WIDOW ROCKFISH

STAR Panel Report

Southwest Fisheries Science Center
Santa Cruz, California
August 1-5, 2005

STAR Panel members:

André Punt (Chair), University of Washington, SSC representative
Mark Maunder, Center for Independent Experts
Robert Mohn, Center for Independent Experts
Tony Smith (rapporteur), Commonwealth Scientific and Industrial Research Organization
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Susan Ashcraft, GMT representative
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John Field, GMT representative

STAT members present:

Xi He, Southwest Fisheries Science Center, Santa Cruz
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Alec MacCall, Southwest Fisheries Science Center, Santa Cruz

Overview

The STAR Panel convened the week of August 1-5, 2005 at the Southwest Fisheries Science Center, Santa Cruz Laboratory to review a draft assessment by the STAT for widow rockfish. A draft report was provided to the STAR Panel in advance of the meeting and was updated during the meeting. Although this assessment could have been reviewed as an update, the STAT requested that the assessment be reviewed as a full stock assessment.

The last assessment of this species was conducted in 2003. The same assessment model was used in 2005, but the assessment a) included an additional index of abundance (the triennial bottom trawl survey, as recommended by the 2003 STAR Panel), b) included a prior for steepness, c) estimated the values for the parameter between the juvenile survey index and recruitment, and d) included updates to landings, additional recent and historical age-composition information, and revisions to five other indices of abundance. The assessment assumed a single stock for the west coast of the US from the Canadian to the Mexican borders.

The STAR Panel agreed that the revised assessment for 2005 represents the best available science, and endorsed the updated base-case model and the associated characterization of uncertainty. The 2005 base-case model shows the stock as somewhat less depleted than the 2003 base-case model and with somewhat higher productivity (stock-recruitment steepness 0.28, up from 0.22). This report documents remaining uncertainties in the assessment, and makes recommendations for future research that would reduce some of these uncertainties.

Analyses requested by the STAR Panel

1) Document estimates for all input and output parameters in final STAT Report

This will be included in the final report.

2) Explore sensitivity to early estimates of recruitment (prior to age data being available to the assessment)

This analysis was conducted because the STAR Panel was concerned about the impact of the stock-recruitment relationship on the results, and involved fixing steepness to one and substantially increasing the variance of the recruitment residuals. This resulted in unrealistically high estimates of recruitment in the first years of the assessment. Further exploration of these and other results suggested that the (fixed) level of natural mortality M in the assessment was likely too high. This was confirmed using likelihood profiles, and led to a revision to the value of M included in the base-case model from 0.15 to $0.125 yr^{-1}$.

3) Explore sensitivity to the assumption of logistic versus dome-shaped selectivity for the Eureka-Conception fishery and that the selectivity for the largest length-class is 0.5

All of the selectivity patterns in the base-case model are dome-shaped and the STAR Panel was not certain that this was supported by the data. The results of the assessment were found to be sensitive to the joint specification of the selectivity pattern for the

Eureka-Conception fishery and natural mortality *M*. The STAR Panel and STAT examined the fits of the two models and selected a dome-shaped selectivity pattern for this fishery in the base-case model.

4) The relationship between the actual and effective sample sizes should go through the origin

The results in the draft assessment were based on a model that involved balancing effective sample sizes (i.e. tuning the input sample sizes for the age-composition data so that they equaled the effective sample sizes calculated in the model), but this balancing involved a regression that did not pass through the origin. As a result, small actual sample sizes were increased more relative to large actual sample sizes for the Eureka-Conception fishery as the intercept of the regression exceeded zero. This increased the emphasis placed on recent age-composition data for this fishery, the actual sample sizes for which are small. The STAT provided results when the effective sample sizes were based on a regression that passed through the origin, and the revised base-case model calculates effective sample sizes this way.

5) Estimate selectivity separately pre- and post-1983

The Panel was concerned that the introduction of management restrictions beginning in 1983, which led to sharply reduced catches, may have resulted in changes in fishing practices and therefore selectivity. The STAT explored sensitivity to separate selectivity patterns for the Vancouver-Columbia and Eureka-Conception fisheries before and after 1983. However, this change had little effect on the results of the assessment, and the revised base-case model includes a single selectivity pattern for the entire assessment period.

6) Explore sensitivity to the use of the juvenile survey index

See discussion below. The revised base-case model included this index, but with some important caveats as discussed below.

