Widow rockfish

STAR Panel Meeting Report

**Northwest Fisheries Science Center
Seattle, Washington
April 14-18, 2003**

STAR Panel Members

Ray Conser, Southwest Fisheries Science Center, SSC member, reviewer
Jean-Jacques Maguire, Halieutikos inc, Center for Independent Experts, reviewer
Richard Methot, Northwest Fisheries Science Center, (Chair)
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PFMC Committee representatives

Rod Moore, West Coast Seafood Processors Association, GAP
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Overview

The 2003 STAR Panel reviewed the assessment document prepared by the STAT for widow rockfish (*Sebastes entomelas*).   As in the previous assessment conducted in 2000, the stock was assessed under the hypothesis of a single stock from the USA - Canada border in the north to Point Conception in the south (INPFC Areas US-Vancouver, Columbia, Eureka, Monterey and Conception).   The age-structured population dynamics model was again implemented in the AD Model Builder software, but the model was re-coded. Similar data to that in the 2000 assessment were used. The absence of a fishery independent stock size index and of recent reliable fishery dependent indices of stock size remain a limiting factor in assessing the status of the stock.

The consensus of the 2003 Panel is that the assessment has been conducted using state-of-the-art population dynamics modelling and sound statistical estimation techniques. The stock assessment should be used as the basis for the Council's management decisions for the widow rockfish fishery.

The 2003 STAR Panel thanks the STAT, in particular the STAT member present at the review, for his excellent work and cooperation with the Panel.

Analyses requested by the STAR Panel

1. **Recalculation of input data**: all input data series (landings, CPUE, by-catch index, proportions caught at age, juvenile index) were re-extracted from the databases, in the case of the whiting by-catch index using different filtering criteria. In addition, the standardised CPUEs were re-calculated using a Delta-GLM (to take account of the zero tows) rather than a GLM model to address an issue raised by the 2000 STAR Panel. The 2003 Panel asked that the various input data series be compared. Differences in landing estimates had already been identified by the STAT, but not explained. There are relatively large differences in the CPUE series. The Panel considers that the new standardisation is an improvement over the previous approach. The comparisons of proportions caught at age between this assessment and the previous one is recommended for inclusion in the updated version of the assessment document.

2. **Filtering of the whiting by-catch data**: the draft assessment removed some catch and effort records from the whiting by-catch database prior to standardisation. The Panel considered that most of the filtering criteria were appropriate, but others had the potential of biasing the CPUE downwards. The Panel requested that tows with widow catches larger than 5 tons and those outside 2 standard deviations NOT be removed. It was not possible to re-do the data extraction and standardisation during the meeting and the Panel subsequently concluded that it would be preferable to consider this request as a research recommendation for the next assessment of this stock.

3. **Foreign landings**: estimates of rockfish landings by the foreign fleets have recently become available and those for widow rockfish have been added to the assessment at the request of the 2003 Panel. The modelling was correspondingly extended backwards to start in 1958 rather than in 1968 as in the previous assessment.

4. **Catch at age**: data files for the observed and predicted catch at ages were requested. The predicted catch at age were provided. The observed catch at age remains to be calculated for inclusion in the updated version of the assessment document.

5. **Triennal surveys**: the 2000 STAR Panel recommended that the triennial survey "be examined more closely to reconcile the discrepancies between the survey trends and the apparent population trends based on the population dynamics model", because it considered that the triennial survey, being the only fishery independent index of stock size, should be given a higher weight. This examination was not done, and the draft assessment did not use the triennial survey in model fitting. The 2003 STAR Panel supports the observation and the recommendation of the 2000 Panel that the triennial survey be analysed further (by area, post-stratification, exclude anomalous tows etc.) and be considered for

inclusion in the assessment. This should be done in the next assessment of widow rockfish.

