorn	*DB-SRA estimate.*
Rosy	*DB-SRA estimate.*
Silvergray	*DB-SRA estimate.*
Speckled	*DB-SRA estimate.*
Squarespot	*DB-SRA estimate.*
Starry	*DB-SRA estimate.*
Stripetail	***DB-SRA estimate. Only status determined from 2013 data-moderate assessment, so presumed to remain a cat. 3 stock.***
Swordspine	*DB-SRA estimate.*

Stock	Comments
Tiger	*DB-SRA estimate.*
Vermilion	*DB-SRA estimate.*
Yellowtail	*DB-SRA estimate.*
Minor Slope Rockfish South	Sum of OFL contributions of component stocks in the complex.
Aurora	***Projected using a 50% SPR from the 2013 full assessment. The portion of the coastwide stock south of 40°10' N lat. (81%) is based on average survey biomass.***
Bank	*DB-SRA estimate.*
Blackgill	*Projected using a 50% SPR from the 2011 full assessment.*
Pacific ocean perch	*No harvest contribution (3a stock).*
Redbanded	*DB-SRA estimate.*
Rougheye	***Projected using a 50% SPR from the 2013 full assessment. The coastwide OFLs are apportioned north (98%) and south (2%) based on average landings during 1985-2012.***
Sharpchin	***Coastwide OFLs projected using a 50% SPR from the 2013 data-moderate assessment. OFLs are apportioned north and south of 40°10' N lat. (80%N, 20%S) based on average swept area biomass estimates from the triennial survey.***
Shortraker	*DB-SRA estimate.*
Yellowmouth	*DB-SRA estimate.*
Other Flatfish	Sum of OFL contributions of component stocks in the complex.
Butter sole	*Based on the average catch during 1994-1998 + a 60% discard rate estimated from the EDCP study.*
Curlfin sole	*Based on the average catch during 1994-1998 + a 60% discard rate estimated from the EDCP study.*
Flathead sole	*Max. catch = 35 mt in 2005*
Pacific sanddab	***DB-SRA estimate. Only status determined from 2013 full assessment, so presumed to remain a cat. 3 stock.***
Rex sole	***Projected using a 50% SPR from the 2013 data-moderate assessment.***
Rock sole	*DB-SRA estimate.*
Sand sole	*DB-SRA estimate.*
Other Fish a/	No analytical basis for the status quo OFL.
Big skate	*Derived from survey biomass and MSY harvest rate estimates*
Cabezon (WA)	
California skate	*Derived from survey biomass and MSY harvest rate estimates*
Finescale codling	
Kelp greenling (CA)	*DB-SRA estimate.*
Kelp greenling (OR & WA)	
Leopard shark	*DB-SRA estimate.*
Pacific grenadier	*Derived from survey biomass and MSY harvest rate estimates*
Ratfish	*Derived from survey biomass and MSY harvest rate estimates*
Soupfin shark	*DCAC estimate.*
Spiny dogfish	*Projected using a 50% SPR from the 2011 full assessment. 2015 and 2016 OFLs projected using the status quo 45% SPR rate are 2,921 and 2,893 mt, respectively.*

Notes for the SSC:

- *During our discussion of terms of reference for stock assessments for the next cycle, we should revisit the issue of how to make status determinations for Bayesian data-moderate stock assessments (e.g., XDB-SRA or XSSS).*
- *Need approach to revised scientific uncertainty as a stock assessment's results become increasingly outdated.*
- *Updates to historical catch data series may mean that updates are needed to the data-poor assessments.*
- *Revisions to relationship between depletion and PSA based on results of new assessments.*
- *As part of a rebuilding analysis, the final catches from the rebuilder should be put back into Stock Synthesis as a double-check that the rebuilder run has been correctly specified.*
- *The terms of reference for data-moderate assessments calls for a tabulation of available length and age composition data. John DeVore has not yet received all of the needed information. We need to watch out for this in the next round of data-moderate assessments.*

8. Consider Stock Complex Aggregations

Mr. Dan Erickson provided an overview of the methods the Groundfish Management Team (GMT) plans to use to identify stocks which may be at risk of overfishing and hence which the Council may choose to manage individually, and Mr. Corey Niles outlined how the GMT plans to summarize information which can be used to determine which stocks are "in the fishery".

