BOCACCIO ROCKFISH

STAR Panel Report

July 13-17, 2009

Southwest Fisheries Science Center
110 Shaffer Road, Santa Cruz, CA 95060

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Overview

A draft assessment of bocaccio rockfish (*Sebastes paucispinis*) off the west coast of the United States, from the U.S.-Mexico border to Cape Blanco, Oregon (Conception, Monterey and Eureka INPFC areas) was reviewed by the STAR panel during July 13-17, 2009. The population is treated as a single stock within the assessment area. Although the range of the species extends considerably further north, there is some evidence that there are two population centers of bocaccio, one in southern California and another off the west coast of British Columbia, with a relative scarcity of bocaccio in the region between Cape Mendocino and the mouth of the Columbia River.

This assessment used the Stock Synthesis platform (version 3.03a) and incorporated a variety of data sources. Catch and length-frequency data from six fisheries were used in the assessment, including two trawl fisheries (north and south of 38º N), one hook-and-line fishery, one set net (gillnet) fishery and two recreational fisheries (south and north of Point Conception). Fishery-dependent relative abundance (CPUE) indices used in the model were calculated from the trawl fishery and the two recreational fisheries. The model also uses a recruitment (age-0) index based on recreational pier fishing. Fishery-independent data included the CalCOFI larval abundance time series, the triennial trawl survey index, the NWFSC shelf-slope survey index, the NWFSC Southern California Bight hook-and-line survey, and the coastwide pelagic juvenile survey. No age data were used in this model as it is notably difficult to determine the age of bocaccio in the assessment area.

The last full assessment of bocaccio rockfish was done in 2003, and it was subsequently updated in 2005 and 2007. Major changes made in this assessment, compared with the previous assessment include:

- Use of SS3 modeling framework instead of previously employed SS1;
- Extension of the north boundary of the assessment area from Point Mendocino to Point Blanco;
- Extension of period modeled from 1951 to 1892;
- Use of two trawl fisheries rather than one, as was used in the past;
- Use of a revised catch history based on Ralston et al. (2009)
- Addition of NWFSC shelf-slope trawl survey (referred to as NWFSC combined survey in the assessment report);
- Use of revised triennial trawl survey estimates using a GLMM approach (instead of area-swept approach previously used);
- Addition of NWFSC Southern California Bight hook and line survey;
- Use of revised juvenile indices (Pier index and juvenile trawl survey index).

The STAR panel concluded that the bocaccio rockfish assessment constitutes the best available scientific information on the status of bocaccio 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 hard work and willingness to respond to panel requests.

Analyses requested by the STAR Panel

The Panel requests were addressed using a base model (Mod50) slightly different than that in the draft assessment. It included a corrected fecundity relationship and CPFV observer length composition data split from those from RecFIN. These changes made the assessment slightly more pessimistic (depletion 25% compared to 26% in draft base model).

1. **Eliminate the recreational index north of Point Conception (recCEN)**

   Rationale: These data could be misleading because they may be more indicative of changes in the spatial pattern of the fishery than in the fish stock.

   Response: Dropping the recCen index changed the depletion from 25% to 22%. This run was treated as an interim base model for comparison with the runs below.

2. **Iteratively up-weight each informative index (adjust lambdas) to determine the major conflicts in the model; estimate current biomass and depletion under each scenario.**

   Rationale: To identify major conflicts amongst the biomass indices and determine which indices were optimistic and which were pessimistic.

   Response: Because of time constraints, and because it was already reasonably clear which of the indices were optimistic or pessimistic (see request 3), the STAT only partially filled this request, and focused on addressing these points in request 3.

3. **Re-weight optimistic indices and pessimistic indices**

   Rationale: To provide a useful pair of runs to bracket uncertainty.

   Response: This analysis highlighted a conflict between two pessimistic indices – triennial survey and trawlsou (both of which show a steep decline in the 1980s), and two optimistic indices – recSO and CalCOFI (which show stronger rebuilding in the early 2000s). Upweighting both pessimistic indices resulted in a better fit to the 1980s decline and changed depletion to 16%. Upweighting the optimistic indices produced a better fit to the 2000s incearse and indicated less depletion (39% when recSO was upweighted; 36% when CalCOFI was upweighted).

