

Center for Independent Experts Review

Stock Assessment Review (STAR) Panel for
Blue Rockfish and Black Rockfish

Pacific States Marine Fisheries Commission
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Executive summary of findings

Historically, different rockfish species catches and landings have been combined as a single group simply called rockfish in hard data records. Additionally, there is evidence of substantial rockfish landings from otter trawling particularly in the early 1940s. This means that one of the primary sources of uncertainty in all individual rockfish species assessments is what total rockfish catch there was historically, and what proportion of that catch was the species in question. There is considerable overlap among rockfish species in the places in which they occur, the fishing methods used to capture them, the regulations introduced to limit catches and the fishery-dependent sampling being carried out.

Many of the research questions and techniques that may be used apply equally to each rockfish species. A list of research recommendations for rockfish was developed during the meeting. Until these issues are addressed, they will continue to cause difficulties in the assessment of rockfish stocks into the future. Recommendations included the development of a fishery-independent coast-wide abundance survey, a database for maintenance of catch history, full descriptive analysis of the fisheries to aid CPUE interpretation, standardization of methods of producing abundance indices from recreational fisheries, development of informed priors for q for CPUE and/or tagging studies, examination of spatial and temporal variability in growth, age validation and between reader comparisons, and fine-scale mapping of rockfish species habitat.

Blue rockfish

An assessment of blue rockfish was presented that used non-equilibrium Schaefer logistic production model within the ASPIC modeling framework. The Panel was not satisfied with the attempt to model the blue rockfish stock using the ASPIC model because (a) the ASPIC model failed to converge when both the RecFIN and CPFV CPUE indices were included, (b) many assumptions regarding the population dynamics of the stock needed to be simplified in order to apply the dynamic surplus production model (c) uncertainty would be greatly underestimated, given that much of the available data could not be included.

The Panel believed that it would be possible to develop a simple SS2 model that would be broadly comparable to ASPIC, but also able to accommodate all of the available data and data quality measures as well as allowing more complete evaluation of model assumptions and uncertainty. Such an SS2 or similar model is required to allow an evaluation of the use of a production model such as ASPIC in preference to a length or age structured model for blue rockfish assessment. The Panel considered that in the limited time available, and with no operational SS2 model, it was not possible to produce an adequate assessment during the meeting. A list of essential and desirable features of a revised assessment was developed, and it was recommended that the revised assessment be presented at the “mop-up” meeting in October.

Black rockfish off Oregon and Northern California

An assessment of southern black rockfish was presented that used SS2 with explicit spatial structuring probably for the first time at a STAR Panel review. The areas in this assessment were only linked by their pooled contribution to spawning biomass and the resulting recruits.

A large number of alternative model configurations were explored during the meeting that incorporated changes such as one, two or four areas, different methods for distribution of recruits across areas, estimation of some growth parameters, splitting CPUE series based on when regulation changes occurred, time blocking selectivity by area, reduced weighting on length frequencies, time blocking recruitment proportions and iterative re-weighting of input data sets.

At the end of a series of requests and responses a one area model that included some time blocking of selectivities produced acceptable model diagnostics and plausible results, except that estimated exploitation rates for the Area-A recreational fishery were, in the opinion of the STAT, too high compared to estimates from the Newport tagging study. The Panel did not necessarily agree with the STAT concern because an analysis of the relationship between the tagging estimate of q and that from the assessment had not been carried out. However, there was agreement that an acceptable base model had not been produced during the meeting.

The Panel produced a list of essential elements to include in a revised assessment that included the development of an informed prior on tagging q , capture of catch history uncertainty, a descriptive analysis of recreational fishery CPUE to assist interpretation as an index of abundance, and the provision of more diagnostics for the binomial and positive catch GLMs. Desired elements were to explore alternative stock hypotheses and to continue investigation of explicit spatial structure within the assessment model.

It was agreed that southern black rockfish should be recommended to go to the October “mop-up” meeting after additional work by the STAT to develop a plausible base case.

Black rockfish off Washington

An assessment of northern black rockfish was presented that used SS2. A Petersen tag and recapture study that was explicitly modeled within the previous assessment was included this time as providing a relative abundance index. During the review a number of alternative model configurations were explored that incorporated changes including using the correct CV_growth_pattern in the control file to allow correct interpretation of CV on length at age, alternative catch histories, freeing growth parameters, using a steepness value of 0.6, adding adjustments to the CV on tag abundance, removal of early tagging length composition data, freeing up peak parameter for selectivity for all fisheries, using a base value M male 0.14 and ramp to 0.2 for females, setting λ values to 1 (except length compositions), adding 1983/84 trawl mean size at age data and re-weighting σ_r , length and age compositions.

At the end of a series of requests and responses a base case model was produced that was acceptable, but with a number of deficiencies. The index for tagging abundance was noisy and the trend almost missed all confidence intervals of the observations. Effective q for the tagging index was 0.83 and the STAT thought that this was perhaps twice what it should be. The Panel pointed out that the SS2 value of q is a function of selectivity which is strongly dome shaped for the associated fishery. Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of q based on tagging and the one estimated by SS2. The Panel and STAT agreed that this was the best assessment available at the moment, but there are reservations about the q for the survey and that this dimension was not explored. The STAT was happy to proceed with this base case. They also agreed to use a set of low and high M values and alternative catch history for sensitivity testing.

