Scientific and Statistical Committee's Groundfish Subcommittee
Mop-up Stock Assessment Review Panel Meeting

Black Rockfish Report

National Marine Fisheries Service
Western Regional Center's Sand Point Facility
Alaska Fisheries Science Center
Building 4, Traynor Room 2076, September 28 – October 1
Building 4, Observer Training Room 1055, October 2
7600 Sand Point Way NE
Seattle, WA 98115

September 28 – October 2, 2015

Monday, September 28

Reviewers Present:
Dr. John Field, NMFS Southwest Fisheries Science Center, SSC, Chair
Dr. Andy Cooper, Simon Fraser University, SSC
Dr. Martin Dorn, NMFS Alaska Fisheries Science Center, SSC
Dr. Theresa Tsou, Washington Department of Fish and Wildlife, SSC
Mr. John Budrick, California Department of Fish and Wildlife, SSC
Dr. Neil Klaer, Center of Independent Experts
Dr. Owen Hamel, NMFS Northwest Fisheries Science Center, SSC

STAT Present:
Dr. Jason Cope, NMFS Northwest Fisheries Science Center
Dr. Andi Stephens, NMFS Northwest Fisheries Science Center
Dr. David Sampson, Oregon State University, SSC

Advisors Present:
Ms. Lynn Mattes, Oregon Department of Fish and Wildlife, GMT
Mr. Gerry Richter, Pt. Conception Groundfishermen's Association, GAP
Mr. John DeVore, Pacific Fishery Management Council

Overview

During the initial STAR Panel review of a coastwide black rockfish stock assessment in July of 2015, an acceptable base model for the Oregon stock could not be developed, and the Oregon model was subsequently recommended for review by the "mop up" Panel. The referral to the mop up formally took place at Scientific and Statistical Committee meeting of the PFMC on Sept. 11, 2015. The SSC also delayed final approval of the California and Washington models to allow for potential changes in them that could allow consistency among all three assessments.

As described by both the July STAR Panel chair and members of the STAT, the primary challenge for both past and contemporary assessments of black rockfish has been the apparent absence of older female black rockfish in fisheries catches, a phenomena that has long challenged the development of plausible assessments for black rockfish and other species that exhibit this tendency (including canary and yellowtail Rockfish). Past modeling approaches, and those taken during the STAR Panel review, have explored both "hiding" older females (e.g., applying dome-shaped selectivity to fisheries, which often results in what are considered to be implausibly high "cryptic" biomass levels of old, unavailable fish) or "killing" off older females (one common formulation being a ramp up natural mortality rates of reproductive-age females) in order to fit the observed data.

The Mop-up STAR Panel received documentation and supporting materials for a proposed base model from the overall STAT lead (Dr. Jason Cope) as well as an alternative base model from a member of the STAT (Dr. David Sampson). Although the data were generally comparable in each of these models (exceptions are described below), the two models had fundamentally divergent assumptions for natural mortality and selectivity, leading to some unique challenges in reviewing the two models. One benefit was the larger extent of model specifications explored. The basic approach adopted by the STAR Panel was to evaluate major structural elements of the two models and to consider the sensitivity of each model to different parameterization schemes in order to most appropriately enable convergence of the two modeling approaches. All STAT and STAR Panel participants recognized a broad suite of unique challenges in the data and models developed for Oregon black rockfish, which was best described as a "data rich, but information poor" stock.

Summary of data and assessment models

Draft Oregon base model

Dr., Jason Cope provided a presentation of the Oregon black rockfish assessment and base model developed by the STAT, and Dr. Andi Stephens explained the data changes made to the model since the July STAR panel. These changes included (1) the recreational fishery was split into ocean and shore/estuary modes; (2) age bins were extended from 30 to 40 years to be more consistent with the WA and CA assessments; (3) length bins were extended from 60 to 64 to be more consistent with the WA assessment; and (4) unsexed compositional data were removed from the commercial fleets. Index changes included (1) a reworking of the logbook index to only include vessels that fished for at least 3 years; (2) the ORBS charter boat CPUE index was revised to include auxiliary information on the reef fished and changes in bag-limits and depth openings (input data were limited to March through October); and (3) abundance estimates from the first three years of the tagging series were removed because they were deemed to be biased low due to reduced first-year recapture probability. A plot of the indices indicated that they are generally noisy but follow similar patterns, with most showing an uptick in recent years.

It was noted that the Oregon MRFSS index was not used for China rockfish as multiple intercept interviews were done for single trips, meaning that the index is not trip-based as intended. A trip-level index was included for black rockfish, and this known issue was examined in three different ways. The model was generally not very sensitive to the removal of any or all of the indices.

