BLACK ROCKFISH

STAR Panel Report
Southwest Fisheries Science Center
Santa Cruz, California
April 20-25, 2003

STAR Panel Members:
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STAT Team Members Present:
Stephen Ralston, NMFS Southwest Fisheries Science Center

Overview

The STAR Panel convened the week of April 21-25, 2003 at the Southwest Fisheries Science Center at Santa Cruz to review a draft assessment report by the STAT Team for black rockfish. A draft report was provided to Star Panel members in advance of the STAR workshop and an update was provided during the meeting. Dr. Stephen Ralston, the sole member of the STAT Team, summarized the draft document including description of the fishery, biology of the species, and available data sources. He also reviewed relevant features, settings, assumptions and results from his initial base model. Following this review, the STAR Panel requested a number of additional detailed data summaries and analyses to evaluate data quality, catch estimation, appropriateness of model assumptions and interpretation of results.

The Panel had considerable discussions with the STAT team concerning the paucity of information to reconstruct historic catches prior to 1978, especially in Oregon, and the methodology used to estimate them. Because trends in abundance indices were essentially flat over the entire assessment period, the model's estimates of depletion were very sensitive to the assumed level of historical catch. This was particularly the case since the initial model formulation did not use size/age composition information to reconstruct estimates of recruitment in the population. In the final analysis, Panel and Team members established what was considered to be the "best" estimate of catch histories, input into the model as a "ramping up" from 0 in 1945 to 500 mt prior to 1978. This also addressed the Panel's concern that the modeled stock may not have had sufficient time since the start of fishing to reach equilibrium.

The Panel questioned the suitability of modeling male and female natural mortality as being equivalent. After review of existing information, Team and Panel members agreed that sex-specific natural mortality rates would best reflect evidence that females are subject to increased natural mortality during their reproductive years. Because of the uncertainty in the relative level of natural mortality, a sensitivity analysis was conducted to find a range of plausible parameter values.

Building upon new assumptions about sex-specific natural mortality and initial conditions associated with catch histories prior to 1978, the STAR Panel requested an alternative model that estimates recruitment for the years 1975-1998 based on age-composition information. This allows the model freedom to find alternative explanations (depletion trajectories) of the data instead of being constrained by constant recruitment and initial equilibrium conditions associated with fixed rates of historic removals. This model also included a two time-period selectivity for the California sport fishery, which was most consistent with changes in length compositions and flat CPUE indices.

Based on the deliberations above, the STAR Panel and STAT Team arrived at developing a new baseline model with the primary components: recruitment is estimated 1978-1998; sex-specific natural mortality, including increase in age-specific natural mortality for females; and a two time-period selectivity curve for the California sport fishery. As previously mentioned, because depletion is very sensitive to the assumed level of historical catch, the Panel recommend bracketing this uncertainty by contrasting lower and higher catches trajectories (and therefore accumulated catches) during the early time series. The Panel concludes that this assessment is based on the best available data and

provides the Council insight into black rockfish stock status and captures the range of uncertainty. The Panel commends the Team for their professionalism, dedication, hard work and cooperation with Panel requests.

Analyses requested by the STAR Panel.

1) Contrast RecFIN indices using species coefficients from early (1980-1991) and late (1991-Present) time periods. Panel members expressed concerns that the RecFIN index generated by applying a new statistical methodology to weight trips for subsequent Delta-GLM standardization may be sensitive to changes in species composition. Prior to completion of this request, a parallel analysis of the RecFIN data used in the bocaccio assessment indicated no changes in index trajectory. The Panel did not believe it necessary to continue further evaluation of changing species coefficients on the black rockfish index.

2) Compare and contrast CPUE among specific sites visited by the northern California CPFV fishery. Panel members wanted to explore the data to see if there was any evidence of serial depletion among reefs. If fishers were fishing down and then moving on to reefs with greater production, then the CPUE index could remain level, when in fact, the population was declining.

3) Analyze the CPFV data to determine if there has been a spatial change in CPFV site targeting. This analysis was motivated by the observation that mean length in the California sport fishery had declined over time, while mean length in the Oregon fishery had not. The panel sought to evaluate the possibility that such a pattern is due to declining population abundance causing a shift in size or an on-shore shift in fishing patterns in recent years. Although time was not available to do a full analysis, preliminary inspection of the data suggested that there may have been a shift in CPFV effort to shallower fishing sites.