The summary table developed by the GMT to identify stocks which may be at risk of overfishing included the Productivity-Susceptibility Analysis (PSA) score, the recent average catches for three groups of years relative to the 2013 Acceptable Biological Catch (ABC) and the 2013 Overfishing Limit (OFL), the fraction of years during which the recent average catches have exceeded the 2013 ABC and OFL, and the fraction of the coastwide catch north of 40˚10' N. Latitude. The latter statistic provides guidance on the weight which should be assigned to the other statistics for areas north and south of 40˚10' N. Latitude. The GMT plans to aggregate the statistics on a coastwide basis for final decision-making. The Scientific and Statistical Committee (SSC) supports the methods selected by the GMT, but recommends that the fractions north and south of 40˚10' N. Latitude should be updated using recent data. The SSC also notes that statistics based on the most recent catch level may be more informative, particularly if there is a change in catch over time, given changes in the fishery in recent years.

The GMT highlighted the situation of tiger rockfish. The OFL for this species is 1 mt and has been exceeded frequently. The GMT requested the SSC provide advice on whether a stock such as this should be removed from the complex. The SSC is unable to provide definitive advice in this case, but notes that complexes are intended to account for species whose catches are small and variable. It recommends that focus should be on long-term average catches rather than recent catches for species whose catches are small. For tiger rockfish in particular, knowledge of the range of the stock and its relative density spatially could inform a decision on its treatment.

In relation to deciding which species should be "in the fishery", the GMT plans to categorize species in terms of catch (less or greater than 1 mt), the PSA score, and the percentage retained, and to develop options for selecting species. The GMT is planning to consider a large number of species (approximately 500). The SSC agrees that the factors the GMT plan to consider are useful and appropriate, and suggests that where possible, catches should be compared to survey estimates of abundance, as this may provide some measure of relative risk. However, survey data may not

be informative for many of the species under consideration.

A. SSC Administrative Matters, continued

10. Management Strategy Evaluation of Data-Poor Assessment Methods

Dr Thomas Carruthers of the University of British Columbia presented a management strategy evaluation (MSE) to compare the performance of data-poor assessment methods, including methods being used for West Coast stocks, such as Depletion-Corrected Average Catch (DCAC) and Depletion-Based Stock Reduction Analysis (DB-SRA). The MSE is a useful addition to other work evaluating these methods (e.g., Wetzel and Punt (2011)). The MSE compares DB-SRA and DCAC to other data-poor methods being used or considered by other Councils. In general, the methods used by the Council were among the best performing of the data-poor methods, but can show poor performance if the assumptions of the method are incorrect. One particular concern is the poor performance DB-SRA (and DCAC) if the stock is more depleted than is assumed.

Dr Carruthers noted that data-poor methods that rely on expert judgment are inherently difficult to evaluate using simulation testing because statistical properties of expert judgment are not well understood. Dr Carruthers also cautioned that calibration of data-poor assessments using full assessments needed to be done very carefully, since stocks that can be assessed using full assessments may differ in fundamental ways from stocks for which data-poor methods are used. In addition, full assessments are also subject to uncertainty and their results cannot be considered to represent true abundance and status. Finally, Dr Carruthers recommended that more consideration be given to how to update data-poor assessments to incorporate new information, since dynamic procedures often led to better performance in simulation tests.