The draft base model included a fixed female natural mortality rate fixed at 0.17 and a male natural mortality rate estimated at 0.19. It was noted that the estimation of sex-specific natural mortality (M) values is commonly done in other assessments. There was concern that the use of a maximum age of 56 in development of the M prior may have been too extreme, yet it was also noted that the prior is rather broad and does not restrict model estimates, as demonstrated by the very high M values when Ms for both sexes are estimated. It was noted that the tag study data when analyzed in isolation suggests a natural mortality rate in the 0.2-0.24 range (combined male and female).

The Francis method was used to weight and tune length compositions, however the CAAL data are only weighted by the number of age samples per length bin. Weighting and tuning approaches to these models were broadly recognized as needing further investigation (it was noted that a CAPAM workshop planned for later this year that may help to resolve this issue). However, it was also generally agreed that some form of re-weighting for CAAL data would likely be preferable, and it was recognized that available methods would result in an overall down-weighting of CAAL for the OR model. As it is known that the current version of Stock Synthesis adjusts minimum sample sizes to 1, it was also recognized that this could lead to a possible bias when down-weighting is applied to CAAL data which are often associated with small initial sample sizes. Due to this issue, no re-weighting was applied to CAAL data for the WA and CA models accepted by the STAR Panel.

Some members of the STAT and the Panel noted that recruitment deviation estimates in the draft base model appeared to be driven by either the pattern of historical removals, or some other factors, rather than reflecting signals in composition data. The STAT noted that composition data are relatively uninformative about the scale of annual recruitment levels, instead they seem to imply nearly constant availability of fish in a given size and age range. The recruitment residuals showed a high level of autocorrelation, and an overall systematic pattern of below average recruitment to about 1980, above average recruitment to about 2002, and then below average recruitment through the end of the model period. There was a considerable retrospective pattern, with spawning output being revised upwards as successive recent years of data were removed, apparently caused mostly by revisions of the scale of recruitments from about 1990 to 2004. Confirmation that revision of recruitment patterns was the main cause for the retrospective pattern was provided by a re-run of retrospectives for a model that turned recruitment deviations off. It is concerning that available data appears to be uninformative about the scale of auto-correlated recruitment levels over decadal time periods.

For the WA and CA models, the ocean recreational fleet selectivity was modeled with asymptotic length-based selectivity. However, the draft base model OR ocean recreational fishery selectivity was forced to be dome-shaped (length based), with a fixed value of 0.5 used for the right-hand asymptote, in an attempt to balance unrealistic model outputs when the selectivity was estimated or forced asymptotic. The model results were found to be very sensitive to this fixed value, and when freely estimated, the selectivity curve became fully dome-shaped, leading to a steeply declining population with trends that were inconsistent with the abundance indices. Sensitivity analyses showed that the length compositions (and lack of females) are the biggest driver for the difference in the estimated selectivity pattern. This may also account for the estimation of a higher male M than female M, acknowledged to be an undesirable, and perhaps unrealistic, feature of the draft base model.

A likelihood profile for M shows that length and age data, specifically data from the recreational ocean fishery, are most influential. The age data had a well-defined minimum for female M at about 0.26, but length data favored a much higher natural mortality rate (minimum at 0.4). A comparison of these patterns with CA and WA showed that length data provided a more defined minimum than age data for CA, and length and age showed opposing trends for WA, crossing near the 0.16 value.

The draft Oregon base model differed substantively from the structural assumptions of the CA and WA models accepted by the July STAR Panel in the following respects:

- Female M value fixed at 0.17 - the mean of the estimated WA (0.16) and CA (0.18) values

- Oregon tagging abundance index and associated estimated q (with prior). This parameter had the potential to be interpreted as an absolute abundance index. This index was not available for the other states.
- Dome-shaped length-based selectivity for the ocean recreational fishery (asymptotic for WA/CA).

Draft Alternate base model

Dr. David Sampson provided an alternative base model for black rockfish, and in a presentation highlighted differences between the alternative model and the base model, as well as the historical challenges associated with accommodating the apparent lack of old females in past assessments for black rockfish and several other species. The alternative model included mean body weight samples (based on fish counts and total basket weights from the early years of the trawl fishery), to supplement limited available composition data for commercial fleets. This data was not available in time for the base model. As no appropriate method for reweighting mean weight data is currently known, no reweighting was applied. The most significant difference in the alternative model was that the natural mortality rate for young females (to age 10) and males (all ages) was freely estimated at 0.37, with an estimated ramp to 0.5 at age 15 (females only).

