Star Panel Report on the Chilipepper Rockfish (*Sebastes goodei*) Assessment

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Summary of the Chilipepper Rockfish (*Sebastes goodei*) Assessment

The STAR Panel met in Olympia, Washington, during June 16th to 19th, 1998 to review an assessment prepared by the chilipepper rockfish STAT Team comprised of Dr. S. Ralston, NMFS/Southwest Fisheries Science Center, Mr. D. Pearson, NMFS/Southwest Fisheries Science Center, and Ms. J. Reynolds, University of California. Their assessment provided an updated evaluation of the status of the chilipepper rockfish resource off the west coast which was last assessed in 1993.

The STAR Panel identified several sources of uncertainty for the 1998 chilipepper rockfish assessment. These were:

1. There was a concern that commercial fishery size-at-age data could be biased and may not be representative for younger chilipepper due to size selectivity. As a result, growth curves estimated from commercial fishery data may not reflect the average size of juvenile chilipepper. Growth curves for male and female chilipepper were estimated within the assessment model based on commercial fishery size-at-age data. The STAR Panel suggested that other sources of size-at-age data be developed and analyzed, such as research survey collections, to help determine growth curves for male and female chilipepper.

2. Natural mortality of chilipepper rockfish was a source of uncertainty for assessment modeling and interpretation of results. The natural mortality rate used in the previous assessment (M=0.15) was not likely given data used in the current assessment. As a result, the STAT Team used the assessment model to determine separate values of M for males and females that were more consistent with the current data and model configuration. These values of M were then treated as fixed constants in subsequent modeling. The STAR Panel discussed the merits of attempting to estimate M and concluded that this heuristic approach was an appropriate way to determine values that were consistent with current data and knowledge of the population dynamics of chilipepper.

3. Time-varying selectivity was assumed for the chilipepper rockfish fishery based on synchronous patterns in size-at-age observations from the fishery. The STAT Team suggested that fishery selectivity differed between years due to changes in the spatial distribution of chilipepper. Although empirical differences in size-at-age were substantial between some years, for example 1985 and 1993, it was unknown why these patterns occurred. Oceanographic changes due to El Nino conditions were considered to be a likely causal mechanism.

4. Two relative abundance indices of chilipepper rockfish biomass, the trawl logbook index and the NMFS shelf survey index, exhibited different trends. It was uncertain whether the logbook index or the survey index provided a more accurate trend for chilipepper biomass. It was noted, however, that the increase in the logbook index during 1988-89 was consistent with the recruitment of the large 1984 year class to the trawl fishery.

5. Historic landings of chilipepper rockfish were uncertain because landings statistics were reported as unspecified rockfish rather than as chilipepper.

Dr. Steven Ralston, STAT Team leader, presented the draft assessment document. He discussed the types and sources of data available for the assessment, and presented the results of additional model runs conducted since the draft assessment document was distributed. The assessment was conducted using the length-based stock synthesis model.

In the initial model runs, male and female growth curves were estimated within the stock synthesis model. The STAR Panel noted that growth curves could be estimated outside of the assessment model, if representative size-at-age data were available. It was pointed out that commercial fishery age data were the only source of data for growth analysis. Because commercial fishery size-at-age data tend to be biased toward selection of fast-growing fish, the STAR Panel recommended that alternative sources of size-at-age data, such as a research survey collections, be developed. Although some chilipepper rockfish otoliths have been collected during the NMFS shelf survey, these

samples have not been processed for age determination. Processing these otoliths was an important research recommendation that would likely improve chilipepper rockfish growth curves in future assessments.

The STAR Panel reviewed the sources of catch data used in the assessment. Chilipepper catch data was taken from the NMFS Tiburon lab TIGRBASE database. Discards of chilipepper were assumed to be negligible and total catch used in the assessment consisted of estimated landings from the INPFC Eureka, Monterey, and Conception Areas. The ratio of bocaccio to chilipepper rockfish landings was used to estimate the chilipepper catch from 1960-1979 based on landings of bocaccio during this time period. The assessment model used an historical catch level fixed at the 1960-1969 average and included year-specific catch estimates from 1970 to 1998. It was noted that landings in recent years (about 1500 mt) have been well below ABC levels (the 1998 ABC was 3400 tons). Inability to harvest the full ABC might be interpreted as a signal of a decline in chilipepper abundance. Alternatively, inability to harvest the full ABC could also be an artifact of management measures for the Sebastes Complex because chilipepper may have been included in Sebastes Complex landings.

