GOPHER ROCKFISH

STAR Panel Report

Southwest Fisheries Regional Office
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STAR Panel members:

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STAT Team Members Present:

Meisha Key, California Department of Fish and Game
Alec MacCall, Southwest Fisheries Science Center
Traci Bishop, California Department of Fish and Game

Overview

The STAR Panel was convened to review a draft assessment by the gopher rockfish STAT Team, comprised of Meisha Key, Alec MacCall, Traci Bishop, and Bob Leos. A first draft of the gopher rockfish (*Sebastes carnatus*) assessment was provided to STAR panel members in advance of the review meeting. A second draft was provided at the meeting. Meisha Key summarized the draft assessment which included a complete description of the biology, fishery, and available data sources to assess gopher rockfish status. She also described the relevant features, settings, assumptions and results for an initial Stock Synthesis (SS2) base model. Following this presentation, the STAR Panel requested a number of additional detailed data summaries and analyses to evaluate data quality, catch estimation, appropriateness of model assumptions as well as interpretation of results.

This is the first assessment of gopher rockfish, and the assessment considered only the component of the stock north of Pt. Conception. The new assessment contained all readily available biological information on the length-weight relationship, age, growth, maturity, and migratory behavior (from tagging studies) of this nearshore rockfish species. The STAT team collected data on recreational and commercial fishery removals of gopher rockfish from RecFIN, MRFSS, CPFV, CFIS, CALCOM, and related databases. Because these databases are not comprehensive, the STAT team developed estimates of commercial catches during 1965-1968, recreational catches during 1965-1982, and recreational discards during 1965-1983, 1985, 1987, 1989-1992, and 1999. Commercial fishery length frequency composition data were available during 1992-2004. Recreational length frequency composition data were collected from RecFIN (1986, 1993-2004) and CPFV (1987-1998) databases. Two recreational catch-per-unit effort (CPUE) series were also developed using general linear model (GLM) analyses of data from RecFIN and CPFV databases. These CPUE series were used as relative abundance indices in the initial model configurations.

The STAR panel and STAT team discussed the estimation of historical recreational and commercial landings as well as recreational discards. After comparing alternative assumptions and methods to calculate the historical catches, panel and team members agreed on the most appropriate estimates of recreational and commercial catch series. The STAR panel team also discussed the interpretation of model diagnostics and results for the initial model configurations. This led to a comparison of alternative model configurations and results that were provided by the STAT team. The STAR panel had a thorough discussion about the utility of the RecFIN CPUE series as a measure of relative abundance. Overall, the panel concluded that the RecFIN CPUE series did not provide a reliable measure of relative abundance due to changes in regulations and fishery targeting during the 1990s-2000s.

Based on these discussions and the comparisons of various model configurations, the STAR Panel and STAT Team agreed on a baseline model with the primary components: commercial and recreational fishery catches during 1965-2004; recruitment estimation during 1965-2000; one relative abundance index based on the CPFV CPUE series during

1987-1998; commercial length composition data for 1992-2004; recreational length composition data for 1986-2004; natural mortality of M=0.2; fixed growth parameters; and the CPFV CPUE emphasis set to 5.

The STAR panel concluded that the gopher rockfish assessment was based on the best available data. This new assessment constitutes the best available information on gopher rockfish status determination for the stock north of Pt. Conception. It also shows the likely range of uncertainty in assessment results. The STAR panel thanks the STAT team for their hard work, professionalism, and diligence in responding to panel requests.

Analyses requested by the STAR Panel

1) Provide further details on recreational and commercial gopher rockfish catch estimates as well as catch estimates from the group gopher market category. The STAR panel expressed concerns about the use of an average annual ratio of commercial to recreational catches during 1983-2004 to estimate recreational catches prior to 1983. Time trends in these annual ratios along with skewness in the distribution of ratios suggested that use of the ratio based on the entire time series may be inappropriate. The STAT team provided an alternative analysis using the ratio of the sums of commercial to recreational catches during the 1980s. This alternative was accepted as the basis for estimating historical recreational catches. The STAR panel also requested that the methods to estimate gopher catches in the group gopher market category be clarified. A description of the methods used to calculate recreational catches, commercial landings, and group gopher catch estimates will be provided in the final assessment document. A table showing the total annual catch from each source that was used in the assessment will also be provided.

2) Show number of length frequency samples by source and year. This information was provided by the STAT team during the meeting and will be included in the final assessment.

3) Provide the analysis of deviance tables and factor coefficients for the GLM analyses of CPUE data, as well as the fraction of available trip records used in the RecFIN GLM. This information was not available at the meeting due to logistical constraints but will be provided in the final assessment.

4) Provide further information on regulations affecting the targeting of gopher rockfish by recreational and commercial fisheries. Some of this information was provided in Appendix 1 of the draft assessment document. This information was requested by the STAR panel to document the magnitude of changes in fishery regulations during the 1990s-2000s. An appropriate summary will be provided in the final assessment.