Other differences between the draft base and the draft alternative model were (1) The alternative model included age-based dome-shaped selectivity for the trawl, dead, ocean recreational and shore recreational fleets; (2) conditional age-at-length data were reweighted from input sample numbers using the harmonic mean method; and (3) recruitment deviations were estimated from 1977 onward (as opposed to 1960 in the draft base model). The rationale for the age based selectivity in the alternative model was that length selection alone does not allow the large change in available older females apparent in the OR data. It was noted that age-based selection was not required for the WA or CA models accepted by the July STAR Panel. The approach of the alternative model in essence applies both the “kill them” and “hide them” approaches simultaneously.

The alternative model and the base model were to some extent structured around accommodating the results of the ODFW tagging study off of Newport, which provides annual abundance estimates for 2002-2014 for black rockfish off of Newport, potentially providing scale for the OR population in the stock assessment. The basis for arriving at a prior for the catchability coefficient for this survey (tag q) received considerable discussion during the meeting. Estimates of available habitat (from GIS analysis by Troy Buell ODFW and Melissa Monk SWFSC) indicate that approximately 10% of the potential habitat for black rockfish in the waters off Oregon occurs in the Newport tagging study area. The analysis and derivation of the prior for Tag q (revised during the meeting) ultimately indicated that approximately 12% of the exploitable biomass was located off of Newport.

The set of jitter runs for the alternative model indicated four different sets of solutions all producing a nearly equivalent goodness-of-fit to the overall data. Only small differences in model results were shown between the alternative model and the alternative solutions from the jitters. A retrospective analysis for the alternative model did not indicate any systematic bias in the model results, in contrast to the draft base model.

Exploration of model structure

Neither of the draft models presented at the start of the meeting were viewed as acceptable by the Panel. In the base model, a key issue was the extreme sensitivity to the arbitrary setting of 50% selection on the descending limb of the ocean recreational selectivity. For the alternative model, the implausibly high natural mortality estimates were perceived as inconsistent with the life history of the stock. The work of the meeting was to explore the ideal attributes of each model in an effort to facilitate the development of appropriate model structural assumptions and input datasets, and to ultimately enable the development of a single base model for Oregon black rockfish that both the STAT and the STAR Panel would find acceptable.

Requests by the STAR Panel and Responses by the STAT

As the Panel was essentially reviewing competing models, requests by the STAR Panel were typically directed at individual analysts representing either the draft base (Dr. Jason Cope, JC, and Dr. Andi Stephens, AS) or the alternative base model (Dr. David Sampson, DS).

Request 1: Investigate effect of the tag catchability prior by adding 0.07 to the standard deviation with no estimated additional variance and fix the prior (JC).

Rationale: Did the added variance to the tag index affect the expression of the tag catchability coefficient in the model?

Response: Fixing the tag catchability and adding a small amount of extra variance sets the scale of the population much higher, perhaps to implausible levels.

There was some discussion around the observation that Stock Synthesis effectively "ignored" the tag-catchability prior if the model was also configured to estimate additional variance for the tagging study. Consequently, for this model the tag catchability parameter could only be used to focus or fix the scale of the population when the additional variance parameter was also fixed.

In further discussions of the tagging study, the Panel also noted that the Brownie et al. (1985) tag-recapture model follows cohorts and has no time-dependent recapture probabilities. There was a concern over the assumption that all fish tagged are assumed equally likely to be caught, thereby not accounting for selectivity. Tag abundance estimates may therefore only apply to exploitable biomass. A constant selectivity may be more appropriate for use in association with the tag survey abundance. With dome shaped selectivity applied to the tag abundance, the assessed abundance may be underestimated. Questions also arose over whether an index could be representative if it only indexed the population over 10% of the available habitat. A likelihood profile over the catchability coefficient shows that the model estimate is informed, and diverges from the prior to estimate a value near 0.5. The inference that half of the available black rockfish stock is to be found off of Newport, which is the literal interpretation of the model result, was found to be implausible by both the STAT and the Panel.

Request 2: Compare length and age data inputs across states (AS).

Rationale: To explore how these compositional data vary in each state model and to understand selectivity differences.

Response: Length composition data show distinct differences in the mean size of black rockfish, with larger fish in WA, intermediate sized fish in OR, and smaller fish in CA. Examination of the length composition data alone does not provide an indication of whether the ocean recreational fleet selectivity should be dome-shaped while WA and CA are not, due to growth differences among the states.

Request 3: Investigate the retrospective pattern with recruitment deviations turned off (AS).

Rationale: Recruitment deviations appear driven by the pattern of historical removals and also appear to drive the recent decreasing trend in biomass.