Strengths of the existing assessment were that SS2 was used which brings the advantage of standards and a well tested package, and that tagging data has been brought into the model.

A weakness was that tagging is not dealt with in the model as a tagging experiment (this is not possible with current SS2, but is being considered). Uncertainty in q was not explored and could have been expressed as a profile. The assessment would be improved if there was an informed prior on q . There is non-independence of the length/age compositions and of the tagging abundance and CPUE series. Sex-specific selectivity had not been explored as an alternative to elevated M for females as a means to produce less older females in the population. The full uncertainty in the catch history had not been explored.

Blue Rockfish

Background

An assessment of the blue rockfish (*Sebastes mystinus*) prepared by the STAT Meisha Key, Alec MacCall, Debbie Aseltine-Neilson, and Kirk Lynn was reviewed by the STAR Panel. The assessment comprised an incomplete draft assessment document provided to the Panel 10 days prior to the meeting, and two attachments provided during the meeting: (1) a report on the results of the pre-assessment workshop and (2) model results and sensitivity analysis using ASPIC (ver. 5.10.3).

Data available for assessment includes commercial and recreational landings and CPUE information from California north of Point Conception. Landings data for the commercial fishery is from the California Cooperative Survey (CALCOM) database, 1969-2006, and recreational landings are from Marine Recreational Fisheries Statistics Survey (MRFSS) from 1980-2003. For 2004-2006, recreational catches were taken from the California Recreational Fisheries Survey (CRFS). Historical landings covering the period 1969 to 2006 were presented using three scenarios: 1) estimated catches, 2) fisherman supplied catch information for some years, and 3) intermediate catches between the two (average catches=base case).

Abundance indices available for assessment were from catch and effort data from Commercial Passenger Fishing Vessel (CPFV) Recreational Fishery Information system (RecFIN) and California Department of Fish and Game (CDFG) CPFV databases. Delta GLM methods were used to derive abundance indices from these sources. In addition, pre-recruit indices were calculated using GLM methods from the South West Fisheries Science Center (SWFSC) juvenile rockfish mid-water trawl survey data. No fishery-independent abundance information is available for blue rockfish.

Age composition information was available for 1979-1984 from the recreational fishery (2300 otoliths), and more recently from groundfish ecological cruises in 2003-2006 (205 otoliths). A subset of 101 otoliths from the recent period that was subject to re-reads was used to determine ageing errors. Length composition data were available from recreational CPFV and private boats, 1980-2006.

The STAT reported problems with the construction of a simple stock reduction analysis using the SS2 (Version 2.0) software. They reported that the model “did not search the parameter space effectively, probably due to combined properties of a flat response surface, and nearness of the maximum likelihood value to the region where a crash penalty is invoked”. In addition, they also had technical difficulties in using the SS2 toolbox GUI. The Panel did not see the input files prepared for the SS2 model, so was unable to comment on those. Because they were unable to obtain a functioning SS2 model, the STAT therefore chose to use the ASPIC production modeling framework for their assessment.

The non-equilibrium Schaefer logistic production model was chosen over the Pella-Thompson parameterization within the ASPIC framework. This requires the estimation of 4 parameters: B_1/K , K , MSY and $CPUE$ q . The base model used the intermediate catch series from 1969-2006 and the RecFIN CPFV $CPUE$ time series from 1980-2006. The ratio B_1/K was fixed at 0.77 (or greater) so that modeled biomass was not driven to unrealistically low levels. Sensitivity tests explored different fixed levels of B_1/K under the base model average catch time series.

It is not possible to use age and length composition data within the ASPIC model framework, so these data were prepared, but not used. The STAT also had difficulties in using both $CPUE$ time series within the same ASPIC model, so presented results using the RecFIN and CPFV $CPUE$ series separately. Pre-recruit abundance indices were also not used.

As I was unfamiliar with ASPIC, I found the assessment document and background material lacked a satisfactory description of the model implementation. I installed the software and looked through the user manual, treating that as a background document, but perhaps the Prager (1994) paper should have been provided.

Review activities

The Panel considered that the uncertainty in historical catch had not been sufficiently explored. The STAT produced three catch series: (1) based on hard data with some missing information matched across different sources, recreational catch from 1969-1979 estimated assuming the same ratio of recreational to commercial catch from the 1980s, and species composition ratios from 1981 to 1983 assumed to apply to other periods where rockfish catches were not recorded per species, (2) based on fishermen's recommendations the RecFIN catches from 1980-1984 were adjusted down to 400 mt per year and an adjustment down of the ratio of recreational to commercial catch from 1969 to 1978, (3) an average of the two previous scenarios. These catch histories did not consider catches prior to 1969. The average scenario (3) would not be considered a best estimate of the catch as the peak periods in scenarios (1) and (2) are quite different.

Regulatory changes in the recreational rockfish fishery include bag limit changes after 1992 from 15 fish to 10, and then in 2002 to five fish, as well as a limit on the number of hooks per line from 5 to 2 in 2000. The effect of such changes on the recreational fishery $CPUE$ indices is uncertain at this stage and requires investigation.