5) Include recreational discards in the total recreational fishery catch input to the assessment model. The STAR panel was concerned that the discard likelihood component of models that input recreational discard as a fraction of recreational landings was not well-specified. The STAT team re-configured the assessment model to include the recreational discard in the overall recreational fishery catch during the meeting. The practical effect of including the discard estimates in the total recreational catch was moderate but the interpretation of model likelihood components was greatly improved.

6) Provide plots of standardized residuals and trends separately for commercial and recreational length frequency composition data. The STAT panel provided the requested plots during the course of the meeting. Plots for the baseline model will be included in the final assessment document.

7) Conduct model runs to show the effects of removing the RecFIN CPUE series due to regulation changes and estimating recruitment starting in 1980 using a fixed steepness of h=0.65 with the revised historical recreational catches and commercial landings. These runs were requested to show the effect of alternative assumptions about model configuration. The results showed that the model was relatively insensitive to the inclusion of RecFIN CPUE, which was poorly fit. The results also showed that the effect of assuming a lower steepness of h=0.65, in comparison to h=1 in the initial baseline model, was moderate. In contrast, model results were more sensitive to the choice of the initial year to estimate recruitment deviations.

8) Conduct model runs to investigate the effects of estimating recruitment starting in 1930. These runs were requested to investigate the consequences of assuming an earlier start year of 1930 for estimating recruitment (starting year was 1965 in the initial model configuration). Results showed that the model did not converge assuming a steepness of h=0.65. In contrast, the results with h=1 were similar to the initial baseline model but required over 30 more parameters. Overall, these runs suggested that estimating a longer time series of recruitment deviations was not warranted, given the available length frequency data.

9) Conduct model runs to investigate the effects of changing the emphasis on the CPFV CPUE series. After removing the RecFIN CPUE as an abundance index, the STAR panel focused on the relative importance of the CPFV CPUE series as the only measure of relative abundance. The STAR panel requested model runs where the emphasis on the CPFV index was from 0.5, 1, 5, 10, and 100 using a steepness of h=0.65. The model configuration with a CPFV emphasis of 100 did not converge indicating that this value of emphasis was not appropriate. Results for the other emphasis values showed that the pattern of spawning biomass trend varied with CPFV emphasis and was more sensitive in recent years. Recruitment also scaled with CPFV emphasis but exhibited a consistent pattern of relatively higher recruitment in the 1990s. Model fits to the CPFV index improved when CPFV emphasis was 1 or more.

10) Complete a final base model run with two alternative CPFV emphasis values to bracket the uncertainty in choice of fitting the relative abundance index versus fitting length frequency data.
The STAR panel and STAT team agreed that it was appropriate to increase the emphasis on the CPFV CPUE index by a factor of 5 relative to the emphasis on the length frequency data in the final base model. This was deemed appropriate because the gopher rockfish length frequency data were relatively sparse and were not likely to capture the spatial heterogeneity in the length composition (see for example, the differences in length frequencies between the Davenport and Natural Bridges collections near Santa Cruz). In this case, statistical computations of the natural weightings of the data sources were not judged to be reliable.

<u>Final base model included:</u>

<u>Data</u>
Commercial and recreational catches from 1965-2004
CPFV CPUE abundance index during 1987-1998
Do not use RecFIN CPUE abundance index
Commercial length composition data for 1992-2004
Recreational length composition data for 1986-2004

<u>Final base model</u>
Begin model in 1960 at equilibrium catch
Use Beverton-Holt stock-recruitment model with fixed steepness of 0.65
Fix M at 0.2.
Fix length at age coefficient of variation at 0.06.
Estimate recruitment during 1965-2000
Set CPFV CPUE emphasis to 5 for base model versus 1 for low scenario and 10 for high scenario

The STAR panel and STAT team assigned subjective probabilities to the base model as well as the bounding scenarios. They jointly assigned relative probabilities of 0.4 to the base model, 0.38 to the CPFV emphasis equal 10 model, and 0.22 to the CPFV emphasis equal1 model.

11) Complete a decision table. Conduct appropriate projections under the 40-10 harvest policy through 2016 under the base model and 2 bounding scenarios. The decision table is to be completed by STAT team and included in the final assessment document.

Technical merits and/or deficiencies in assessments
The model is technically sound. The model structure is relatively simple, which is appropriate given the very limited reliable data available.

The STAT Team is commended for their substantial efforts in putting this new assessment together and their responsiveness to STAR Panel requests. Their approach to developing a CPUE index using RecFIN data was useful. Any perceived deficiencies in the assessment are likely the result of inadequate fishery and biological sampling or poor data.

Areas of disagreement regarding STAR Panel recommendations

There were no major sources of disagreement between the STAR panel and STAT team. The STAT team did assign relative probabilities of 0.5 for the base model, 0.5 for the CPFV emphasis equal 10 model, and 0 for the CPFV emphasis equal to 1 model, which differed from the Panel's relative probabilities.