4. **Evaluate the effect of the relative weighting of the biomass indices and the compositional data by down-weighting the compositional data**

   Rationale: To determine whether there are any conflicts between the biomass and compositional data.

   Response: Down-weighting the compositional data made a small change in the total likelihood for the indices (~7 points), showing that there was no strong conflict between the compositional data and the indices. The depletion changed from to 22% to 19%.

5. **Do a model run that incorporates all coastwide catches and mirrors selectivity of the northern trawl fishery**

6. **Do an additional model run that incorporates all coastwide catches *and* compositional data**

   Rationale: These two requests evaluate the effect of uncertainty about the northern boundary of the stock.

   Response: The main effect of including OR and WA catches was just to scale up the biomass trajectory. The estimated current status was slightly more pessimistic (23% depletion). When the compositional data were also included, the assessment became more optimistic (28% depletion) but it was unclear why. The length composition data were poorly fitted (most likely because the length bins were not well structured for the large fish that are caught in OR/WA but not elsewhere). Another unsatisfactory aspect of this run is that there is no index for OR/WA.

7. **Fix M for older fish at 0.1 and allow M to be estimated for younger fish.**

   Rationale: Based on the Hoenig method, an M of 0.1 is more consistent with the longevity data than the current value of 0.15. There are also indications that mortality of younger fish (before settlement to demersal habitat) is probably higher that that of older fish..
   Response: Runs were done in which natural mortality had a value of M_{young} (estimated) for ages ≤ 3, M_{old} (fixed at 0.1) for "old" fish, and was interpolated for intermediate ages. When "old" was defined as ≥ 8 y, M_{young} was 0.17 and the depletion was 20%; when it was ≥ 10 y, M_{young} was 0.21 and the depletion was 19%. In these runs, the overall fit degraded (by 25 and 20 points, respectively), with improvement of the fits to triennial survey and trawlsou CPUE indices and degradation to CalCOFI and recSO indices. It was agreed not to change the value of M used in the base model, since assessment is sensitive to the definition of "old" fish age, and there is not enough data to reliably estimate M for "young" fish.

8. **Include in the assessment report reference to the proposed listing of bocaccio in Georgia Basin as endangered (under the terms of the Endangered Species Act).**

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

Response: A new section has been drafted for the assessment report.

9. Assess the effect of the maturity curve by doing alternative runs using the maturity curves of Love et al. (1990) and Wyllie Echeverria (1987).

Rationale: To evaluate the sensitivity of the assessment to previously published maturity curves.

Response: Changing the maturity curve had negligible effect on depletion. Goodness of fit was very similar for all three maturity curves (a range of less than 2 likelihood units), but the Love et al. (1990) version fitted slightly better.

10. Specify the area covered by the assessment in the title of the assessment report.

Rationale: To improved clarity since the entire US west coast was not assessed.

Response: The report title was amended to include the area assessed.

11. Include recCEN index back in the base model (Mod50).

Rationale: It seemed more reasonable that this index be downweighted, rather than removed, and the tuning procedure already does this downeighting.

Response: Reintroducing the recCEN index changed the depletion from 22% to 25%.

12. Conduct two runs to bracket the uncertainty in the assessment: one upweighting triennial and trawlsou indices, and the other upweighting the recSO and CalCOFI indices.

Rationale: To bracket the uncertainty.

Response: Upweighting an index was done by setting the associated $\lambda = 10$. The depletion changed from 25% to 14% when the trennial & trawlsou indices were upweighted, and to 38% when recSO and CalCOFI were upweighted.

13. Provide confidence intervals for model outputs, with and without delta method (McCall, in prep.) contributions for uncertainty in steepness, h, and natural mortality, M.

Rationale: For models in which h and M are fixed, the usual confidence intervals (based on the inverse Hessian) may substantially underestimate uncertainty.

Response: When uncertainty in both M and h was included in the calculation of standard errors, this made the changes caused by the two bracketing runs (see request 12) approximately equivalent to ± 1 s.e. in depletion as estimated by the base model.

14. For the base model use the revised CalCOFI index (presented to the Panel) that utilizes a cloglog link in the binomial part of the GLM (instead of the usual logit link).