Response: It is concerning that the current model uses recruitment trends to fit catch/index data, and this appears to be a consequence of the low information content of the composition data with respect to variable cohort strength. Turning off recruitment deviations demonstrated that the retrospective pattern is mostly produced via alternative recruitment patterns and not via other possible sources such as selectivity changes.

Request 4: Extend the natural mortality profile for all data components to M = 0.4 and compare the profiles for all three state models (AS & JC).

Rationale: To better understand what data are affecting natural mortality estimates and to check for consistency.

Response: The profiles for each of the Cope models by state were provided. The CA profiles showed no great conflicts in the data elements with respect to estimating natural mortality. The OR model showed more data conflict with the length data, which preferred much larger M values (out to 0.4). However, this profile was based on the initial base model with fixed selectivity parameters that the Panel thought less than optimal. The WA model had conflicting age and length information, with age data providing a better fit with larger natural mortality rate values, and length data providing a better fit with a lower M values (interestingly, this was opposite of behavior observed in the OR model).

Request 5: Add mean weights and compare the Cope et al. model with and without these mean weights (JC).

Rationale: To understand the effect of these data.

Response: This changes the biomass trend more in 80's and 90's and seems to be informing recruitments more, but lowers the initial dip in recruitment. Parameter estimates are very similar but fits to indices are slightly degraded. Based on the rationale that all reliable available data should be included in the model, it was agreed that all models should include mean weights.

Request 6: Turn off ascending width parameters in age-based female offset selectivity in the Sampson model (DS).

Rationale: These parameters have very large SDs indicating they are poorly estimated.

Response: There was no degradation of fit and only small change to B0 and depletion. It was agreed that these changes should be made to the alternative model.

Request 7: Provide a run in the Cope et al. model where 1) the male natural mortality rate (M) is fixed and the female natural mortality rate is estimated and a run where 2) both male and female Ms are fixed at the average of the estimates from the CA and WA models (JC).

Rationale: Panel needs to decide options for estimating or fixing natural mortality.

Response: Fixing male M at the average of the WA and CA estimates greatly increased the estimated unfished biomass (B0) and decreased ending biomass resulting in a very low depletion. The model also consistently estimated a lower female M than male M. Essentially, the model had to force a higher initial biomass to account for the higher historical catch. While the lower M values are more consistent with the natural mortality prior and with the life history of rockfish more generally, the biomass trends inferred in the low M models are inconsistent with the steadily high CPUEs observed over recent decades. Fixing female M at the average of estimated WA and CA model values (which was done in the base model) reduced scale of the population significantly.

Request 8: Investigate MRFSS and ORBS comp. data during the 1999-2003 overlap period and compare the sampling area (port) relative to the estimated catch by area (Troy Buell, ODFW).

Rationale: There are apparent data conflicts in these data that need to be reconciled by possibly removing one of these data sources.

Response: Alternatively removing the MRFSS and ORBS length data showed different biomass trends but ended in a similar biomass and depletion. Discrepancies in the length compositions between the ORBS and MRFSS sampling programs during the overlapping years (1999 to 2003), as great as 2 cm differences in mean length, were noted, discussed but not resolved at this meeting.

Request 9: If data are available for the more recent time period, derive a better tag-Q prior based on these data (DS).

Rationale: It's more sensible to base the tag-Q prior based on the same time period as the tagging study.

Response: Re-estimated the proportion of the population off Newport to be 12.7% using more recent CPUE data rather than 9.4%.

Request 10: Provide a bivariate M profile (young M and old M) (DS).

Rationale: Explore consequences of fits to other data sources by fixing M.

Response: The bivariate M profile indicated that both female M1 (young M) and female M2 (old M) showed better fits with high M values. The results also indicated that as the M ramp is adjusted or constrained, the model will adjust selectivities accordingly, such that the M ramp is not affecting the ultimate model result when selectivities are freely estimated. The overall conclusion is that the data are not informative on whether the better model is to kill the older females with high M or hide them with dome-shaped selectivity. It was also noted that in the base model with length-based selection, growth and selectivity are also confounded, such that the alternative model with dome-shaped age-based selectivity had smaller L_∞ values than length-based selectivity models.

Request 11: Assume an asymptotic logistic selectivity curve for the tag-Q study with a knife-edge selectivity at 32 cm and fit the tag abundance data (DS & JC/AS).

Rationale: The tagging study had a minimum length of 32 cm and a derived selectivity curve may be informative of whether there is an interplay with other estimated parameters. The estimated Q may be influenced by the estimated selectivity curve for both models.

Response: The base model with the tagging study selectivity fixed to be knife edge at 32cm exhibited very similar behavior to earlier model runs, with a slightly lower estimated q (about 0.44). Fixing the tagging study selectivity in the alternative model had negligible influence on the overall fit to the data (the total log-likelihood changed by 0.1) but considerable impact some of the assessment results.