The STAT presented a novel method for filtering which trips are included in the delta GLM based on a logistic regression of blue rockfish presence/absence and categorical presence/absence of explanatory co-occurring species. While showing potential, the method has not been fully tested as a standard technique. More specifically, analyses are required to test sensitivity of results to the choice of threshold probability used to select blue rockfish trips.

Findings

The STAT suggested that available data was well suited to the application of a production model and cited supporting literature for the use of simple production models in stock assessments. However, the Panel was not satisfied with the attempt to model the blue rockfish stock using the ASPIC model. Reasons were that (a) the ASPIC model failed to converge when both the RecFIN and CPFV CPUE indices were included, (b) many assumptions regarding the population dynamics of the stock needed to be simplified in order to apply the dynamic surplus production model, and (c) uncertainty would be greatly underestimated, given that much of the available data could not be included.

The Panel believed that it would be possible to develop a simple SS2 model that would be broadly comparable to ASPIC, but also able to accommodate all of the available data and data quality measures as well as allowing more complete evaluation of model assumptions and uncertainty. Such an SS2 or similar model is required to allow an evaluation of the use of a production model such as ASPIC in preference to a length or age structured model for blue rockfish assessment. The Panel considered that in the limited time available, and with no operational SS2 model, it was not possible to produce an adequate assessment during the meeting.

The STAT remarked to me outside the meeting that they were surprised at the rejection of the ASPIC model by all four reviewers. I can say that all of the reviewers arrived at virtually the same conclusions independently, and did not organize any group consensus outside of the meeting. Such an unanimous view among the reviewers gives me good reason to believe that the review outcomes were from a consistent and considered position.

Conclusions

Recommendations from the meeting were directed towards the production of an assessment for the “mop-up” panel in October.

Lists of essential and desired elements for such an assessment were provided by the Panel. Essential elements were the development of historical catch series that bracket the range of uncertainty, provision of justification for alternative stock hypotheses, a detailed justification for the use of CPUE indices as indices of abundance and an analysis of the effects of regulation changes and blue rockfish trip selection methods, and provision of diagnostics for both the binomial and non-zero GLMs. Desired elements were documentation of historic blue rockfish in Oregon, consideration of catches from Southern California and possibly a kelp index for inclusion in the model, growth estimation in the model using conditional age at length and evaluation of temporal changes in fishery-dependent CPUE q .

A list of research recommendations was developed that applies equally to all of the rockfish assessments. Until these issues are addressed, they will continue to cause difficulties in the assessment of rockfish stocks into the future.

Research recommendations applying to all rockfish species

Historically, different rockfish species catches and landings have been combined as a single group simply called rockfish in hard data records. Additionally, there is evidence (e.g. from Cleaver, 1951) of substantial rockfish landings from otter trawling particularly in the early 1940s. This means that one of the primary sources of uncertainty in all individual rockfish species assessments is what total rockfish catch there was historically, and what proportion of that catch was the species in question. There is considerable overlap among rockfish species in the places in which they occur, the fishing methods used to capture them, the regulations introduced to limit catches, and the fishery-dependent sampling being carried out. Therefore, many of the research questions and techniques that may be used apply equally to each rockfish species. During the course of the meeting, the Panel developed a list of common research recommendations that apply to all rockfish species as follows:

- A fishery independent coast-wide abundance index for all rockfish should be developed using fixed sites and volunteer hook and line fishers properly supervised using standard protocols.
- A database for historical rockfish catch histories should be established that contains “best” guesses of all catches and estimates of uncertainty. Appropriate processes for updating and revising the database should also be developed. The database should have associated metadata that describes assumptions made to create the “best” guess catch history from hard data records.
- A full descriptive analysis of the recreational fisheries and fleets is required to allow improved CPUE interpretation. This should not be limited to “rockfish trips” – interactions with other target species are important.
- Methods for producing recreational CPUE indices need to be developed and standardized. These methods should also deal with the peculiarities of the recreational data and regulation changes.
- Informed priors should be developed for abundance index q values (either from CPUE or tagging) using methods such as described in Appendix 3 (provided by Patrick Cordue).
- Examine spatial and temporal variability in growth for improved parameterization of the assessment model.
- Age validation and between state reader comparisons are needed to develop correct ageing error matrices.
- Fine scale mapping of rockfish habitat is required to give quantitative estimates of areas where the species occur (which will inform abundance index q_s).

Given the similarity in methods for dealing with the different rockfish species, and particularly the biological similarity of the northern and southern black rockfish, there is still further scope to standardize assessment data preparation and analysis across assessment teams. For example, the Panel attempted to bring the input SS2 biological parameter values chosen by the northern and southern black rockfish STATs into closer alignment during the meeting. Such work should continue outside STAR Panel reviews through coordination among the rockfish STATs.

Black Rockfish off Oregon and California

Background

An assessment of the black rockfish (*Sebastes melanops*) off Oregon and California prepared by the STAT David Sampson was reviewed by the STAR Panel. The assessment comprised an incomplete draft assessment document provided to the Panel 10 days prior to the meeting.