SSC Subcommittee Assignments, September 2013

Salmon	Groundfish	Coastal Pelagic Species	Highly Migratory Species	Economics	Ecosystem-Based Management
Robert Conrad	**Vlada Gertseva**	**André Punt**	Robert Conrad	**Cindy Thomson**	**Martin Dorn**
Owen Hamel	Martin Dorn	Owen Hamel	André Punt	Vlada Gertseva	Vlada Gertseva
Meisha Key	Owen Hamel	Dan Huppert		Dan Huppert	Pete Lawson
Pete Lawson	Tom Jagielo	Tom Jagielo		Todd Lee	Todd Lee
Charlie Petrosky	Meisha Key	Meisha Key		André Punt	André Punt
Will Satterthwaite	André Punt			David Sampson	Will Satterthwaite
	David Sampson				Cindy Thomson
	Tien-Shui Tsou				Tien-Shui Tsou

Bold denotes Subcommittee Chairperson

PFMC
10/10/13

Appendix A

Agenda Item G.7.b
SSC Groundfish Subcommittee Report
September 2013

SSC GROUNDFISH SUBCOMMITTEE STATEMENT REGARDING A CHANGE IN TARGET SPR RATE FOR WEST COAST ELASMOBRANCH SPECIES

Background of the problem

The Pacific Fishery Management Council (the Council) uses biological reference points to determine whether a stock is in an overfished state, and whether overfishing is occurring. The former is determined from the estimated depletion level, which is the ratio of the reproductive output (number of eggs or embryos) in the fished condition, to the reproductive output in the unfished condition. The latter is determined by a fishing mortality rate (F), expressed based on spawning potential ratio (SPR). This ratio is the number of eggs (or another appropriate measure of reproductive output) produced by an average recruit over its lifetime when the stock is fished, divided by the same metric when the stock is unfished. The SPR is based on the principle that certain proportions of fish have to survive in order to spawn and replenish the stock at a sustainable level.

The spiny dogfish shark (*Squalus suckleyi*) is an elasmobranch fish species that inhabits waters of the North Pacific Ocean. In North America, spiny dogfish occur from the Gulf of Alaska to southern Baja California. The status of this species off the West Coast of the United States, in the area managed by the Council, was assessed for the first time in 2011 (Gertseva and Taylor 2011). The spiny dogfish assessment model estimated the reproductive output of the stock at the beginning of 2011 to be 63% of its unfished level, which is well above the MSY proxy reproductive output of 40% of the unfished condition of the stock.

The default proxy fishing mortality rate for spiny dogfish used by the Council has been $F_{SPR45\%}$. This value is not based on an analysis specific to spiny dogfish or other elasmobranchs, but rather on teleost species (whose life history is quite different), since information on elasmobranch species is generally limited.

The current spiny dogfish assessment model predicts that fishing at the current proxy rate of $F_{SPR45\%}$ will severely reduce the reproductive output of the stock over the long term, due to low productivity and other reproductive characteristics. The current assessment indicates that a rate no greater than $F_{SPR79\%}$ (higher SPR values equate to lower fishing mortality rates) would be required to maintain reproductive output near MSY proxy reproductive output.

The spiny dogfish Stock Assessment Review (STAR) Panel suggested that the Council's Scientific and Statistical Committee (SSC) consider the appropriateness of the current proxy fishing mortality rate for spiny dogfish. The SSC agreed that the Council's F_{MSY} proxy of $F_{SPR45\%}$ may be too aggressive for spiny dogfish. The Council tasked the SSC to evaluate the current proxy and, if needed, propose a new target SPR value for spiny dogfish, as well as other elasmobranchs (sharks, skates, and rays) managed under the Groundfish Fishery Management Plan, since they share similar life history characteristics.

The analysis

Introduction

The SSC has previous noted that proxy reference points should ideally be based on analysis and consideration of multiple species within a taxonomic group with similar life history characteristics, to avoid problems of high variability in estimates of SPR and MSY reference points within and between stock assessments, for any individual species (Haltuch et al. 2008). Exceptions to this would only be for stock assessments displaying a remarkable degree of consistency and certainty. Following the 2009 petrale sole assessment, the Council revised the reference points for flatfish, separately from other groundfish species. Then, the SSC rejected the notion of setting the target SPR rate based upon a single stock assessment and species[1], and revised the flatfish proxies only after undertaking a meta-analysis involving multiple species.[2]

Zhou et al. (2012) compiled information on fishing mortality reference points for more than 200 species and stocks worldwide that have been assessed with various methods, and conducted a meta-analysis to link fishing mortality-based reference points to natural mortality and other life history traits. Zhou et al. used Bayesian hierarchical errors-in-variables models to investigate the relationships and included the effect of taxonomic class and order.