Unfished spawning output changed from about 1530 to 1040; 2014 depletion changed from about 85% to 81%. The estimate catchability coefficient for the tag study remained near 0.09. The STAT and Panel agreed that separating the tag index and its selectivity in this way was more appropriate given the means by which the tag abundance could be used in the model.

Request 12: Fix female natural mortality (M1, for young fish) at 0.17 in the Sampson model and develop a likelihood profile over age at which the step function in natural mortality occurs and estimate the natural mortality of older fish (M2, bounded at 0.25) (DS).

Rationale: Fixing the natural mortality rate of young fish at 0.17 is plausible and the exploration of a reasonable mechanism to explain missing older females needs to be done.

Response: DS presented a likelihood profile over step-ages from 7 to 17. There was a clear minimum total likelihood when the female natural mortality was allowed to change at age 10, but the change in total likelihood over this range of step-ages was only 2.28 log-likelihood units. The model used to conduct the profile analysis did not have the fixed selection curve for the tagging study (Request #11).

Request 13: Re-run both models with swapped datasets (.dat files), identify differences, and compare fits (DS & JC/AS).

Rationale: Eventually one dataset and model will need to be chosen as the base.

Response: The STAT participants agreed to include the mean weight data in the model, to exclude the length composition data from the “small fish” study (a targeted study intended solely to provide length at age data for small fish to better inform growth, the data are included as conditional age at length data), and to use the input sample size values from the alternative (DS) model for the data file for the base case.

Request 14: For the age-based selectivity in the Cope models, fix female M at 0.17 and estimate the male offset (JS/AS).

Rationale: To compare age vs. length-based dome-shaped selectivity assumptions.

Response: The resulting model estimated a male natural mortality offset consistent with a male natural mortality rate of 0.19. There were modest differences in the model dynamics, and some change in scale, but the base results did not change tremendously. There was an improved fit to the recreational ocean fishery length composition data, however growth estimates for male and females (L_∞ values) began to converge again, a characteristic considered undesirable. The existence of fish greater than 50cm in the data may be more consistent with the length-based selectivity model. It was noted that there are no current viable hypotheses regarding where older fish are. It was noted that potential research recommendations could include short-term trawl or other sampling, particularly off OR, to look for areas where larger individuals may be found.

Request 15: Provide a run with a step M function (M1 of 0.17 for males and females) and estimate an M2 for females that results in a logistic ocean recreational fishery selectivity in the Cope model (JC/AS).

Rationale: This may inform the trade-off between M and selectivity.

Response: Age-based selection will be investigated as an improved alternative to attempting to use other methods to objectively determine length-only selectivity for this fleet.

Requests 16-21 were agreed changes to the base model.

16. Include all recreational fishery lengths (JC/AS)
17. Remove small fish lengths (JC/AS)
18. Include mean weight data (JC/AS).
19. Use knife edge selectivity for the tag index (JC & DS).
20. Use the number of trips for effective sample sizes in the ORBS data for reweighting (JC/AS).
21. Reweight age composition data using harmonic mean (JC/AS).

Request 22: Consider a model with recruitment deviations off, natural mortality for young females and males fixed at 0.17, with a step at age 10 to a higher M for females (but bounded at 0.25), and age tuning (JC/AS). Provide a set of runs where the final recreational ocean fishery selectivity parameter is 1) freely estimated, 2) fixed at several intermediate levels, and 3) logistic (JC/AS).

Rationale: To explore a combination that provides an improved model.

Response: This model structure was described as highly sensitive to age tuning, due to the greater influence of the length composition data. Essentially, when the recreational ocean fishery selectivity was logistic, the model results were highly pessimistic (a very depleted, overfished population), whereas with fully dome-shaped selectivity the results were highly optimistic results (very healthy population, with an upscaled B_0). The M step always went to the M2 bound of 0.25. With the addition of age based selectivity for the descending limb for females (ascending limb for both sexes still length based), the result was reduced tension between the age and length data, and more plausible estimates for the growth parameters.

Request 23: Turn off the tag-Q prior as a sensitivity (JC/AS & DS – with model structure under #27).

Rationale: To understand the effect of the prior (i.e., is the same Q value derived analytically as estimated with the prior?)

Response: There was insufficient time to complete this request.

Request 24: Determine the implied age at maturity from the growth curves in the WA and CA models.

Rationale: This may help justify the M2 step age.

Response: The implied age at 50% maturity in the CA and WA models is 10 and 11 yrs., respectively.