4) Analyze the RecFIN catch data to see if there is an increasing trend of "nearshore" species composition in recent years. Again, the panel sought to evaluate the possibility that the pattern in item (3) is due to declining population abundance causing a shift in size or an on-shore shift in fishing patterns in recent years. Is there an increasing trend of trips directed at nearshore species? The assessment is highly dependent on trends in fishery-dependent abundance indices.

5) Tabularize all annual changes in State and Federal regulations influencing the commercial and recreational black rockfish fisheries. Both State and Federal regulations restricting nearshore rockfish harvest may influence black rockfish catch and CPUE. Interpretation of the CPUE indices is problematic when there are changes in regulations that might influence fishing behavior.

6) Link California and Oregon trawl selectivity. There are no apparent biological or gear differences between the California and Oregon trawl fisheries. However, a model run with linked selectivity degraded fit to the California trawl length comps. Selectivity was left separate.

7) Conduct sensitivity analysis with knife-edge selectivity at age (1-8) and "dome shaped" selectivity for the historical catch. The base model initially presented by the STAT team had mistakenly specified historical catch selectivity to be set to knife-edge at age 1 (-1 in synthesis Input file). Modeling of historical catch was modified such that knife-edge selectivity was no longer required.

8) Tabularize annual age and length sampling by port and year for the Oregon Sport fishery. Concern was expressed that only the Garibaldi fishery was sampled prior to 1990 and data did not represent the total catch taken by the Oregon Sport fishery. Because this was the case, it was agreed to truncate the earlier time series of data.

9) Plot mean length over time by cohort. Information indicated an abrupt decline in mean size at age of black rockfish in the Oregon sport fishery. This plot showed an apparent decline in mean size at age and was especially evident beginning in the early 1990's. However, this corresponded to a change in age readers, so it is not clear whether this trend was due to misspecification of ages or real.

10) Plot mean length time series for RecFIN and Oregon and California sport length data with associated sample sizes. These data were pooled by State and concern was expressed that the two data collection programs may measure different segments of the fishery.

11) Plot empirical CVs for length-at-age from the ODFW data instead of the fitted data. The Panel was concerned that the fit to the length composition was very sensitive to the CVs associated with each age used as input into the model. Results showed that a difference in CV estimates between the two estimation methods was inconsequential. Based on empirical analysis, CVs for young and older ages were higher than middle ages; a pattern that Synthesis cannot model. CVs for young and oldest fishes were then estimated from a regression applied to ages 5-14 of the truncated Oregon time series of ages.

12) Explain the derivation of the catch history for each of the fisheries. The Panel noted an unusually large catch for the Oregon trawl fishery in 1978, the first year of the model period. The STAT team explained the derivation and an alternative procedure was developed which gave a more plausible estimate.

The panel was concerned about the initial equilibrium assumptions in the model. Before 1978, the model assumes that a constant annual "historical catch" has caused the population to reach an equilibrium age structure in 1978. This creates two problems. First, there may not have been sufficient time, since the beginning of the fisheries, for the population to have reached "equilibrium", and second, the appropriate level of "historical catch" is unknown.

Model estimates of depletion are very sensitive to the assumed level of historical catch. The Panel recognized the early catch history was highly uncertain due to lack of information (little or no species composition samples). The Panel worked with the STAT team to develop a plausible catch history, which avoided the need to assume historical catch and equilibrium conditions in the first year of the assessment.

13) Estimate selectivity for two time periods (early period before 1990) for the California sport fishery. The systematic pattern of residuals suggested change in selectivity at or about 1990. This could help explain decline in mean length of sport catch in California. There was no apparent change in CPUE during this time period.

14) Provide alternative model runs using sex-specific natural mortality. Sensitivity analysis indicated the "best" model fit was when male natural mortality was fixed at 0.12 and female initial natural mortality was fixed to 0.12 and increased to 0.20 at age 10. This outcome is plausible and was comparable to other independent analysis (catch-curve, Hoenig 1983).

15) Construct an alternative model that estimates recruitment for years 1975-1998 and compare to the constant recruitment model. The Panel recommended that the model be allowed freedom to find alternative explanations of the data (different depletion trajectory) instead of being constrained to the explanation implied by constant recruitment and initial equilibrium conditions.

16) Using the final base model, profile on steepness to evaluate biomass sensitivity and fit to likelihood components. Although results show little model sensitivity, in terms of relative change in total log likelihood, the profile likelihood did find a broad peak at 0.65-0.7. Furthermore, evidence from other rockfish studies indicate steepness should be much lower than 1.0. The meta-analysis in Dorn (19xx) leads us to believe that a range between 0.52 - 0.67 is most appropriate for rockfish. Panel endorsed using a steepness value at 0.65, which was coincident with the best model fit.