To inform an appropriate target SPR rate for West Coast elasmobranch species managed by the Council, Dr. Martin Dorn conducted the following analysis using results reported in Zhou et al. (2012). The SSC Groundfish Subcommittee reviewed this analysis and formed its recommendation for the Council during a conference call that took place on August 16, 2013.

Methods

To obtain a target SPR value for elasmobranchs, the posterior distribution for F_{MSY}/M as reported for Chondrichthyes in the meta-analysis conducted by Zhou et al. (2012) was used. Chondrichthyes (with n=12) was used since the distributions at the lower taxonomic levels were considered unreliable, due to small sample sizes. Values of natural mortality used in Zhou et al. were highly uncertain; therefore the analysis used the mean-unbiased distribution of F_{MSY}/M ratio, in which measurement error in M was taken into account. This distribution has a mean of 0.460 and standard deviation of 0.088 (Zhou et al. 2012). A large set of random draws was taken from the F_{MSY}/M posterior distribution. Normal and lognormal distributions for the sampled F_{MSY}/M ratio were explored. These two distributions did not differ substantially (Figure 1), and the results of the analysis were not sensitive to the assumed distribution. Therefore, the normal distribution was used for the target elasmobranch SPR analysis.

The shark assessments used in the Zhou et al. meta-analysis were all based on aggregate biomass dynamics models and thus, values of F_{MSY} reported by Zhou et al. would not necessarily be

[1] PFMC Agenda Item E.6.c. Supplemental SSC Report, June 2009: "The SSC does not consider that a strong enough case has been made that the estimate of B_{MSY} is sufficiently reliable to be used for fisheries management… the SSC recommends that these analyses and model changes be reviewed by the SSC Groundfish Subcommittee at a short meeting during August. … The Groundfish Subcommittee may also consider whether a single proxy could be used for west coast flatfish stocks, since other assessed flatfish show the high productivity characteristics of petrale sole."

[2] PFMC Agenda Item E.2.c. Supplemental SSC Report, September 2009; SSC groundfish subcommittee Report on Petrale Sole: "The use of proxy estimates of F_{MSY} and B_{MSY} was adopted by the council due the inherent statistical difficulties in estimating these quantities in any single stock assessment and because of a well-developed scientific literature supporting the use of proxies."

comparable to F_{MSY} values produced by the age-structured models that were used in the spiny dogfish and longnose skate assessments, which are the only two West Coast elasmobranch species that have been assessed. To convert the Zhou et al. F_{MSY}/M ratio to dogfish and longnose skate SPR rates, we used life history parameter vectors from the most recent (and only) dogfish and longnose skate assessments, and solved for SPR rates that produce an equilibrium (Catch/Mean exploitable biomass)/M ratio, which is equal to the F_{MSY}/M ratio from Zhou et al. It was assumed that Catch/Mean exploitable biomass approximates a production model fishing mortality, (i.e., $C = F\,\bar{B}, F = C/\bar{B}$). Since both catch and exploitable biomass can be expressed on a per recruit basis, the per recruit term cancels out, so that the developed relationship does not depend on the shape of the stock-recruit curve.

Life history vectors used included natural mortality at age, mid-year weight at age, reproductive output at age, selectivity at age, and fishery weight at age. All vectors were sex-specific. For spiny dogfish, where multiple fisheries were modeled in the assessment, a weighted average selectivity was used, with weights informed by the relative fishing mortality in each fishery. Fishery weights at age for spiny dogfish were also weighted averages. The resultant transfer functions for converting the Zhou et al. F_{MSY}/M ratio to dogfish and longnose skate SPR rates are shown in Figure 2.