The draft assessment used the Stock Synthesis 2 (SS2) modeling framework and assumed a unit stock in the waters off Oregon and California, covering the PMFC statistical areas from 1B (in the south) to 2C (in the north). Considerable effort had been made to develop a plausible reconstruction of historical landings extending back to 1915, taking into account anecdotal information that black rockfish formed a significant portion of large rockfish landings by otter trawlers in the early 1940s.

The model used SS2 explicit spatial structuring probably for the first time at a STAR Panel review. The areas in this assessment were only linked by their pooled contribution to spawning biomass and the resulting recruits. There were four areas defined by aggregating adjacent Pacific Marine Fisheries Commission (PMFC) areas - Areas A & B are off Oregon, and areas C & D off California. Three different fisheries were defined in each area: recreational, commercial hook and line, and commercial trawl, giving a total of twelve fleets.

Fishery dependent CPUE indices were calculated using delta GLMs from recreational fisheries data from RecFIN for all areas, the Oregon Ocean Recreational Boat Survey (ORBS) for areas A and B, CPFV for area D only.

Length frequencies were available for all areas from RecFIN MRFSS for sexes combined, and from ORBS by sex for Oregon. Age composition data are available from the recreational fishery mostly from Oregon.

Estimates of the exploitation rate from a tag and recapture program off Newport were presented, but not explicitly included in the assessment model.

Although the STAT was not satisfied with the base model presented to the meeting, they were willing to work with the Panel to explore a wide range of alternative models in an effort to establish a base case. Data preparation had been a substantial task for the STAT prior to the meeting, but the good state of the input data sets allowed such an effort during the meeting.

Review activities

A large number of alternative model configurations were explored that incorporated changes such as one, two or four areas, different methods for distribution of recruits across areas, estimation of some growth parameters, splitting CPUE series based on when

regulation changes occurred, time blocking selectivity by area, reduced weighting on length frequencies, time blocking recruitment proportions and iterative re-weighting of input data sets.

At the end of a series of requests and responses a one area model that included some time blocking of selectivities produced acceptable model diagnostics and plausible results, except that estimated exploitation rates for the Area-A recreational fishery were, in the opinion of the STAT, too high compared to estimates from the Newport tagging study. The Panel did not necessarily agree with the STAT concern because an analysis of the relationship between the tagging estimate of q and that from the assessment had not been carried out. However, there was agreement that an acceptable base model had not been produced during the meeting.

Findings

The relative weighting given to the various input data sets was one of the principal sources of uncertainty at least for the models examined during the meeting, causing a major change in the result for a number of model scenarios. Main dimensions of uncertainty suggested by the Panel in relation to the base case were high and low M values, and alternative catch histories.

Application of a spatially explicit model shows considerable promise for stocks such as this one that apparently exhibit quite different abundance trends in different areas. A disadvantage right now is that the technique is new within the SS2 framework, and experience with the advantages and pitfalls of its application has not yet had time to develop. My own view is that spatially explicit models should be developed in parallel with single area models in the early stages so that advantages and disadvantages of adding the spatial dimension can be evaluated more easily for the stock in question.

The Panel produced a list of essential elements to include in a revised assessment that included the development of an informed prior on tagging q , capture of catch history uncertainty, a descriptive analysis of recreational fishery CPUE to assist interpretation as an index of abundance and the provision of more diagnostics for the binomial and positive catch GLMs. Desired elements were to explore alternative stock hypotheses and to continue investigation of explicit spatial structure within the assessment model.

Conclusions

The Panel and STAT agreed that southern black rockfish should be recommended to go to the October “mop-up” meeting after additional work by the STAT to develop a plausible base case.

Research recommendations listed for all rockfish in the blue rockfish section of this report were all reiterated as important for improvement of the southern black rockfish assessment.

Black Rockfish off the Washington Coast

Background

A draft assessment of black rockfish (*Sebastes melanops*) off the Washington coast prepared by the STAT Farron Wallace, Yuk Wing Cheng and Tien-Shui Tsou was reviewed by the STAR Panel. Biological features unusual to this stock were discussed, including the lack of old females in population samples compared to numbers of males. It may be that females provide sustenance to the young and therefore have a “harder” life than males, and are therefore killed off more quickly than males. Alternatively, there may be a sex-specific selectivity difference – for example caused by settlement of females on the bottom or moving off the reefs and becoming less available to the fishery and therefore hidden. In short, modeling methods to deal with these alternative methods for dealing with older females may be termed “kill them or hide them” methods.

Modeling selectivity separately by sex is managed in SS2 using offset values, so the previous method using a change to a higher M for older females (kill them) is the only option that has been explored at present. Sex-specific selectivity (hide them) should be pursued as an option in the future. The STAT also pointed out that black rockfish may have unusual breeding habits where about 10% of the older females don't appear to spawn in any year.