6. **Selectivity**: the draft assessment estimated yearly selectivities for four fisheries. The results indicated variability over time, but little systematic changes, while those changes that were seen were counterintuitive with management action. In addition, the Panel noted that the mesh size in the bottom trawl fishery had been changed in 1992 (in the cod end) and 1995 (for the whole net). The Panel requested that selectivities be estimated by block of years: Vancouver-Columbia would have 3 periods (before 1983 when bottom trawl and midwater trawl are not separated in the statistics, 1983 to 1995 for bottom trawl when mesh size was 3 inches in the body of the trawl, and from 1996 with 4.5 inches mesh). The other areas / fishery would have two blocks: prior to 1996 and since 1996. The results suggested it was only in the Oregon bottom trawl fishery that the selectivity had changed, and the change was counterintuitive with higher selectivity on younger fish since the increase in mesh size. Given the paucity of reliable information on recruitment since 1996, and because the juvenile midwater index suggest that recruitment was low, it may be that the model explain higher catches of young fish in recent years that could be due to stronger year classes as higher selectivities. Although the 2000 assessment included time-varyin g selectivity, The 2003 STAR Panel concluded that one selectivity curve should be estimated for the whole time period for each of the four fisheries. The Panel considers that this topic may require further analyses in the next assessment.

7. **Natural mortality**: the draft assessment allowed the model to estimate a slightly higher natural mortality for males than for females based on the observation that there were more older females than males in the fishery. The Panel noted that the catch composition by gender showed a greater proportion of males at younger ages, possibly due to difference in selectivity by gender. Allowing for different natural mortality had little impact on model results and the difference in M were small. The Panel considered that until the reason for the difference in age composition has been elucidated, the same natural mortality value should be used for both genders.

8. **Spawner-recruitment**: The current assessment includes estimation of a spawner-recruitment curve and annual recruitment deviations from this curve, in contrast to the previous assessment which estimated each recruitment as a free parameter. The Panel requested an exploratory model run in which the recruitments were freely estimated. The first batch of these runs gave larger than expected initial stock conditions for the years prior to any data availability - although biomass at the beginning of the period for which data are available was similar to runs with the S-R relationship imposed. In subsequent runs, the S-R relationship was re-introduced primarily to smooth the transition from the no-data period to to the data period.

9. **Iterative re-weighting**: the panel noted that the estimation of sigma R (for recruitment deviations) and some of the CV's on the by-catch indices were estimated as model parameters in the draft assessment. The Panel notes that internal estimation of variance can contribute to unstable model performance. Although this did not necessarily occur here, the Panel requested that Sigma R and the bycatch CVs be assigned fixed values before running the model. The panel was also concerned that the CVs estimated by the GLM analyses may not capture all of the variability in the CPUE indices, such as inter-annual changes in catchability. The subject of how to assign weights to the various sources of information needs further investigation. In the end, the Panel recommended that the root mean squared error of the fit to each index in a preliminary run be used to calculate the CV to be used in subsequent model runs.

10. **Juvenile survey index:** The index is compared to the model's estimate of recruitment raised to a Power. The index has a range of about 100 and the recruitment estimated by the model has a range of 10. However, the estimated power of 10 in the draft model configuration implies a dynamic recruitment range of only 1.5 from the survey range of 100. Hence the inclusion in the model of the juvenile index with a power of 10 does not provide information on recruitment variability but in fact dampens the estimate of recruitment variability. Although the previous assessment argued for a power relationship due to compensatory larval mortality, there is no bio-ecological explanation for such a high power. The Panel asked for a profile of assessment results on the power, which showed that the power of the relationship between recruitment and the juvenile index has a large influence on the population estimate. In the end, the Panel recommended a fixed power of 3.0 for the base model and a

profile from 1.0 to 5.0 to describe a relevant component of the uncertainty in the model results. Approximate probabilities for these results can be determined from the respective likelihood values.

11. **Base model**: more than 20 additional model formulations were requested by the Panel and performed by the STAT to investigate the behaviour of the model under different hypothesis on natural mortality, selectivity, stock and recruitment variability, stock and recruitment relationships, reliability of stock size indices, and the functional form of the juvenile index relationship with recruitment at age 3. The Base run used a fixed value of M=0.15, it included foreign landings from 1966 onwards, the last 3 points of the whiting domestic index were excluded, one fishery selectivity over time was estimated for each fishery, the power on juvenile survey index was fixed at 3.0 and the index's contribution to the objective function was downweighted to 0.50, Sigma R for recruitment deviations was fixed at 0.50, and the CVs on each CPUE or survey index were set equal to the RMSE for the fit to that index in an initial model run with CVs set at 0.50 for all indices.