Request 25: For the likelihood profile across the final selectivity parameter in the Cope model, plot biomass trends for each value in the profile.

Rationale: To understand the behavior of the model when that value is changed.

Response: The result was consistent with the result from request # 22.

Request 26: As a sensitivity, run the CA and WA base models with a natural mortality (M) step structure (male and female young, M1, and female old, M2, at age 10 and estimate both parameters; bound female M2 at 0.25). Compare biomass trends, parameter estimates, and likelihoods.

Rationale: Comparing a natural mortality step structure in the other state models may help to better understand a reasonable step in natural mortality rates for old females in the OR model.

Response: Not completed due to time constraints.

Request 27: Specify female M1 = 0.17 with a female M2 step at age 9 in the Sampson model with and without recruitment deviations; don't worry about multiple tuning iterations. (DS).

Rationale: To better understand the effect of estimating recruitment in the Sampson model.

Response: Model I, with recruitment deviations estimated, combines age-based selectivity with the M step. The weighting took 8 or 9 iterations. There was a fairly significant difference in results caused by movement to knife edge selection for tagging. Growth estimates suggested L_∞ for females of about 49 cm. It was surprising that indices were not better fit with the recruitment deviations estimated; however, there was a considerable improvement in likelihood with recruitment deviations estimated (170 likelihood units). Most of that change came from improvements to the mean body weight index, as well as the tagging study index (which was not tuned, so had unrealistically tight CVs).

Request 28: Apply age composition data variance adjustment as lambdas and compare that to reweighted age composition data using harmonic means as a sensitivity (JC/AS & DS).

Rationale: There is concern that the weighting is over-emphasizing very small samples (SS does not allow input Ns to be less than 1, so very small samples would be "upweighted" relative to larger ones).

Response: Not completed due to time constraints.

Request 29: Compare the amount of black rockfish habitat in CA and OR with unfished biomass (B_0) estimates.

Rationale: Evaluate the plausibility of inferred densities by state.

Response: The inferred densities of black rockfish relative to the likely available habitat provided some basis for evaluating highly implausible biomass levels.

Request 30: Compare the new base model with estimated tag-Q with current prior (consistent with Q = 12.7%) and no added deviance (b).

Rationale: An emerging candidate for a base model has recruitment deviations turned off, fixes the tag-Q at the equivalent (in log space) of 25%, is fully tuned (Francis length, harmonic age tuning), includes an M step with M1 = 0.17 and M2 (females only) set at 0.2 (step at age 10), and uses length-based selectivity with female offset (males asymptotic) for age-based selection in trawl and dead fishery, the shore based recreational fishery has length-based selectivity with no sex offset, all other fishery selectivities are the same. This request was to evaluate model results with greater emphasis from the Newport tagging study.

Response: Without added variance there is a predictably greater influence of the tagging study on the scale of the total biomass.

Request 31: If possible, do Request #30 with added variance turned on or variance tuned.

Rationale: To better understand the effect of added variance parameter.

Response: With added variance there is a predictably weaker influence of the tagging study on the scale of the total biomass.

Request 32: Run the emerging base configuration with recruitment deviations estimated.

Rationale: To better understand the model behavior when recruitment deviations are estimated.

Response: The Panel and a majority of the STAT were increasingly uncomfortable including recruitment deviations in the model.

Request 33: Provide retrospective analyses for the model with recruitment deviations estimated.

Rationale: To better understand the model behavior when recruitment deviations are estimated.

Response: Some concern over the retrospective patterns.

Request 34: Provide plots of unavailable spawning output for the agreed base model.

Rationale: To better understand the magnitude of the "cryptic" biomass.

Response: The magnitude of cryptic biomass in this model was high, but not extraordinary.

Request 35: Report on a new base model, which has recruitment deviations turned off, M1 at 0.17, M2 (females only) step to 0.2 at age 10, the tag-Q is fixed at the value associated with 25%, fully tuned (harmonic age tuning), logistic length-based trawl with female offset for dome-shaped, and dead fish fishery with length-based selectivity, the shore based recreational fishery has length-based selectivity with no sex offset, the live fish fishery is dome-shaped with no sex specific offsets, the ocean recreational fishery is ascending asymptotic length for males and females, descending age based selectivity for females. The decision table compares the new base model with a high state of nature in which the tag-Q is fixed at the mean of the current prior (consistent with Q = 12.7%) and no added variance, the low state of nature model is to estimate Q with the prior (effectively making the prior uninformative).