Input data are available from three main fisheries – commercial trawl, commercial non-trawl and recreational sport fishery. Known catches commence in 1963 for trawl, 1970 for non-trawl and 1975 for the sport fishery. It is known that the species was caught back to at least the 1940s, so historical catches were reconstructed by assuming a linear increase from 1940 to the 1964-65 average for trawl and 1974 for the sport fishery. The non-trawl fishery was assumed to commence with a linear increase starting in 1950 to 1969. Particularly in early years, black rockfish were not identified at the species level in catches, and were recorded as part of a combined catch of all rockfish. Ratios from periods where the black rockfish fraction of the catch was known have been applied to unknown periods for each fishery. Some of this procedure was presented by the STAT, but a complete detailing of all of the assumptions made to generate the historical catch series is required.

Size and age composition samples commencing in 1976 are available for each of the fisheries. The Panel noted that the size samples often include the same fish in the age samples, so there is not complete independence of these series. Abundance indices are available from a tagging program that commenced in 1981 as Petersen tag and recapture estimates and also a CPUE from tagging effort.

Statistical methodology for deriving the Petersen estimates from tag-recapture, sex-specific length-weight and age-length relationships, aging error, age-weight conversion errors, age-length-maturity relationships, total mortality and natural mortality were presented. The Panel noted that there was a residual pattern in the fitted relationship used to estimate tag loss for spaghetti tags, suggesting a non-linear relationship. Also, in fitting

fecundity, the model has a positive intercept, so is not strictly proportional to weight. The Panel suggested that effort used in the M estimation should be from all sources of mortality, and not just the sport fishery, and that there is also an element of double use of the data if these estimates are used in the assessment. However, total and natural mortality estimates from these procedures were not used in the assessment, and were provided for information and comparison with estimates from other sources.

The tagging program is carried out off Westport by volunteers, and the effort measure is the number of rod hours. Tagging is mostly done before the commencement of the sport fishery each year. Recaptures are from the wider sport fishery. Although several boats were probably used early in the program, most of the tagging is done from a single vessel. The region tagged is the same each year, but not the exact positions. From 1998 onwards the effort was distributed according to known black rockfish habitat, but before that was across all areas. The Panel noted that Petersen population estimates are from the same tagging effort that produces the tagging CPUE, so there is possibly a problem with independence of these two series.

The STAT thought that the q value for the tag Petersen index should be about 0.3 or less, as the survey covers about that portion of the available habitat along the central Washington coast, but in models presented, q was estimated and the index is used as relative index. The CV for the tag index used in the model was 0.6, and the index values were in numbers of fish. Calculated values for the survey CV range from about 0.1 to 0.25. The distribution of the recapture fleet changes through time due to economic factors. The Panel noted that it is questionable whether the assumption of mixing between tag and release holds depending on how far the tagged fish move, and the extent of overlap between tagging and release fishing effort. It is not possible to determine from returns where the fish were caught. The STAT pointed out that 80% of fish move less than about 10 miles. The Panel noted that it would be worthwhile to carry out a study to determine whether there has been any trend in the recapture fleet that may cause a bias in this index.

Selectivity for tag release is different to the sport fishery because fishing is shallower in the water column to avoid barotrauma. The release selectivity is showing as more dome shaped in the stock assessment than the sport fishery. It may be that the sex ratio is affected by this as well.

A CPUE index is also available from the sport fishery. The STAT presented results of standardization of the sport fishery CPUE using a delta lognormal GLM, but did not use this index in the assessment as they regarded it as not reflecting abundance due to the effects of changes in bag limits and a switch to bait fishing in the early to mid-1990's.

The coast wide recruitment survey has not been used as there are only 6 years of data available from this source, which the STAT considers too limited to use at this stage.

The age-specific mortality function for females uses age at first and full maturity for inflections (10 and 15). The base natural mortality rate of 0.14 for males and females was

found by previously freeing and fitting it within SS2, and the base rate for mature females of 0.22 was found by comparison of models external to SS2.

Results from SS2 model presented by the STAT show a large 1999 year class that is now 7/8 years old, forming a central portion of the fishery. By the mid-1990s length compositions and age compositions from the sport fishery show a definite truncation of older age classes indicating an impact of fishing.

The draft base model estimates l_{\min} , l_{\max} and K growth parameters, but does not include mean size at age data. Alternative model scenarios were presented that include mean size at age data from the trawl fishery and the sport fishery estimating l_{\min} (at age 5) and l_{\max} .

Fits to length and age composition likelihood components were best for the range of models presented for high values of M. High M values are associated with higher 2006 SSB values (in the order of 10,000 t).

Review activities

There was Washington catch landed in Astoria in the 1940s that may have contained large catches of black rockfish based on anecdotal information from Cleaver (1951). The Panel was concerned that the current reconstruction of historical catch does not capture any of this uncertainty and suggested that as a first step, an alternative catch history be developed that accounts for such a potentially large historical catch, and that historical catches may have commenced in about 1915.

For both the trawl and sport fishery to some extent, there is a general underestimation of fish at older ages. The peak parameter for selectivity has been fixed, so these results suggest that it needs to be estimated.

Expected length frequencies show marked spikes, indicating the CV on length at age needs to be increased (CV_growth_pattern was set to 3 instead of 0).

The model has difficulty fitting length compositions from the tagging fleet prior to about 1990, and the Panel suggested that they might need to be down-weighted or disregarded.