17) Complete three model runs using final base model with two alternative catch streams to bracket the uncertainty in historical catch.

Final Base-Run Model(s) included:

Data
Reconstructed time series of catch histories
Excluded ODFW length and age composition data preceding 1990
Uses ODFW mean length-at-age data
Use all of the available RecFIN length composition data (Oregon and California)
Use all of commercial length composition data (trawl, hook-and-line for each State)
Use all available CPUE indices (ODFW sport, RecFIN by State and CPFV for California)

Model
Profile on sex-specific natural mortality rates
Include age specific step increase in female natural mortality
Use a two-period selectivity model for the California sport fishery
Begin the model(s) in 1945 at equilibrium and assume no historical catch prior to 1945
Model(s) include estimated versus constant recruitment

Final Base Model
Fix steepness at 0.65
For males, fix natural mortality at 0.12

For females, fix initial natural mortality to 0.12 and step up to 0.20 at age 10

Technical Merits and/or deficiencies in assessments
The STAT Team is commended for the extraordinary amount of effort put into this assessment and responsiveness to STAR Panel requests. Their approach to developing a CPUE index using RecFIN data was innovative and novel. Any perceived deficiencies in the assessment are likely the result of inadequate or poor data.

Complete analysis of raw data sets is required to fully understand and present the properties, dynamics and uncertainty of CPUE indices. The Oregon CPUE index was prepared from summarized information, which did not allow full evaluation by either the analyst or the Panel. Full documentation and descriptions (sample protocols, size and stratification, etc.) of other data sets were somewhat incomplete. The Panel recognizes a need for a systematic process (step-wise regression) to fully evaluate what effects could have been modeled in a CPUE index.

Areas of disagreement regarding STAR Panel recommendations
None

Unresolved problems and major uncertainties
Model results indicate that black rockfish biomass decline precipitously before 1980. Depletion is very sensitive to early catch history because the indices are noisy, relatively flat and follow the declining biomass period. Two alternatives catch streams are used to bracket this uncertainty, but this may not capture the full range of uncertainty. Natural mortality estimates remains uncertain and are confounded with selectivity. As with most assessments, there was model sensitivity to steepness.

Recommendations for future research
Fishery independent survey(s) and biological data collection programs provide necessary components for stock assessment that is severely lacking for nearshore rockfish species. Currently, there are no fishery independent surveys in Oregon or California. Furthermore, observation of the CPFV fishery in northern California ports was discontinued. This program provided data extremely important for modeling stock status for a number of species including black rockfish. Future assessment for nearshore species is largely dependent upon developing fishery independent surveys and continuing fishery data collection programs.

Need for pre-assessment meeting(s) to evaluate data. Time constraints make it difficult for the stock assessment analysts to develop population dynamics models and achieve a full familiarity with all data sources. Pre-STAR assessment meetings with personnel familiar with the various data sources and technical experts on modeling would greatly facilitate well developed methods, documentation and understanding of all data sources.

Develop consistent methods and data sources to estimate catch histories. Work needs to be done to refine how catch history is used in the model (how best to begin the model with appropriate initial conditions) so there is sensible initial depletion that is consistent with the data and is plausible. Paucity of real information on historic catches across numerous rockfish assessments creates the need to estimate data gaps between fisheries

and over years. Consistent statistical or extrapolation procedures should be developed across numerous rockfish complexes.

Further analysis is needed to reconcile whether there have been changes in growth and investigate other possible causes of changes in mean length at age. This overlaps with the need to test and resolve possible differences in ageing over time (change in age-readers).

This and other rockfish assessments depend upon fishery-dependent CPUE indices either due to the lack of research survey information or the difficulties encountered when sampling rocky habitats with bottom trawls. Recent attention to this problem has focused on the Northern cod stock collapse and the use/misuse of fishery-dependent CPUE indices. The RecFIN CPUE index used in this assessment as in others should be fully evaluated to verify its proper use as an index of abundance. There are technical aspects of the statistical methods used to weight the trips in the Delta-GLM standardization methods that should be more fully investigated as well.

CPFV data should be more fully explored to evaluate serial depletion among reefs. Perhaps such an approach could allow reefs to be random effects in a mixed effect depletion analysis that attempts to estimate the likely variation in depletion of CPUE.

Further investigation should be done to evaluate stock separation or a stock model with two spatial regions.