Preliminary catch streams should be based on status quo, on estimated ACL catches (for purposes of filling out a decision table only, assume category 2 stock, sigma at 0.72, p* 0.45 equating to 8.7% buffer, pending Council decision on these values), and OFL removals. As these may not provide sufficient range of catches, consider the ACL removals from the low productivity model and/or any relevant GMT or Council recommended catch streams. Include in final document the typical suite of sensitivity runs and profiles as done for WA and CA models, typically retrospective analyses, and including a sensitivity run with recruitment deviations estimated from 1977 through 2010.

Rationale: A majority of STAT and all of Panel agreed that this was a plausible base model and appropriate axis of uncertainty for Oregon black rockfish

Description of the Base Model and Alternative Models used to Bracket Uncertainty

Ultimately, the STAT and STAR Panel were able to agree on a hybrid model that incorporated elements of both the draft base and draft alternative model, the exact sequence of changes to each model are provided largely in the STAR Panel request (above). Highlights of the final base model are as follows.

Natural mortality

The meeting agreed that an overall natural mortality rate (M) for OR was best fixed at 0.17 for females given (a) estimated M for females in WA of 0.16 and CA of 0.18, (b) the maximum age of old fish observed for the males (and a small number of females) in OR and (c) that both models freely estimate implausibly high values of M. The Panel agreed that there is little biological reason to suggest that the M for younger ages should be different for males and females, and that M should be the same value for young females and all ages for males.

To account for the low number of observed older females, the STAT and STAR Panel agreed on a step function, which avoids additional complexity of a ramp slope. It was agreed that the most appropriate age for a step in M was age 10. Since age 10 is roughly the age at 50% maturity for female black rockfish, a step increase in mortality may have a biological explanation as being caused by the additional physiological and behavioral stress associated with reproduction. With respect to the magnitude of the step, the Panel noted that differential male and female natural mortality rates are estimated in the Washington and California models. Consequently, a procedure was devised to derive some means of rough consistency for the increased natural mortality rate for females in OR with the values obtained in the WA and CA assessments. Specifically, a step value for old female rockfish was developed that would lead to the same sex ratio of old female to male black rockfish in Oregon as inferred in the Washington model, where the natural mortality rate for females was estimated to be higher than that of males. This suggested a value of 0.20 for the natural mortality rate of Oregon black rockfish older than age 10, and this was agreed upon by the STAT for both models.

Selectivity

Throughout various analyses it was found that length-based selectivity alone does not appear to provide sufficient freedom for the model to adequately "hide" old females sufficiently to fit the compositional data for the ocean recreational fisheries. The length-based selectivity also showed greater sensitivity to data weighting. The Panel and STAT agreed that age-based dome-shaped selectivity provided greater flexibility in fitting the data. This addressed the arbitrary fixing of the semi-dome length selectivity in the draft base model, and was found to be acceptable to the STAT for both models.

Conditional age-at-length data weighting

There was general agreement that some form of reweighting procedure should be applied to available conditional age-at-length data, while recognizing that standard procedures are lacking, that there are trade-offs when weighting conditional age-at-length data, and that a bias problem exists in the current code for sample sizes less than one. There was insufficient time during the meeting to investigate the full extent of possible bias, but the harmonic mean method as implemented for the alternative model was agreed as the procedure to be used for the agreed base model.

Recruitment deviations

Model exploration during the meeting indicated that both Oregon models tended to estimate low frequency trends (highly autocorrelated residuals) or strong recruitment events that did not appear to be informed by compositional data. The composition data in general do not appear to be strongly indicative of highly variable cohort strength, indeed the apparent consistency of the age composition data was noted as somewhat unusual for a rockfish by the Panel. Instead, it seemed that the recruitment deviations were providing the flexibility to accommodate other tensions in conflicts among data sources; for example, the greatest improvement in likelihood with recruitment deviations estimated was in the mean weight compositional data for the trawl fishery. Improvements to the compositional data themselves were typically modest relative to model runs without recruitment deviations estimated. Moreover, growth parameters were highly sensitive to the estimation of recruitment deviation values in the base model; when estimated the male and female asymptotic lengths converged, resulting in far lower female L_∞ values, and higher male L_∞ values, than those estimated in the California and Washington models. Additionally, freeing of recruitment deviations often resulted in strong dynamics towards the end of the modeled period that appeared to be inconsistent with both relative abundance and compositional data. Finally, examination of recruitment deviations from the 2007 assessment suggested that that assessment appeared to share many of the same issues examined during this meeting, particularly strong autocorrelation and an overall cyclical pattern.

After consideration of these sensitivities, in particular the cumulative impacts on model structure and behavior when recruitment deviations were estimated, a majority of the STAT and all of the STAR Panel agreed that recruitment deviations should be turned off. It was recognized that even with recruitment deviations turned off that composition data are still highly informative with regard to growth and selectivity. This decision to turn off recruitment deviations was not agreed to by all parties (see areas of disagreement).

