YELLOWEYE ROCKFISH

STAR Panel Report

August 3-6, 2009

Hotel Deca
4507 Brooklyn Ave NE
Seattle, WA 98105

Panel Reviewers

Stephen Ralston	Panel Chair, Scientific and Statistical Committee (SSC) Representative
Richard Methot	NMFS, Northwest Fisheries Science Center (NWFSC)
Vivian Haist	Center for Independent Experts (CIE)
J. J. Maguire	Center for Independent Experts (CIE)

Panel Advisors

John DeVore	Pacific Fishery Management Council
Robert Alverson	Groundfish Advisory Subpanel (GAP) Representative
Rob Jones	Groundfish Management Team (GMT) Representative

Stock Assessment (STAT) Team members present

Ian Stewart	NMFS, Northwest Fisheries Science Center (NWFSC)
John Wallace	NMFS, Northwest Fisheries Science Center (NWFSC)
Carey McGilliard	University of Washington, School of Aquatic & Fishery Resources

Overview

A draft assessment of yelloweye rockfish (*Sebastes ruberrimus*) stock status off the U. S. west coast (California, Oregon, and Washington) was reviewed by the STAR panel from August 3-6, 2009 in Seattle, WA. Within the model the population is treated as a single stock with separate sub-population structure within each of the three States, allowing for State-specific estimates of unexploited stock size and current depletion. The biological underpinnings of the model structure are that adults are site-attached and do not move appreciably among the three states whereas larval dispersal is widespread, assumptions that are well-supported in the scientific literature. In addition, because the age- and length-compositional data are not informative of the time series of recruitment and because it was infeasible to integrate across the range of uncertainty in these recruitments, stochasticity in the spawner-recruit relationship was not modeled.

The yelloweye stock assessment used the Stock Synthesis platform and incorporated a variety of data sources. Catch, length-frequency, and conditional age-at-length data from six fisheries were used in the assessment, i.e., commercial and recreational fisheries in each of the three states. The fishery-dependent relative abundance (CPUE) indices that were used in the model were developed from recreational fisheries data and were unchanged from the last assessment conducted in 2007. Separate fishery-independent time series of abundance were developed for Oregon and Washington using International Pacific Halibut Commission (IPHC) longline survey data. In addition, time series of yelloweye rockfish abundance in the triennial and NWFSC combined trawl surveys were estimated and incorporated into the base stock assessment model.

The last full assessment of yelloweye rockfish was completed in 2006 (an off-year) and that model was subsequently updated in 2007. Major changes made in this assessment, compared with the previous assessment include:

- Use of SS version 3.03b modeling framework instead of SS2;
- Incorporation of reconstructed landings that extended the modeled period to 1916 instead of 1925;
- Treatment of the population dynamics in an area-based model with recruitment apportioned to areas based on internal parameter estimation;
- Removal of stochasticity in recruitment;
- Addition of NWFSC shelf-slope trawl survey (referred to as NWFSC combined survey in the assessment report) and the triennial trawl survey;
- Incorporation of weight-specific fecundity based on a meta-analysis of rockfish reproduction;
- Revision of aging error estimates using software developed by Punt *et al*. (2008)
- Inclusion of age data as conditional age-at-length compositions;
- Estimation of gender-specific natural mortality and spawner-recruit steepness in the model using newly developed priors.

The STAR panel concluded that the yelloweye rockfish assessment constitutes the best available scientific information on the status of yelloweye rockfish off the U.S. west coast and recommends that it be used for status determination and management in the Council process.

The STAR panel thanks the STAT team members for their exceptional preparation, hard work, and willingness to respond to panel requests.

Panel Requests to the Yelloweye STAT

The following prioritized requests were made by the STAR panel to the yelloweye STAT:

Request 1: In figure 55, verify that observations in bin 70 are real and not the result of an aggregation at 70 – new base.

Rationale: Length-frequency distributions for gender-combined yelloweye rockfish from the Oregon recreational observer program show large observations in bin 70, suggesting that this bin could be an accumulator bin. Data verification request to verify that the data have been correctly used.