Models presented had recruitment λ set to 0.1 and σ_r set to 0.55 which was the RMSE for one of the model runs after using an initial value of 0.6. The Panel suggested setting all λ values back to 1 and re-weighting σ_r based on the RMSE value from the same model.

Best likelihood values for M were high at 0.2 for males and 0.26 for females. Best fits to Petersen tag abundance only were for lower values of M, but the STAT thought that those values for M seemed unrealistic. The Panel suggested that M was a primary source of model uncertainty, and that it might be possible to select a range of M values that could be used for sensitivity testing that could be the same for the northern and southern black rockfish assessments. The Panel also noted that M values used for southern black rockfish were generally lower than those used for northern.

The Panel suggested a value of 0.6 instead of 0.7 for steepness for consistency with the southern black rockfish assessment.

A number of alternative model configurations were explored that incorporated changes including using the correct CV_growth_pattern in the control file to allow correct interpretation of CV on length at age, alternative catch histories, freeing growth parameters, using a steepness value of 0.6, adding adjustments to the CV on tag abundance, removal of early tagging length composition data, freeing up peak parameter for selectivity for all fisheries, using a base value M male 0.14 and ramp to 0.2 for females, setting λ values to 1 (except length compositions), adding 1983/84 trawl mean size at age data and re-weighting σ_r , length and age compositions.

At the end of a series of requests and responses a base case model was produced that was acceptable, but with a number of deficiencies. The index for tagging abundance was noisy and the trend almost missed all confidence intervals of the observations. Effective q for the tagging index was 0.83 and the STAT thought that this was perhaps twice what it should be. The Panel pointed out that the SS2 value of q is a function of selectivity which is strongly dome shaped for the associated fishery. Without an objective evaluation of an informed prior on q it is difficult to compare a prior conception of q based on tagging and the one estimated by SS2. The Panel and STAT agreed that this was the best assessment available at the moment, but there are reservations about the q for the survey and that this dimension was not explored. The STAT was happy to proceed with this base case. They also agreed to use a set of low and high M values and alternative catch history for sensitivity testing.

Findings

The major uncertainties in the assessment are the relationship of model q and that estimated from tagging, the sex-specific natural mortality rate, and whether sex-specific selectivity provides a viable alternative mechanism to explain lower numbers of older females in the population.

I find the “hide them” hypothesis for older females to be an interesting alternative, although I am also wary of models that include cryptic spawning biomass. Cryptic spawning biomass scenarios may produce populations where higher catch levels are possible in comparison to populations without the cryptic component. A conservative approach would not allow acceptance of such a hypothesis without strong direct evidence from field observations that the cryptic portion of the population actually exists. Comments from a fisherman at the meeting suggested that fishers know where to find concentrations of older females. Such observations require verification.

Conclusions

The STAT and Panel agreed to proceed with the base case developed during the meeting. They also agreed to use a set of low and high M values and alternative catch history for sensitivity testing.

Strengths of the existing assessment were that SS2 was used which brings the advantage of standards and a well tested package, and that tagging data had been brought into the model.

A weakness was that tagging was not dealt with in the model as a tagging experiment (this is not possible with current SS2, but is being considered). Uncertainty in q was not explored and could have been expressed as a profile. The assessment would be improved if there was an informed prior on q . There is non-independence of the length/age compositions and of the tagging abundance and CPUE series. Sex-specific selectivity has not been explored as an alternative to elevated M for females as a means to produce less older females in the population. The full uncertainty in the catch history has not been explored.

Research recommendations listed for all rockfish in the blue rockfish section of this report were all reiterated as important for improvement of the northern black rockfish assessment.

Appendix 1. Bibliography of materials provided by the Center for Independent Experts

I. Current Draft Stock Assessments

- A. Assessment of Blue Rockfish (*Sebastes mystinus*) in California.
Meisha Key, Alec D. MacCall, Debbie Aseltine-Neilson, and Kirk Lynn.
- B. Status of the black rockfish resource off the Washington Coast in 2006.
Farron R. Wallace, Yuk Wing Cheng, and Tien-Shui Tsou.
- C. *TO BE DISTRIBUTED VIA EMAIL:*
Status of black rockfish off Oregon and California. David Sampson.