Some of the above issues were raised by the 2000 STAR Panel also. More attention to the previous STAR report could have improved preparation for this review.

Comments on technical issues and recommendations for remedies

The modelling in the assessment of widow rockfish is state-of-the-art. However, there remains considerable uncertainty in current stock status and recent trends because of the absence of fishery independent stock size index and of recent reliable fishery dependent indices of stock size. The CPUE indices derived from the by-catch in the whiting fishery do not provide information on current stock size: the index derived from the foreign whiting fishery covers 1976 to 1988, that for the joint venture fishery covers 1983 to 1990, and even though that for the domestic whiting fishery covers 1991 to 2001, values from 1999 onwards are not considerable representative of changes in stock size and they were not included in model fitting. The Oregon bottom trawl CPUE index derived from logbook data cannot be calculated after 1999 because the catches have been too small to be considered representative of changes in stock size and changes in management measures are expected to have more influence on the CPUE than changes in stock size, particularly in recent years. In addition, the CPUE from logbooks is calculated from landings, not from catches, and there is no account for changes in efficiency over time. The midwater trawl juvenile index is available from 1984 to 2002, but the area sampled is small compared to the distribution area of the stock, there are some years with insufficient catches to calculate the index suggesting that juveniles were probably distributed outside of the sampled area in those years (because recruitment was not zero and not considerably lower than neighbouring years), and the functional form of the relationship between the abundance of 100 days old juveniles in the survey and year class size estimated three years later in the population model is unknown. There is therefore an obvious need for collecting data with a view to derive abundance indices. The 2000 Panel recommended that "a hydro-acoustic survey for widow rockfish, possibly using industry vessels, could provide invaluable information that would improve the assessment". The 2003 Panel supports that recommendation.

Areas of Disagreement

There was no unresolved area of disagreement.

Unresolved problems and major uncertainties

The stock is arbitrarily defined from the USA-Canada border and south even though the species does exist in Canadian waters and a fishery developed since the mid-1980s. The current assessment assumes that the Canadian fishery has no influence on the resource in US waters. This assumptions needs to be evaluated. If it is concluded that the catches in Canadian waters have no influence on the resource in US waters, the current approach can be continued. Otherwise, it may be necessary to do a joint assessment.

Recent management measures have been such that catches in the Oregon bottom trawl fishery have been insufficient to derive CPUE estimates for 2000-2002. However, even if catches had been higher, there

would remain considerable concerns in treating the CPUE series as a consistent series. Changes in management measures over time have been such that it could be desirable to divide the logbook data in two or more time series with relatively consistent management. This was recommended by the 2000 Panel, and the absence of overlap between periods was considered an impediment. The 2003 Panel did not investigate this further but further research is required.

The 2002 juvenile index derived from the Santa Cruz laboratory midwater trawl survey is considerably higher than any other estimates since 1989. As indicated earlier, the index is derived from sampling in a relatively small geographical area compared to the expected distribution of the juveniles and the index is expected to be sensitive to changes in distribution and not only changes in juvenile abundance. If the 2002 year class is as large as the index suggests, it could result in substantial stock increases. However, the relationship between the index and subsequent recruitment has been highly variable, and given the concerns about the reliability of the index, there remains considerable uncertainty about the size of the 2002 year class.

The value of the power in the curvilinear relationship between the juvenile index and subsequent recruitment is a major source of uncertainty on current stock status and recent trends. This subject requires further research in order to identify reasons for the existence of such a curvilinear relationship and for reducing the range of possible values for the exponent.

Various assessments in the Council's area treat time-varying selectivity in different manners. The widow rockfish assessment used a parameterised curve with one parameter allowed to change each year in the draft assessment. The Pacific Ocean Perch assessments uses a non parametric approach, while the whiting assessment uses a parameterised approach, but with random walk and penalty. These various approaches should be examined and compared with the view of providing guidelines for a structured approach. As a general rule, changes in selectivities should be linked to known changes in management, in the behaviour of the fleets (market conditions) or in changes in fish distribution / migration. Alternatively, the statistical properties of the random walk approaches need to be well investigated.