7) Estimate a selectivity pattern for the triennial survey

The selectivity pattern for the triennial survey is currently assumed to be the same as that of the Oregon bottom trawl fishery. The Panel requested that the selectivity of the survey be estimated using the length-composition data from the survey. It proved impossible to construct age-compositions for the survey catches during the meeting, but the STAT showed that the results of the assessment were not notably sensitive to alternative assumptions about survey selectivity.

8) Finalize the Decision table

The decision table will be finalized before the report is submitted to the Council.

Final base-case model and quantification of uncertainty

Full specifications for the base-case model will be included in the final STAT report. Important changes from the 2003 base-case model involve:

- including an informative prior for steepness (He *et al*, in review[1]);
- reducing *M* from 0.15 to 0.125yr^{-1};
- requiring that regressions for effective sample sizes pass through the origin; and
- estimating the power term for the Santa Cruz juvenile survey index.

The STAT and STAR Panel agreed that it was suitable to characterize uncertainty in the assessment using three alternative models in addition to the base-case model. Full details of these alternative models will be provided in the STAT report, but their key differences are summarized in the Table below. In relation to the base-case model, the alternatives bracket uncertainty in productivity (steepness and *M*) and depletion (current spawning output divided by unfished spawning output). The STAR Panel and STAT agreed on relative probabilities (essentially ranks) for each alternative state of nature, on the basis of likelihoods, and plausibility of model structure.

State of nature	Depletion	Steepness	M (yr^{-1})	Probability
Base-case (T2)	31%	0.28	0.125	0.4
M011	38%	0.31	0.11	0.3
T1	25%	0.45	0.125	0.2
T2M015	26%	0.25	0.15	0.1

Stock projections should be conducted both with and without the Santa Cruz juvenile survey index in the assessment. In cases where this index is used, projections should account for the uncertainty arising from its inclusion, including parameter uncertainty in the value of the power parameter, the standard deviation of the survey indices, and the uncertainty associated with the estimates of most recent recruitment.

Technical merits and/or deficiencies in the assessment

The STAR Panel spent a considerable amount of time debating the derivation of the prior on recruitment steepness (He *et al.*, in review) and its suitability for use in the assessment of widow rockfish and those of other species. While endorsing the biological premise underlying the approach, some concerns were expressed about the assumptions in the modeling, including closure of the population and stationarity in parameters, and whether or not stocks of some species with particular life history characteristics do indeed suffer local extinctions from time to time. The Panel also observed that consideration could be given to deriving a prior that considered the plausibility of very high levels of steepness. On balance, the STAR Panel endorsed the use of the prior for steepness in the widow rockfish assessment, but emphasized that this did not imply that it is endorsed for use in other assessments. This needs to be decided on a case-by-case basis.

The STAT is commended for the high quality of the draft assessment and Xi He is thanked for his efforts to respond to the requests by the Panel during the meeting.

Areas of disagreement regarding STAR Panel recommendations

[1] He, X., M. Mangel, and A.D. MacCall. In review. A prior for steepness based on a persistence principle. Submitted to Fishery Bulletin.

There were no remaining areas of disagreement between the STAT and the STAR Panel.

Unresolved problems and major uncertainties

The main source of uncertainty in the widow rockfish assessment is the lack of useful indices of abundance, particularly in recent years. Of the six indices used in the assessment, three are derived from bycatch in the whiting fishery and are highly variable. The Oregon CPUE index stopped in 1998, and the triennial bottom trawl survey is not the appropriate sampling method for this semi-pelagic species and consequently this index is also highly variable. The final index used, the mid-water trawl juvenile survey, is discussed further below. There are long time series of age data available for each major fleet and these are generally informative, but the sample sizes in recent years are very low.

There was considerable discussion about the appropriate use of the Santa Cruz juvenile survey data. In the first place, the survey indices are highly variable (which is not unexpected) and do not appear to be influential in the assessment. Second, the index has not always identified strong year-classes, which raises concerns for its use in stock projections. Third, a power term is used to transform this index, and its estimation has been controversial. The previous (2003) STAR Panel recommended that the power term be set to 3, but the justification for this decision is not clear from the report of that Panel. The current Panel noted empirical support for density-dependent survival in juveniles of blue rockfish (Adams and Howard, 1996[2]), in part addressing one of the concerns raised by the 2003 STAR Panel. The current Panel recommended that the power term should be estimated from the data if the index is used in the assessment.