Response: Observations at 70 cm for Oregon recreational observer length frequencies were a formatting error. The error was corrected and all other bins remain unchanged.

Request 2: Provide a run with a normal approximation of Hamel's prior for natural mortality (M) on both males and females – new base.

Rationale: Runs where M was estimated with a higher M prior for the males resulted in estimated M for males very close to that estimated for female. Figure 41 in the draft assessment provides the rationale for higher M for males. Dr. Owen Hamel has completed a meta-analysis of M and his results were considered potentially more useful as prior information to be used in the model.

Response: Fixing the OR recreational observer length frequencies and using the Hamel prior for natural mortality resulted in minor changes in the model results. Correcting the error in the LF changed steepness by 0.01. Henceforth the base case is with OR recreational observer LF corrected and using new M priors.

Request 3: Provide a run keeping the observations after 1999 for the recreational CPUE series to estimate the effect of truncating the indices in 1999. Previous analyses had suggested that management measures after 1999 may not have substantially affected the indices until 2001 or so.

Rationale: This is essentially seen as a sensitivity run to document the effects (or not) of including those points in the assessment, inasmuch as they were included in some previous assessments.

Response: There is a difference of opinion between current and previous STAT teams on how to treat those points. The current STAT thinks that regulatory changes after 1999 were sufficient to potentially impact recreational CPUE and it considers that the burden of proof is to demonstrate that they did not. Including the 2000 and 2001 points made little change in the results and the Panel agreed that the base case would not include the recreational CPUE estimates for 2000 and 2001.

Request 4: Provide a run where stock size indices are up-weighted compared with the age / length compositions.

Rationale: This is also seen as a sensitivity run to understand the potential effect of giving more weight to the stock abundance indices compared with the length and age compositions.

Response: This request was addressed by increasing the lambdas on the stock size indices 10-fold. This resulted in lower stock size in 2009 and depletion equal to 15.4%, compared with 20.3% for the base case. Steepness decreased from 0.417 to 0.302. The likelihood of the age and length compositions did not change much suggesting that they were not strongly affected by the index data. This was not intended to change the base case.

Request 5: Provide sensitivity run with the exponential parameter on Q turned off for recreational CPUE time series.

Rationale: Another sensitivity run to understand the effect of allowing a non-linear relationship between abundance and CPUE in the fishery-dependent recreational data.

Response: Assuming that recreational CPUE series were linearly related to stock size had minimal effects on the results. The Panel agrees with the STAT that the potential for catchability to be nonlinearly related to stock size should be retained in the base case. The Panel noted that excluding 2000 and 2001 from the series and allowing for catchability to be nonlinearly related to stock size implied that the recreational CPUE were downweighted.

Request 6: In the GLM for the IPHC, drop the stations where yelloweye have never been caught and estimate a station effect. Plot the two time series versus time to investigate the difference.

Rationale: Given the association of yelloweye rockfish with rocky and other high relief habitats, a relatively strong station effect would be expected. However, because no yelloweye rockfish were caught at many stations it was not possible to estimate the station effect in the GLM when all stations were included in the analysis. Removing stations that had never caught yelloweye was suggested as a possible way of estimating station effects.

Response: Removing the stations where no yelloweye rockfish had ever been caught increased the absolute value of the stock size index, but did not change the trends over time for either the OR of WA indices. Including site effects makes it possible to include covariates in the CPUE modeling. Excluding stations where yelloweye rockfish have never been caught could be counterproductive in the future, however, if as the yelloweye population increases it expands its range and populates new areas. The Panel did not recommend that the base case should be changed to include CPUE standardized with site effects, but noted that this issue should be reviewed in the next update assessment. The Panel also noted that the IPHC longline survey could be a good survey for yelloweye if sampling intensity was higher, but higher sampling intensity could catch a considerable portion of the total OY.

Request 7: IPHC survey and Triennial surveys catch large yelloweye off WA, but neither the IPHC survey nor the NWFSC catch large yelloweye off OR. Does the NWFSC catch large yelloweye off WA?

Rationale: This is a first step in evaluating the selectivity curves for the different areas and gears versus the availability of large yelloweye in the various areas.