II. Background Materials

- A. 2006 Workshop Summary Reports
 1. A Summary Report from the NWFSC Bottom Trawl Survey Workshop held October 31 – November 2, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
 2. A Summary Report from the WC Groundfish Data/Modeling Workshop held August 8-10, 2006 in Seattle, Washington. NOAA Fisheries, NWFSC, FRAM Division.
 3. Report of the Groundfish Harvest Policy Evaluation Workshop, Southwest Fisheries Science Center, La Jolla, California. December 18-20, 2006. A Workshop Sponsored by the Scientific and Statistical Committee of the Pacific Fishery Management Council
 4. Pre-Recruit Survey Workshop. September 13-15, 2006. Southwest Fisheries Science Center, Santa Cruz, California. A Summary Report Prepared by Jim Hastie NOAA Fisheries, Northwest Fisheries Science Center and Stephen Ralston, NOAA Fisheries, Southwest Fisheries Science Center.
- B. Previous Black Rockfish Assessment and STAR Panel Reports
 1. The Status of Black Rockfish (*Sebastes melanops*) Off Oregon and Northern California in 2003, Stephen Ralston and E. J. Dick. 2003
 2. STAR Panel Report for Black Rockfish, April 20-25, 2003.
 3. The Status of The Black Rockfish Resources in 1999. Farron R. Wallace, Annette Hoffmann, and Jack V. Tagart. 1999.
 4. Black rockfish STAR Panel Meeting Report, June 20-24, 2005.
 5. STAR Panel Report 1999. May 24-28, 1999
 6. Black Rockfish STAT Executive Summary. 1999. Farron R. Wallace, Annette Hoffman, and Jack V. Tagart
- C. SS2 Model Related
 1. SS2 Zip File – includes User’s Manual, example files, and powerpoint presentations
 2. R Software Zip File – Code developed by Ian Stewart to perform model diagnostics and plotting of SS2 output. This is not an official SS2 add-on and is not part of the NOAA toolbox. File contains User’s Guide, example files as well as powerpoint presentations.
- D. Terms of Reference (TORs) for the West Coast Groundfish Stock Assessment and Review Process for 2007-2008. The Scientific and Statistical Committee (SSC) of the Pacific Fishery Management Council. 2006.

- E. GAO Report: Pacific Groundfish: Continued Efforts Needed to Improve Reliability of Stock Assessments. United States General Accounting Office, Report to Congressional Requesters. June 2004.
- F. Coastwide Pre-Recruit Indices from SWFSC and PWCC/NWFSC Midwater Trawl Surveys (2001-2006). Stephen Ralston. April 6, 2007.
- G. Estimation of black rockfish (*Sebastes melanops*) exploitation rates from mark-recapture data for the recreational fishery off Newport, Oregon. Troy V. Buell, Steven J. Parker, and Robert W. Hannah. 2007. (Provided by David Sampson).

III. Meeting Materials

- A. Draft Agenda
- B. STAR Panel Meeting Location Information
- C. Driving Directions to PSMFC
- D. List of STAR Panel Participants

Appendix 2. Statement of work

Consulting Agreement between the University of Miami and Dr. Neil Klaer

Statement of Work

April 16, 2007

General

The Stock Assessment Review (STAR) meeting is a formal, public, multiple-day meeting of stock assessment experts who serve as a peer-review panel for one or more stock assessments. External, independent review of West Coast groundfish stock assessments is an essential part of the STAR panel process that is designed to make timely use of new fishery and survey data, analyze and understand these data as completely as possible, provide opportunity for public comment, and assure the best available science is used to inform management decisions.

The stock assessments will report the status of the black rockfish and blue rockfish resources off the west coast of the United States using age and/or size-structured stock assessment models. Specifically, the information includes a determination of the condition and status of the fishery resources relative to current definitions for overfished status, summaries of available data included in the models, and impacts of various management scenarios on the status of the stocks. The information is provided to the Pacific Fishery Management Council and NOAA's National Marine Fisheries Service to be used as the basis of their management decisions, which are subsequently approved and disseminated by the Secretary of Commerce through NOAA and NMFS.

The consultant will participate in the Stock Assessment and Review (STAR) Panel of the Pacific Fishery Management Council (PFMC) for the review of the black rockfish and blue rockfish stock assessments. The consultant should have expertise in fish population dynamics with experience in the integrated analysis type of modeling approach, using age- and size-structured models, use of MCMC to develop confidence intervals, and use of Generalized Linear Models in stock assessment models.

The Pacific Fishery Management Council's Scientific and Statistical Committee requests that "all review panelists should be experienced stock assessment scientists, i.e., individuals who have done actual stock assessments using current methods. Panelists should be knowledgeable about the specific modeling approaches being reviewed, which in most cases will be statistical age- and/or length-structured assessment models" (SSC's Terms of Reference for Stock Assessments and STAR Panel Process for 2007-2008)

Documents to be provided to the consultants prior to the STAR Panel meeting include:

- Current drafts of the black rockfish and blue rockfish stock assessments;
- Most recent previous stock assessments and STAR panel reports for black rockfish (this is the first assessment for blue rockfish);
- An electronic copy of the data, the parameters, and the model used for the assessments (if requested by reviewer);
- The Terms of Reference for the Stock Assessment and STAR Panel Process for 2007-2008;
- Summary reports from the West Coast Groundfish “Off-Year” stock assessment improvement workshops held in 2006;
- Stock Synthesis 2 (SS2) Documentation; and
- Additional supporting documents as available.

Specifics

Consultant’s duties should not exceed a maximum total of 14 days: several days prior to the meeting for document review; the 5-day meeting; and several days following the meeting to complete the written report. The report is to be based on the consultant’s findings, and no consensus report shall be accepted.