The Panel noted strong interactions in the assessment between effective sample size, natural mortality rate, and estimates of current depletion and steepness.

Stock structure issues, in particular the relationship to the Canadian stock, remain an important source of uncertainty.

Recommendations for future research

Specific to widow rockfish

A) Given the uncertainties associated with all of the current indices of abundance, a priority is to find alternative indices (more specific to widow rockfish) that would reduce the uncertainty in the assessment. The Panel noted recommendations of the two previous STAR Panels that hydro-acoustic surveys be initiated in conjunction with the fishing industry, and noted that a workshop was held in 2004 on this topic. Results from a pilot widow rockfish acoustic survey in 2005 should be evaluated for their utility in future assessments.

B) The data from ongoing juvenile surveys being conducted by industry should be examined for possible integration into the current juvenile index, and in future

[2] Adams, P.B. and D.F. Howard. 1996. Natural mortality of blue rockfish, *Sebastes mystinus*, during their first year in nearshore benthic habitats. *Fish. Bull*. 94: 156-162.

assessments. If a juvenile survey index is to remain in the assessment, the impact of environmental factors on the indices should continue to be explored.

C) The assessment is clearly sensitive to assumptions regarding the selectivity of the fisheries and the surveys. It would be very useful to design and conduct a survey to try to obtain a representative sample of the age-structure of the population. This might be done in conjunction with a hydro-acoustic survey.

D) Sample sizes for existing age-collection programs (by fishery and survey) should be increased substantially.

E) The age-composition for the triennial survey should be determined by applying year-specific age-length keys to the survey length-frequencies, and included in future assessments as a basis for estimating survey selectivity.

F) The current assessment assumes a single coast-wide population, but growth differs between the north and south. The assessment therefore allows growth to differ spatially and estimates the proportion of the population with each growth curve based on the spatial distribution of catches. Future assessments should explore the possibility of a two-area model based on the current north-south split. The details of Canadian assessments of widow rockfish should be obtained and considered in future assessments.

G) If future assessments are based on Stock Synthesis 2, a comparison with the current assessment model should be made.

H) Consideration should be given to the possibility of including the results of the NWFSC Combined Survey in future assessments.

I) Recent discard data should be analyzed and, if warranted, previous discard estimates should be adjusted.

Generic recommendations

A) There should be further consideration of the implications of using the prior on steepness derived by He *et al*. (in review), including its implications for species with other life history characteristics.

B) The approach used to estimate B_0 for widow rockfish had been modified from the 2003 assessment to be consistent with that on which rebuilding analyses are based (multiplying average recruitment in the early years of the fishery by unfished spawning biomass per recruit). This led to a change to the current depletion of 10%. There is a need for more explicit guidance regarding determination of B_0 in assessments and in rebuilding analyses.

C) There is a need for a series of cut-off dates for data to be included in assessments, with cut-offs dependent on the type of data. The lack of such dates means that assessment authors may be forced to revise decisions on base-case models very close to the date the assessment needs to be submitted to the STAR Panel, and even revise the draft assessment after this. Given that documents are supplied to reviewers two weeks in advance of meetings, major changes in assessments thereafter could compromise the integrity of the review.

D) Several of the 2005 assessments have conducted historical catch reconstructions. An effort needs to be made to develop a consistent approach to reconstructing catch histories. The ideal outcome would be a single document outlining the best reconstructed catch histories for each species (c.f. Rogers (2003)[3] that lists foreign catches). The California landing receipts on microfilm back to 1950 should be incorporated into the landings database.

E) There is still some inconsistency in how assessment authors decide whether to include or exclude recreational indices in assessments. Attempts to provide guidelines for the development and use of indices of abundance based on recreational catch and effort data would be worthwhile.

F) Stock Synthesis 2 should be extended to: a) allow assessment authors to include weight-frequency data in assessments; b) estimate the parameters of the ageing error matrix; and c) estimate the extent of overdispersion of the indices.

G) The raw data on which recreational length-frequency and catch-effort information are based should be made available to assessment authors in a convenient format. This will allow more detailed examination of the spatial patterns, and allow more sophisticated analyses of the catch-effort information; at present it is impossible to distinguish between lack of data and zero catch records.

[3] Rogers, J.B. 2003. Species allocation of Sebastes and Sebastolobus sp. Caught by foreign countries of Washington, Oregon, and California, U.S.A. in 1965-1976. NMFS, Northwest Science Center.