Response: There were a few larger yelloweye in the NWFSC survey off WA suggesting that the NWFSC can catch larger yelloweye rockfish if they are present. The Panel concluded that there was insufficient support to change the base case dome-shaped selectivity curve to asymptotic selectivity for the NWFSC trawl survey off OR.

Request 8: Is the IPHC survey off OR potentially dome shaped?

Rationale: This is related to request 7 where the IPHC survey seems not to be catching large yelloweye off OR. The question arose as to whether this is due to lack of large yelloweye in the area or because of dome-shaped selectivity.

Response: With the correction to the OR recreational observer length frequencies the selectivity for the IPHC survey in OR wanted to go dome shaped. The fit to the data with either domed or asymptotic selectivity are similar, although the residual pattern is somewhat improved with domed selectivity. Given that the selectivity for the IPHC in WA was asymptotic and because the absence of large fish in OR could be due to growth differences, the Panel recommended to keep the asymptotic selectivity for the IPHC survey in OR until there is a better understanding of growth and biological parameters. The selectivity pattern for both the trawl surveys and the IPHC longline surveys should be open for further investigation in subsequent assessments.

Request 9: Provide a plot of the gender ratio over time.

Rationale: This is to assess if there are temporal trends in the gender ratio over time.

Response: Expected gender ratio by State, age, and year were plotted. The difference in gender ratios was small, with the ratio of males to females between 0.90 and 1.1. While the difference in gender ratio by State, age, and year may not be sufficient to justify modeling genders separately, it is necessary to do so to accommodate variable female fecundity by size.

Request 10: Overlay length at age, color coded for WA, OR and CA, on the growth plot to estimate if there are differences by area.

Rationale: The intent is to investigate if there are differences in growth in the three areas.

Response: Yelloweye do get somewhat larger off WA, but the Panel did not recommend changing the base case. The Panel recommended that the next assessment evaluate the appropriateness of estimating biological parameters by area.

Request 11: Provide a plot of the profile of steepness as a function of M.

Rationale: The intent is to better understand the joint behavior of M and steepness and to evaluate if steepness should be used as an axis of uncertainty.

Response: The graph reinforced the impression that there is little information to estimate steepness from a one way trip. Steepness has a large effect on the rebuilding potential and the Panel and STAT agreed to use a combination of catch and steepness to provide nine states of nature to depict uncertainty scenarios.

Request 12: The stock assessment report should contain a reference to the proposed listing of yelloweye in Puget Sound as endangered (under the terms of the Endangered Species Act)).

Rationale: A proposed listing of a distinct population segment of yelloweye rockfish is important background information that managers may want to consider when developing management measures for yelloweye rockfish.

Response: Text will be incorporated in the final assessment, similar to what was included in the bocaccio assessment.

Description of base case model and alternative models to bracket uncertainty

- Start year of the model = 1916;
- Spatial structure has coastwide spawner-recruitment pool, with recruitment apportioned among three State areas according to estimated proportions;
- Each fishery and survey is specific to one State area;
- Discard incorporated into total catch;
- Sex-specific ***M*** estimated to be 0.047 yr^{-1} for females and 0.047 yr^{-1} males (with Hamel's normal approximation prior);
- ***h*** estimated to be 0.417 (with Dorn's prior);
- No recruitment deviations estimated in base model;
- von Bertalanffy growth parameters, including dispersion of individual growth, estimated for females and males;
- Fishery CPUE indices fit using density-dependent catchability.

Fisheries:

California commercial (all gears)
California recreational
Oregon commercial (all gears)
Oregon recreational
Washington commercial (all gears)
Washington recreational
Foreign and research catches included in commercial catch

Abundance indices:

IPHC longline survey – WA (1999-2008)
IPHC longline survey – OR (1999-2008)
Triennial trawl survey – WA (1980-2004); break in catchability in 1995
NWFSC shelf-slope trawl survey – OR (2003-2008)
Recreational (CPFV) CPUE – CA (1988-1998)
Recreational CPUE - CA (1980-1986, 1993-1999)
Recreational (CPFV) CPUE – OR (2004-2008)
Recreational CPUE - OR (1979-1999)
Recreational CPUE - WA (1990-1999)