Tag q

Subsequent analysis indicated that approximately 24% of the recreational catch is landed in that region. Ultimately, the tagging study was pinned to this estimate. Some panel members thought it would be an improvement to use only the CPUE that temporally overlaps with the tagging study to develop the prior, and this was done to produce a revised prior. It was also agreed that the first 3 years of tag abundance information should be removed due to probable bias caused by reduced first-year recapture probability. The most appropriate selectivity to apply to the tagging study in the stock assessment was also discussed, with a suggestion that knife-edged flat selectivity from about length 32cm could better reflect the assumptions of the simplified methodology of the tagging study (no age-specific mortality, and no accounting for dome selectivity).

The OR black rockfish habitat area combined with CPUE density estimates provides a means for scaling the absolute annual abundance indices from tagging for the Newport area to the coastwide population. The study when re-calculated using CPUE from the time period of the tagging study estimated that 12.7% of the coastwide population resided in the Newport area. An agreed base model that applied all of the above agreed changes estimates (given the updated prior) tag q at values near 50%. The meeting considered that if the calculated q value of 12.7% has made valid assumptions, and the interpretation of the tag q in the assessment (that uses dome selectivity for the ocean recreational fishery and sex-specific M values) is near correct, then the 50% value must be seen as implausible. The highest defensible value for the tagging study catchability that was generally acceptable by the meeting was 25%, comparable to the fraction of the Oregon recreational catch that occurs in the Newport tagging study area.

Agreed base model

When all of the above changes were made to both the draft base model and the alternative model, both produced very similar results in terms of overall trend, final depletion and biomass scale. However, there remained some very minor differences in the selectivity characteristics for the dead and trawl fisheries. It was agreed to use the modified draft base model as a basis for the provision of management advice – hereafter called the agreed base model.

Technical Merits of the Assessment

The assessment made very good use of the abilities of stock synthesis, all of the available data were exhaustively vetted and evaluated, and the sensitivity of the model to a tremendously wide range of model structures were very rigorously explored. Although it was recognized by all participants that the final base model included substantial "hide" and "kill" components that make unvalidated assumptions which in turn have considerable influence on the final model result, the stability of the age and length composition data (which suggest a relatively constant availability of individuals ranging from roughly age 6 to age 9), and of most of the relative abundance indices, provided some assurances that the population was in a relatively healthy, or at minimum, stable condition. A majority of the STAT and all of the STAR Panel were of the opinion that despite the considerable challenges and uncertainty, the final proposed base model was an improvement from the 2007 assessment, and thus represents the best available science for management purposes.

Technical Deficiencies of the Assessment

The uncertainties and deficiencies in the final base model are numerous, and include low information content of the data, the reliance on essentially a "fixed" catchability coefficient to anchor abundance to a tagging study that does not survey a majority of the habitat or (presumably) the population, the continued high uncertainty regarding appropriate estimates for natural mortality rate for both sexes and among a range of ages, the considerable uncertainty regarding the extent to which fish may or may not exhibit movement or other behaviors that would represent "hiding" (e.g., the lack of a well understood mechanism for dome-shaped age-based selectivity for older females), the lack of robust or accepted means of weighting and tuning both mean weight and conditional age at length composition data, and the apparent inability to model recruitment variability in a robust manner.

Axes of uncertainty

Given the very substantive influence on the model result associated with fixing the catchability coefficient in the tagging study, and the relatively reduced sensitivity of the model to other results (changes in M or selectivity) with this parameter fixed, the STAT and Panel agreed that the sensitivity of the model results for the axis of uncertainty should focus on this parameter. As a fixed value of 25% for tag q was recommended at the meeting for the agreed base model, based on the relative recreational catches in the Newport area, the "high productivity" state of nature was proposed in which catchability was fixed at 12.7% (based on the mean of prior distribution for the Tag-Q parameter), and the "low productivity" state of nature was proposed in which catchability was freely estimated. The models associated with these changes provide a considerably wide range of overall biomass scale and current depletion levels that encompass other dimensions that might also be used.

Areas of Disagreement

Among STAR Panel members (including GAP, GMT, and PFMC representatives): None.

Between the STAR Panel and the STAT:

The alternative model analyst, Dr. Sampson, did not agree with the decision to not estimate recruitment deviation values in the final base model. The basis for the disagreement was concern that constraining the model by not allowing for recruitment variation forced the stock dynamics to be driven primarily by the catch series, which Dr. Sampson did not consider to be a tenable assumption.

Future research

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.