Similar to other rockfish species in the area, the biomass of widow rockfish has decreased steadily since the early 1980s and recruitment during that period is estimated to have been considerably smaller than before the mid 1970s. The reason for the lower recruitment since the early 1980s could be due to lower spawning stock biomass, but it could also be due to a lower productivity regime. If recruitment is currently low because of hydro-climatically unproductive conditions, it may not be possible to rebuild to the target biomass until more productive conditions occur. If the conditions improve, rebuilding could be faster than expected. The spawner-recruitment curve included in this assessment appears to track the trend in recent recruitment and to provide a stabilization of early, data-poor recruitment estimates. If recruitment is truly related to spawning output by this relationship, the current assessment indicates that rebuilding will be slow. However, the estimated parameters of this relationship are relevant for the climate regime of the past approximately 20 years and other aspects of the model formulation. Because of this uncertainty, the panel does not recommend that this estimated s-r relationship be used as the only basis for calculation of rebuilding targets and rates for widow rockfish. Long-term fluctuations in the climate could result in revised spawner-recruitment parameters as the stock is monitored over a longer period.

Recommendations for future research and data collection

1. For the next assessment, the STAT should systematically compare data and results with those of the 2003 assessment. In the same spirit, the STAT should explicitly report progress on the recommendations made in the current Panel report.

2. The Panel recommends that a rockfish survey by hydro-acoustics or other methods be initiated, possibly in cooperation with the fishing industry (this was also recommended by the 2000 Panel).

3. The 2003 STAR Panel supports the observation and the recommendation of the 2000 Panel that the triennal bottom trawl survey be analysed further and be considered for inclusion in the assessment.

4. Preliminary information for 2002 suggest that discards may have decreased substantially compared to the assumed 16% currently used. New discard data should be analysed and, if warranted, past discard estimates should be adjusted.

5. The assessment assumes a unit stock from the USA/Canada border and south, but there is little information to ascertain the stock structure of widow rockfish. This should be studied through genetic studies and other stock identification techniques.

6. Investigate with recent data whether growth and maturity in the northern area and in the southern area are really different.

7. The model included estimation of a spawner-recruitment curve. Such a curve can stabilize estimation of recruitments from data-poor portions of the time series, and it can provide a basis for calculation of Bzero and future recruitments. However, inclusion of a curve with a particular parametric form (in this case the Beverton-Holt curve, and with some runs using a Ricker curve) has the potential to influence the trend in recruitment if there are not sufficient data to provide solid information about the trend. Since some assessments use the s-r curve internally and others do not, the Panel recommends an analysis to fully investigate the pros and cons of this approach.

8. Considerable uncertainties exist in the estimated stock and recruitment relationship, and it is likely that additional factors besides stock size in US waters are contributing to recruitment variability. The Panel recommends compiling oceanographic time series and investigating whether these data can be used as covariates in estimating the stock-recruitment relationship of widow rockfish. This investigation should take into account stock structure, including consideration of fish in Canadian waters, and should take a multiple species approach because of the possible synchronicity of rockfish recruitment.

9. Filtering of whiting by-catch data should NOT exclude tows with widow catches greater than 5 tons NOR those outside 2 standard deviations of the standardised values.

10. The current CPUE standardisation treats each 64 OR bottom trawlers and 61 geographical units as individual categories. The Panel recommends that the usefulness of regrouping the vessels and geographical units be investigated. In all standardizations, the straight average index should be compared with the standardized estimates to appraise the magnitude of the effect of the standardization.

11. The Oregon CPUE is an important index in the assessment, yet it is may not be a consistent index of stock size over the period of the assessment because of changes in fishery management and of changes in fishing efficiency of individual fishing units. The data should be analysed to evaluate the desirability of breaking the series in two or more time periods.

12. The base case assessment estimates a single selectivity for each of the four fisheries, but the Panel considers that the topic of time-varying selectivity requires further research.

13. Similarly, the weighting of the various indices, including iterative re-weighting of the series and the weights of individual points within each series, should be re-investigated in future assessments.