Length compositions:

Recreational (CPFV)– CA (1988-1998)
Recreational - CA (1993-2008)
Commercial - CA (1978-2007)
Recreational (CPFV) - OR (2004-2008)
Recreational - OR (1978-1989, 1993-2003)
Commercial - OR (1992, 1995-2008)
Recreational - WA (1998-2001, 2004-2008)
Commercial - WA (1994-2008)
IPHC – longline survey - OR (2003-2008)
IPHC – longline survey - WA (2003-2008)
Triennial trawl survey – WA (1980-2004)
NWFSC shelf-slope trawl survey – OR (2003-2008)

Age compositions (as conditional age-at-length/sex):

Recreational - CA (1983, 1996)
Commercial - CA (1978-1983, 1985-1986, 1988, 2001, 2005)
Recreational - OR (1979, 1984-1987, 1989, 2001)
Commercial - OR (2001-2007)
Recreational - WA (1998-2001, 2004-2008)
Commercial - WA (1993, 2001-2008)
IPHC – longline survey - OR (2003-2008)
IPHC – longline survey - WA (2003-2008)

Uncertainty – The magnitude of historical landings of yelloweye rockfish is a substantial source of uncertainty in this assessment and strongly affects the absolute magnitude of estimated stock abundance, although not the long-term trend and depletion. The assessment was able to obtain reasonable estimates of natural mortality and spawner-recruitment steepness, but the magnitude of the steepness parameter is not precisely determined and is expected to have a substantial effect on projected rates of stock rebuilding. The magnitude of historical catch and spawner-recruitment steepness were selected as two axes of uncertainty for this assessment. The panel recommends that this uncertainty be carried forward into the rebuilding analysis.

Technical merits of the assessment

The yelloweye stock assessment team was exceptionally well prepared and had conducted a wide variety of analyses and sensitivity runs supporting their development of a proposed base-case model. The transition of the assessment to an area-specific model represents a substantial improvement in our understanding of regional variation in stock depletion. Likewise, incorporation of extensive historical catch reconstructions by the STAT provides greater insight into regional yelloweye productive capacity. Of significant concern to the STAR panel was that historical harvests from the State of Washington may be biased low, a concern likely to be addressed when the next assessment is completed.

Explanation of areas of disagreement regarding STAR panel recommendations

A. Among STAR panel members (including concerns raised by the GAP and GMT representatives

There were no areas of disagreement among STAR panel members.

B. Between the STAR panel and the STAT team

There were no areas of disagreement between the STAR panel and the STAT team.

Unresolved problems and major sources of uncertainty

Recently completed historical catch reconstructions had a marked influence on the yelloweye rockfish stock assessment, particularly on regional estimates of B_0. As a consequence, the STAT came to the meeting with a recommendation that uncertainty be bracketed by ranging historical catches ±50%. A particular problem identified by the STAR panel and the STAT is that Washington reconstructions were less well-developed than those from Oregon and California and estimates may be biased low. The panel therefore recommends that work continue on historical catch reconstructions and that updated catch time series from all three States be incorporated into the next stock assessment.

Another major unresolved problem facing the yelloweye stock assessment is the need to develop a good abundance statistic that can be used to track stock recovery. Two avenues worth pursuing were identified during the review: (1) development of *in situ* visual survey abundance measures in yelloweye habitat using ROVs, AUVs, submersibles, etc, and (2) improvement of the IPHC survey yelloweye rockfish bycatch index by increasing sample size and improving the statistical model (e.g., incorporating station effects). Given that Washington and Oregon have taken different approaches to supplementing IPHC survey sample size, the latter issue will be challenging to solve.

The STAR panel, in consultation with the STAT, ultimately identified two axes of uncertainty to carry forward into a decision table, i.e., historical catch reconstructions and statistical error in the estimate of stock productivity ($\boldsymbol{h}$ = 0.42). The former was bracketed by 75% and 150% of the base-case reconstruction, whereas the latter was bracketed by assigning 25% of the probability mass to high and low values of steepness equal to 0.34 and 0.51 (based on likelihood profile). The two uncertainty axes were crossed, resulting in nine states of nature that should be carried forward into the rebuilding analysis, each with a specific probability of occurrence.