The STAR Panel discussed whether any trends in the ratio of boccacio to chilipepper landings existed prior to 1980; such trends would affect catch estimates of chilipepper during the early years of the assessment time horizon. Based on long-term experience in the California rockfish fishery, one fishermen indicated that chilipepper was a high percentage of rockfish landings (80%) in the 1950's and early 1960's but was a low percentage (20%) in the 1970's. This anecdotal information contrasted the constant boccacio to chilipepper ratio used in the assessment. Given the uncertainty in the early catch data, the STAR panel discussed alternate time horizons for the assessment model as well as the effect of estimating the initial age composition in 1980 versus 1970. The STAR Panel recommended that the STAT Team conduct a sensitivity analysis to assumptions about the pre-1980 landings. Also, it was recommended that the STAT Team consider a model that began in 1980 versus 1970 to explore the

consequences of estimating recruitment levels based on the uncertain historic catch data.

The STAR panel discussed the utility of MRFSS recreational fishery catch-per-unit effort (CPUE) as a tuning index for chilipepper biomass. It was not clear how effort was measured in the MRFSS index and this was a substantial source of uncertainty. In particular, it was unknown whether effort was measured for all bottomfish boat trips or for all recreational fishing trips, including those targeting salmon. If recreational effort included salmon trips, it seemed unlikely that the MRFSS CPUE would be a useful tuning index. Further, it was noted that recreational fisheries have operated at different depths over time and this would also affect trends in the MRFSS CPUE. The STAR Panel expressed reservations about the MRFSS CPUE index given uncertainty in how effort was calculated. Overall, the STAR Panel recommended that the STAT Team consider omitting the MRFSS CPUE index from the assessment model.

The STAT Team applied a general linear model to compute a CPUE index of relative chilipepper abundance (kg/hectare swept) from selected NMFS triennial trawl survey tows. Survey tows within selected latitude and depth ranges where chilipepper are common were included in this analysis. The STAR Panel supported this approach to analyzing chilipepper CPUE from the NMFS shelf survey.

The STAT Team used the SWFSC midwater trawl survey to estimate an index of chilipepper recruitment (projected number of age-1 fish per tow). The coefficient of variation (CV) of the recruitment index was adjusted to have the same level of variability as estimated recruitments from a model run that excluded the index. The STAR Panel supported the use of the midwater trawl recruitment index in the assessment model.

The STAT Team derived a CPUE index from California trawl logbook data. Because rockfish catches have historically been reported in an aggregate market category containing several rockfish species, calculation of this index required estimation of the proportion of chilipepper within unspecified rockfish landings. To estimate this proportion, the STAT Team

identified CDFG trawl blocks where chilipepper rockfish were landed by linking commercial market sample data for rockfish to trawl logbook data. As a result, the STAT Team found 26 CDFG trawl blocks that had a high proportion of chilipepper. The STAR panel noted that the variance of the logbook CPUE index underestimated actual variability because it did not account for the unknown error involved in estimating the proportion of chilipepper catch. The STAR Panel recommended the STAT Team consider increasing the CV of the logbook CPUE index in the assessment model. Alternatively, it was recommended that the STAT Team consider reducing the emphasis of the logbook CPUE as a likelihood component.

The STAT Team reported a trend in mean size at age from commercial fishery samples. This suggested that selectivity was probably changing through time. Their results indicated that mean size at age of chilipepper in 1985 and 1993 decreased across fisheries and ages. Re-examination of age-reading data as well as re-ageing of some samples from 1993 did not suggest that this effect was due to a change in age-reading criteria. In addition, the STAT Team pointed out that time-varying growth was unlikely because this would have implied negative fish growth for some years. The STAT Team also showed that the proportion of the stock on the continental shelf varied between surveys. This supported the notion that chilipepper distribution changed between years and suggested that changes in spatial distribution might explain the shifts in fishery size-at-age data. To address the changes in size-at-age data, the assessment model was configured to estimate year-specific fishery selectivity functions. Model parameters to determine selectivity changes were linked across fisheries to account for the similar patterns of change. The STAR Panel supported the use of time-varying selectivity functions in the chilipepper rockfish assessment model.