The consultant’s tasks consist of the following:

- 1) Become familiar with the draft stock assessments and background materials.
- 2) Actively participate in the STAR Panel to be held in Portland, Oregon from May 21-25, 2007. Participants are strongly encouraged to voice all comments during the STAR Panel so the assessment teams can address the comments during the Panel meeting.
- 3) Comment on the primary sources of uncertainty in the assessment.
- 4) Comment on the strengths and weaknesses of current approaches.
- 5) Recommend alternative model configurations or formulations as appropriate during the STAR panel.
- 6) Complete a final report after the completion of the STAR Panel meeting.
- 7) No later than June 8, 2007 submit a written report consisting of the findings, analysis, and conclusions (see Annex I for further details), addressed to the “University of Miami Independent System for Peer Review,” and sent to Dr. David Die, via e-mail to ddie@rsmas.miami.edu, and to Mr. Manoj Shivlani, via e-mail to mshivlani@rsmas.miami.edu.

Submission and Acceptance of Reviewer's Report

The CIE shall provide via e-mail the final reports of the consultants in pdf format to Dr. Lisa L. Desfosse for review by NOAA Fisheries and approval by the COTR, Dr. Stephen K. Brown by June 22, 2007. The COTR shall notify the CIE via e-mail regarding acceptance of the report. Following the COTR's approval, the CIE shall provide the COTR with pdf versions of the final report.

ANNEX 1: Contents of Panelist Report

1. The report shall be prefaced with an executive summary of findings and/or recommendations.
2. The main body of the report shall consist of a background, description of review activities, summary of findings (including answers to the questions in this statement of work), and conclusions/recommendations.
3. The report shall also include as separate appendices the bibliography of all materials provided by the Center for Independent Experts and a copy of the statement of work.

Appendix 3. Development of an informed prior for a CPUE proportionality constant

The development of an informed prior for an abundance-survey proportionality constant (q) is relatively common in New Zealand (e.g., see hoki and orange roughly stock assessments in Sullivan et al. 2006). A prior is often useful to help stabilize stock assessment results and, in a full Bayesian assessment, provides a natural method for incorporating ancillary information into an assessment. Also, comparison of the estimated q with the prior provides a useful diagnostic for point-estimate assessments or a full Bayesian assessments (posterior compared with prior). Informed priors for CPUE qs have never been developed in New Zealand, but there is no theoretical reason why they should not be.

For assessments that depend largely on CPUE indices for abundance information an informed prior on a CPUE q could be very useful for ground-truthing assessment results. The equations of a simple model which could be used to develop CPUE q priors are given below. Not all details are covered – this is the presentation of a concept rather than a definitive method.

Let X be a CPUE abundance index in a given year for a given species and area. Assume that it is part of a time series (GLM standardized or not) and that the units of the catch rate have been retained (e.g., numbers per angler hour).

By definition,

$$E(X) = qN$$

where N is the total number of fish in the vulnerable population (i.e., the fish selected by the associated fishery). Further, assume that the CPUE index is proportional to density:

$$E(X) = \alpha d$$

where d is the average density across “fishing spots” (i.e., the specific areas which are fished) and α is a proportionality constant. Note the distinction between q and α ; they are both unknown proportionality constants, but one relates density to catch rate and the other relates catch rate to population numbers. We need to express q in terms of its components – which we know something about – in order to develop a prior for q , and α is one of those components. The other main component is the area occupied by vulnerable fish.

Let,

A = total area of fishing spots

D = total background area (areas not fished, but which contain vulnerable fish)

b = average background density where $b = \beta d$.

Then,

$$N = dA + bD = d(A + \beta D)$$

and

$$E(X) = \alpha d = \frac{\alpha N}{A + \beta D}$$

Hence,

$$q = \frac{\alpha}{A + \beta D}$$

The denominator in this equation appears tractable. Certainly something is known about the area of the “total habitat” ($A + D$) and the area fished (A). Also, it is not too difficult to obtain suitable experimental data on the relative densities found in the “fishing spots” and the “background” (using the specified fishing method).

The numerator appears to be more difficult. How does catch rate (in a fishing spot) relate to the underlying density? Clearly α is a function of several variables and could be highly species specific. Certainly, the relationship between density and catch rate will vary, even for a given species, by time of day and season and many other factors. However, α relates an average density (over all fishing spots) to an expected catch rate for an associated CPUE index (so daily and seasonal variation are not a particular concern).

One way to explore potential ranges for α is through a simulation study. It might be possible analytically but it would be much easier to simply simulate fishing under a number of different conditions – e.g., density, clusters of lines and hooks, biting probabilities, “effective hook volumes” - and examine the relationship between catch rates and fish densities. Depending on the sub-model used, it may be that information/opinions on values of the sub-model parameters could be available.

There are at least two alternatives which could be supplementary to or used instead of such a simulation study. First, it may be possible to use a depletion experiment design (which need not be destructive - perhaps some/most fish could be retained alive in tanks and later returned to the fishing spot). Second, there may be some comparable species which have reliable assessments which include CPUE indices – and the estimates of their CPUE qs could be “borrowed” (this could be possible for q if the areas are comparable, otherwise it could be done for α if there is information on the habitat area for the comparable species).

References

Sullivan, K.J. et al. 2006. Report from the fishery assessment plenary May 2006: stock assessments and yield estimates. (Draft document available from the N.Z. Ministry of Fisheries.)