It is unlikely that the yelloweye rockfish stock assessment can be considerably improved in two years, other than by updating the historical catch reconstructions (especially for Washington) and the IPHC GLM indices to include supplemental sample sites that have been occupied in Oregon and Washington. Both issues, however, have the potential to alter the stock assessment and may exceed the requirements for stock assessment updates as specified in the PFMC's Groundfish Terms of Reference. The panel was therefore unsure whether to recommend that the next assessment should proceed as an update or as a full assessment. From a practical perspective it would be desirable if the Council's process could accommodate an "extended update" that could allow exploration of these two issues in 2011 without requiring a whole week of review.

Management, data, or fishery issues raised by the GAP and the GMT representatives

The yelloweye rockfish stock assessment is spatially explicit, with separate sub-population components modeled for Washington, Oregon, and California. Not surprisingly, given the constraining nature of the yelloweye rockfish resource on the array of groundfish management options available to the Council, there will be considerable interest in the allocative implications of the new assessment. For example, the accepted base model estimates that the stock is less depleted in the north but potential yields are greater in the south due to differences in unexploited stock size. Given the sensitivity of yelloweye rockfish OY allocations to the states, the GMT representative wanted some assurance that regional model scenarios could be run using the base model to better inform the Council as it works to develop yelloweye management measures for the 2011-12 biennial period. The STAT can therefore expect a number of requests from the GMT to model the effect of various state- and fishery-specific catch projections on population growth and recovery.

Prioritized recommendations for future research and data collection

1. Develop and implement an effective visual survey of yelloweye rockfish abundance.

2. Conduct a scientific review of current efforts to develop and improve stock size indices for yelloweye based on IPHC sampling (including the addition of new stations) and make recommendations on the best approach to develop such indices. In particular, divergent 'enhanced' sampling designs (stratified random vs. adaptive fixed stations) in Oregon and Washington makes it difficult to compare results. The next assessment should be able to make direct use of these additional stations, if sampling is continued in 2009 and 2010.

3. Recalculate GLMM estimates from the IPHC survey to explore inclusion of station effects and allow incorporation of sites that differ in occupancy over time.

4. Continue to refine historical catch estimates using ex-vessel prices, etc., particularly in the State of Washington.

5. Investigate the development of a Washington recreational yelloweye CPUE statistic based on trips from the recreational Pacific halibut fishery. Consider a full time series and one ending in 2002, since the yelloweye RCA in waters off northern WA was implemented in 2003.

6. Encourage the collection of specimen samples to refine estimates of biological parameters, particularly maturity and fecundity.

7. Continue to evaluate the spatial aspects of the assessment, including growth, the number and placement of boundaries between areas, as well as the northern boundary with Canada.

8. Sample organization and curation of specimen materials (e.g., otoliths) from the IPHC survey should be revisited. Currently biological samples cannot be linked to the station from which they were collected. Age data for 2003-2005 is disconnected from the

relevant length and sex information and other unknown problems may exist in the data. A thorough evaluation of what data are reliable and a final determination of what information is lost, or can potentially be recovered, is needed

General research recommendations

1. Investigate alternative methods of re-weighting the data series in Stock Synthesis.

2. More work is needed to better understand the performance of maximum likelihood and Bayesian estimators of stock size and trends when large numbers of poorly informed recruitment deviations are estimated. Although it is logically appealing to include such uncertainty, even when there are little coherent data informing cohort strengths, technical and computational issues need to be solved before this approach can be implemented in situations such as yelloweye rockfish.

3. Investigate how best to account for variability in calendar dates in trawl surveys, especially through a meta-analysis of multiple stocks.

4. Continue to refine coast-wide historical catch estimates.

5. Accessing and processing recreational intercept data from RECFIN and the three states is much too cumbersome for the STATs. A single database that holds all the raw recreational data in a consistent format would greatly expedite processing and interpretation of the data and would reduce the potential for introduction of errors.

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