Results

For spiny dogfish, the mean SPR at F_{MSY} is $F_{SPR49\%}$, at a full selection F of 0.026 and a catch/biomass ratio of 2.9%. For longnose skate, the mean SPR at F_{MSY} is calculated to be $F_{SPR45\%}$, at a full selection F of 0.085, and a catch/biomass ratio of 9.0%. The distributions of longnose skate and spiny dogfish SPR obtained in the analysis are shown in Figure 3. An average mean SPR at F_{MSY} across both distributions is $F_{SPR47\%}$.
The longnose skate assessment expresses reproductive output in spawning biomass (in common with most fish stocks), which may not accurately reflect elasmobranch reproductive biology; therefore it is reasonable to place more weight on the spiny dogfish result. Even in this case, $F_{SPR50\%}$ is the highest fishing mortality rate that does not exceed the F_{MSY} value with 50% probability for either longnose skate or spiny dogfish (Table 1).

SSC Groundfish Subcommittee Recommendations

The SSC's groundfish subcommittee continues to emphasize importance of using proxies as a general practice for management. It is usually very difficult to obtain reliable stock-specific estimates of F_{MSY} and B_{MSY} in any particular assessment (Haltuch et al. 2008). From a meta-analytical perspective, useful inference about management-related parameters can be drawn by comparative analysis of information drawn from studies of related species. Also, the use of proxies has a stabilizing influence on stock reference points, which is beneficial to the management process.

The SSC's groundfish subcommittee agrees that target elasmobranch SPR analysis (described above) represents the best available science and recommends that the Council adopt $F_{SPR50\%}$ as the default proxy fishing mortality rate for elasmobranch species in the West Coast of the United States, managed by the Council.

The subcommittee will continue to review existing information that is relevant to the target fishing

mortality rate for elasmobranches, which may influence and/or supersede this recommendation, and if so, the recommended value will be refined in the future.

References

Gertseva, V. V., Taylor, I. G. 2011. Status of the spiny dogfish shark resource off the continental U.S. Pacific Coast in 2011. In Status of the Pacific Coast Groundfish Fishery through 2011, Stock Assessment and Fishery Evaluation: Stock Assessments, STAR Panel Reports, and Rebuilding Analyses. Pacific Fishery Management Council, Portland, Oregon.

Haltuch, M.A., Punt, A.E., Dorn, M.W. 2008. Simulation testing alternative estimators of unfished stock size. Fish. Res. 94: 290-303.

Zhou, S., Yin, S., Thorson, J., Smith, T., Fuller, M 2012. Linking fishing mortality reference points to life history traits: an empirical study. Can. J. Fish. Aquat. Sci. 69: 1292–1301.

Table 1. Probability of different F values exceeding F_{MSY} for spiny dogfish and longnose skate.

	Spiny dogfish	Longnose skate
$Pr(F_{35\%}>F_{MSY})$	0.997	0.969
$Pr(F_{40\%}> F_{MSY})$	0.950	0.801
$Pr(F_{45\%}> F_{MSY})$	0.731	0.474
$Pr(F_{50\%}> F_{MSY})$	0.386	0.193
$Pr(F_{55\%}> F_{MSY})$	0.164	0.061
$Pr(F_{60\%}> F_{MSY})$	0.048	0.017