Unresolved problems and major uncertainties

A major uncertainty in this assessment is the use of recreational CPUE to measure the relative abundance of gopher rockfish. There are three primary concerns. First, CPUE may not be proportional to stock size. A primary mechanism for a nonproportional relationship would be due to choice of fishing in high CPUE/density areas and a lack of sampling in low abundance areas. This may lead to hyperstability in CPUE indices, e.g., CPUE decreasing more slowly than actual abundance. Alternatively, CPUE might decrease more rapidly than abundance (hyperdepletion), although mechanisms for this behavior are less likely, with the exception of fixed gear fisheries. Second, technological improvements in fishing equipment may have improved recreational and commercial catch rates independent of stock size. Such technological changes are difficult to quantify but should be considered in the interpretation of CPUE series as measures of relative abundance. Third, changes in fishery targeting and changes in fishery regulations may substantially alter the expected relationship between CPUE and stock abundance. This concern may be particularly important in multispecies fisheries where changes could affect several species in differing ways. Each of these concerns are sufficient to bring into question the accuracy of abundance trends derived from CPUE series as used in an assessment model.

To address the first concern, it would be useful to consider a model that has a nonlinear (for example, power-law) relationship between CPUE index and stock size. However, it must also be recognized that there may be insufficient information to estimate such a nonlinear relationship since it will require at least one more parameter to be estimated. Sensitivity analyses that fix the nonlinear parameter at a plausible value could be conducted to show its possible effect. To address the second concern, it would be useful to consider an adjusted CPUE sensitivity analysis, where the calculated CPUE is deflated by a multiplicative factor each year, e.g., multiply CPUE in year T by a discount fishing power rate 1/(1+d) raised to the Tth power. To address the third concern, it may be useful to separate a single CPUE index into two or more indices that reflect appropriate time blocks reflecting changes fishery targeting or regulations. However, such splitting of a CPUE series would reduce its relative length and relative importance as an abundance index through time.

Research recommendations

There are two categories of research recommendations, those specific to gopher rockfish, and those applicable to all rockfish.

Gopher rockfish recommendations

Additional length and age composition data should be collected for gopher rockfish. This would help to characterize spatial and possibly temporal variation in growth.

Generic rockfish recommendations

The historical catch is an important input into any stock assessment. Although efforts have been made to construct catch time series for California rockfish, a more sustained effort is needed to do this for all rockfish species. It should not be left to individual analysts to do this for a species as stock assessments arise. It should be done by a specialist team for all species simultaneously, so that consistent times series can be established.

Management changes affect fisher behaviour and alter the correct interpretation of CPUE time series. As for catch histories, it is important that a specialist team consider and document all management changes and how they may have impacted on catch rates for all species. Again, this should not be left to individual assessment authors as the issues are generic and patterns might not be obvious without a multi-species perspective.

Improved documentation of input data and output for GLM analyses of CPFV and RecFIN CPUE data is recommended. In general, GLM analyses should provide analysis of deviance tables, estimated coefficients, and their standard errors to document these calculations. Information on amount of RecFIN records filtered by species association also needs to be presented to show the effect of the species association analysis. Although this method is an objective approach to filtering records, it is unknown how well works in practice to reduce the potential biases of CPUE data. A paper describing a comprehensive application of GLM methods to CPFV and RecFIN CPUE data on California rockfish would be a valuable contribution to the stock assessment process and the primary literature.

Many rockfish assessments use CPUE data from the CPFV fishery as an index of population abundance. The CPFV fishery is focused primarily on marketing a successful “fishing experience” that is related to the desirability of the species caught, quantity, body size, and fighting characteristics. The default assumption of proportionality between CPUE and abundance has not been evaluated for a fishery with these characteristics. Simulation modeling of fleet dynamics in a multi-species context is one possible way to address these issues.

A more complete understanding of the multi-species aspects of rockfish population dynamics is needed. Although some rockfish stocks have declined in recent decades under heavy fishing pressure and environmental change, other rockfish species have apparently increased. Are these species adapted to different environmental conditions, or are these increases due to the indirect effects of reduced competition and/or predation?

Conducting additional assessments of the many relatively uncommon rockfish in California is a difficult but worthwhile objective. To facilitate this process, the Panel has a number suggestions:

1. Keep the models simple.
2. Make reasonable assumptions based on life history and better studied species for parameters that cannot be reliably estimated, such as natural mortality, stock-recruit steepness, selectivity.
3. Think meta-analytically. For example, similar species that are often caught together are likely to have experienced similar fishing mortality rates and trends. There are also more rigorous methods for sharing information between related stocks that could be considered.
4. Make the most of CPUE data:
    - For several assessments, indices from GLM analyses of site-specific CPFV data apparently tracked population trends better than indices from RecFIN data, even when a subset of records had been selected using the Stevens and MacCall (2004) procedure. Greater priority should be given to collecting site-specific CPUE data. Given the ubiquity of GPS systems and hand-held data recorders, obstacles to collecting site-specific information from fisheries are now logistic rather than technological.
    - Location information for the historic groundfish catch data of all species is currently available, in hard copy form only, from the California Department of Fish and Game. Putting this information into electronic format would greatly improve the ability to assign catches of all species to specific stocks on a trip-by-trip basis.
5. Do not put too much trust in model results. Models are no better that their input data and assumptions, and for many rockfish species, the data are sparse and potentially misleading.