The STAR panel observed that the initial assessment model which estimated growth, year-specific selectivity, and natural mortality had unstable convergence. That is, when the model solution was randomly changed by +/- 10% and model parameters were re-estimated starting at the random offset from the solution, the new solution differed from the original one. In particular, model estimates of 1998 biomass

varied by about 4500 tons (17%) when the randomization process was performed many times. This suggested that the model likelihood surface was flat near the model solution and that the model results were sensitive to the choice of initial parameter values. To alleviate this difficulty, the STAR Panel requested a methodical progression from a simpler model with fewer parameters to more complex models under the criterion that convergence be stable at each step. The STAR Panel recommended that the STAT Team present a less structured model and evaluate convergence stability in a sequential manner as more complexity was added. In particular, the STAR Panel recommended starting with a model configuration that did not use the length data and fixed growth, natural mortality, and selectivity parameters. Convergence stability was recommended to be evaluated using a randomization test with about a 25% random offset for about 40 runs.

The STAT Team made the recommended changes to the model configuration. Results of a randomization test showed much better convergence properties (estimates of 1998 biomass varied by 200 tons, <1%). The STAR Panel recommended that the STAT Team continue in a stepwise fashion, adding complexity and testing convergence stability at each step. The suggested steps of additional complexity was: 1) Estimate growth parameters and include mean length-at-age likelihood component; 2) Estimate time-varying selectivity parameters; 3) Estimate M by sex.

The STAT Team configured the assessment model to accomplish step 1) above but found that this model did not exhibit stable convergence. The STAR Panel recommended a return to the stable model and suggested that the CV of the logbook CPUE index be increased to better reflect its variability and that the MRFSS CPUE index be removed.

The STAT Team made the suggested changes but model convergence appeared to be less stable than before. To ensure convergence stability, it was suggested that the STAT Team consider the model configuration with the logbook CPUE index CV set back at the STAT teams recommended level of 0.10, with the MRFSS CPUE index removed, natural mortality and growth parameters fixed, and with constant fishery selectivity functions.

The STAT Team made the suggested model run and found improved convergence stability in comparison to the previous model. Next the STAT Team suggested altering the improved model configuration to estimate year-specific selectivity functions for all fisheries. Model parameters were estimated and the new model was subjected to 70 randomization tests using a 10% random offset and a convergence criteria of 0.001 likelihood units. Results of the randomization tests indicated that the new model had acceptable convergence stability (range of 1998 biomass was 3%). As a result, the new model was adopted as the preferred model by the STAT Team and STAR Panel. The STAR panel noted, however, that the fixed values of the natural mortality and growth parameters were not known with certainty and suggested that the final report include likelihood profiles over values of M and K to characterize this uncertainty. The STAR Panel also requested that the STAT Team examine residuals of two tuning indices (the trawl survey and the logbook index) for gross departures from model assumptions. The STAT Team found some moderate residual patterns for these indices. This was expected given the conflicting trends of the trawl survey and logbook indices. Further evaluation of trawl logbook CPUE as an index of abundance and its relation to the NMFS shelf trawl survey index was recommended as an area for future research.

The STAR Panel expressed concern that the strength of the 1993 year class, which was estimated to be larger than other recent year classes, was uncertain. Though the assessment model included a recruitment index, the amount of information supporting the strength of this year class was limited to one year of catch data from a partially-selected year class. The STAR Panel recommended a cautious interpretation of projections of future population size and allowable catch due to this uncertainty.

Analyses Requested by the STAR Panel

The STAR Panel commended the STAT Team for their diligent and timely responses to STAR Panel requests. Most requests were completed during the review meeting. Nonetheless, some items could not be completed during the meeting due to time and logistical constraints and

were requested to be in the final assessment document. These items were:

a. A Stock Summary Report.

b. Profile likelihood plots for natural mortality (M) and the Brody growth coefficient (K).

c. Sensitivity analyses for a higher and a lower level of natural mortality.

d. Harvest projections at the F40% fishing mortality rate for at least 3 years.

e. Sensitivity analysis of model results to the 1970-79 catch levels.

Prioritized Research Recommendations

1. Age chilipepper rockfish otoliths collected during NMFS triennial shelf trawl survey(s) to characterize male and female growth curves.

2. Investigate why the trawl logbook index and the shelf trawl survey index have different trends.

3. Continue the midwater trawl survey to ensure a consistent recruitment index through time.

4. Continue to monitor age and length composition of fishery catch.

5. Report logbook catches of rockfish by species, e.g. chilipepper rockfish, rather than as unspecified rockfish.