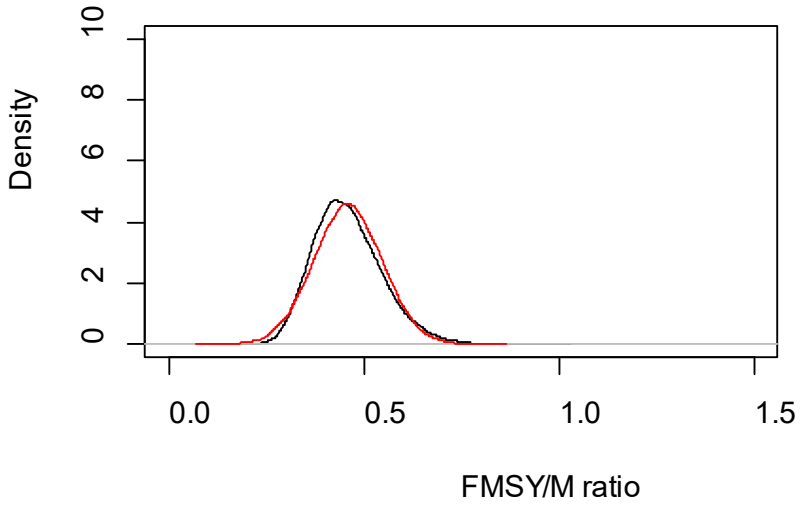

Figure 1. Comparison of normal and lognormal distributions for F_{MSY}/M developed based on results in Zhou et al. (2012). The curve on the right (red) is the normal distribution and the curve on the left (black) is the lognormal distribution. A normal distribution for F_{MSY}/M was assumed for the analysis.

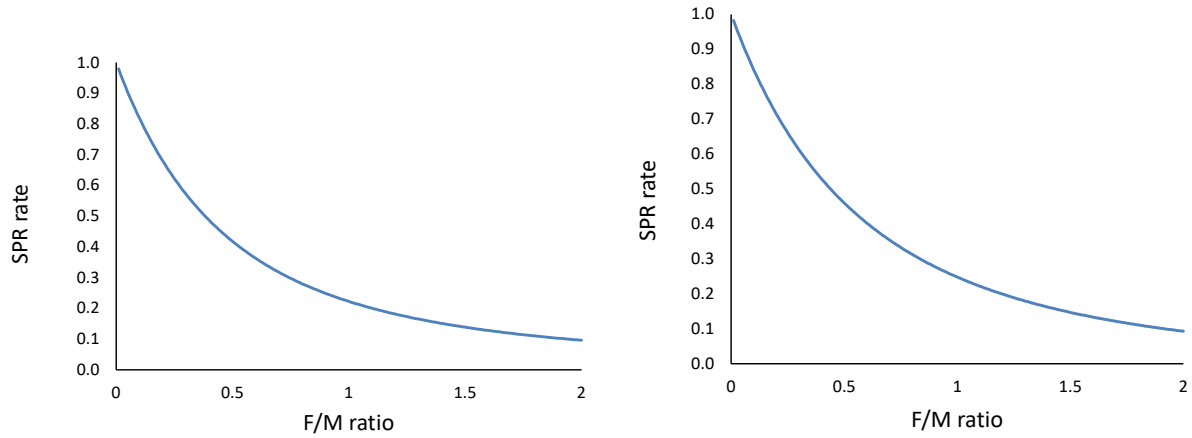

Figure 2. Transfer functions converting F_{MSY}/M to SPR for longnose skate (left panel) and spiny dogfish (right panel).

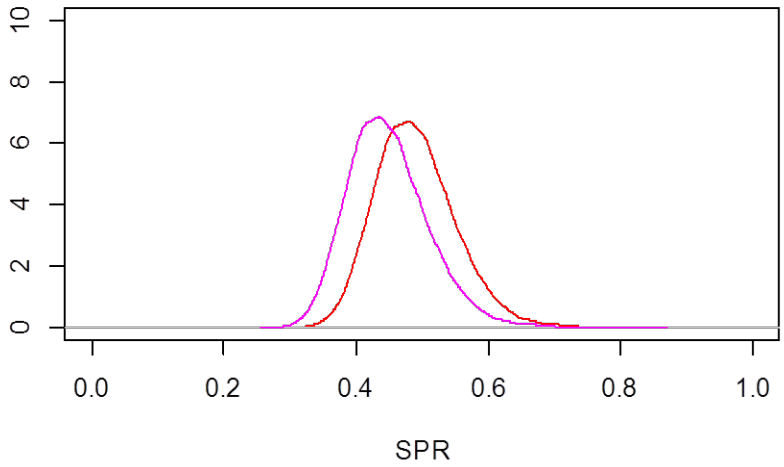

Figure 3. Distributions of spiny dogfish and longnose skate SPR obtained in the analysis. The curve on the right (red) represents spiny dogfish SPR distribution and the curve on the left (pink) represents longnose skate SPR distribution.