Rationale: An alternative GLM, using a cloglog link in the binomial model, rather than the previously used logit link, fit the CALCOFI data better (AIC decreased by 20).

Response: This change had only a slight effect on the biomass trajectory, changing the depletion from 25% to 26%.

15. Conduct run in which catches N of 40° 10´ were removed.

Rationale: To evaluate the consequences of using the assessment to manage bocaccio fisheries south of 40° 10´.

Response: This change had only a slight effect on the biomass trajectory, changing the depletion from 26% to 27%. The catch north of 40° 10´ throughout the assessment period was approximately 6.7% of the total catch. The 2009 spawning biomass for the model excluding the catch north of 40° 10´ is 5.4% lower, while the summary biomass is 5.0% lower.

Description of base case model and alternative models to bracket uncertainty

Start year of the model =1892; discard incorporated into total catch;
M fixed at $0.15yr^{-1}$ for both females and males; h estimated (but with Dorn's prior); $\sigma_R = 1$;
Von Bertalanffy growth parameters - L_{min} fixed, others estimated for females and males.

Fisheries

- Trawl south of 38^o N
- Trawl north of 38^o N
- Hook and line
- Set net
- Recreational south of 34.5^o N (Point Conception)
- Recreational north of 34.5^o N (Point Conception)

Abundance indices:

- Trawl fishery CPUE, abbreviated as trawlsou (1982-1996)
- RecFIN CPUE south, abbreviated as recSO (1980-2002)
- RecFIN CPUE north, abbreviated as recCEN (1980-2002)
- CalCOFI (1951-2008)
- Triennial trawl survey (1980-2004)
- CPFV CPUE (1987-1998)

NWFSC Southern California Bight hook and line survey (2004-2008)
NWFSC shelf-slope survey (2003-2008)
Pelagic juvenile index (2001-2008)
Recreational pier fishing recruitment index (1954-2008)

Length frequencies:

Trawl fishery (1978-2004)
Hook and line fishery (1979-2002)
Set net fishery (1978 -1998)
Recreational south of 34.5^{o} N (1975-2008)
Recreational north of 34.5^{o} N (1978-2008)
Trawl north of 38^{o} N (1978-2002)
Triennial trawl survey (1980-2004)
CPFV (1987–1998)
NWFSC Southern California Bight hook and line survey (2004-2008)
NWFSC shelf-slope survey (2003-2008)

Uncertainty was bracketed by regarding two alternative sets of indices to be more reliable indicators of stock trends. The low biomass scenario was obtained by upweighting ($\lambda = 10$) the triennial and trawlsou indices, while the high biomass scenario was obtained by upweighting ($\lambda = 10$) the recSO and CalCOFI indices. These scenarios also provided useful contrast between stock trends north of Point Conception (where recovery is apparently slower and may depend on an influx of fish from further south), and south of Point Conception (where trend data indicate more rapid recovery).

Technical merits of the assessment

This is a very thorough assessment, with good use of recent research results and sensitivity runs to evaluate alternative model assumptions. Recommendations from previous STAR panels were considered in detail. Substantial improvements were made to both the CalCOFI index and the maturity curve parameters. While there remain unresolved problems with the assessment, progress on these problems is likely to be difficult and incremental. Based on these considerations the Panel recommends that the next bocaccio rockfish assessment be an update rather than a full assessment.

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

Stock structure is a major uncertainty and unresolved problem – particularly the location of the northern and southern stock boundaries, and the extent of mixing with adjacent stocks. The apparent northwards diffusion of fish as they grow older also presents a difficulty for bocaccio assessment. The use of area-specific selectivities is an attempt to model this situation, but this is an imperfect solution because diffusion is likely to be a complex process that occurs sporadically and/or exhibits density-dependent characteristics. But given the limited data available, it is hard to see any alternative to this approach.

The value of natural mortality used in the assessment appears inconsistent with information on bocaccio longevity.

Finally, the lack of age data is a substantial limitation in the assessment.

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

GMT and GAP representatives pointed out that extending northern boundary of the assessment from Cape Mendocino to Cape Blanco in this assessment raises issues for the management of bocaccio rockfish. While scientific information is the over-riding consideration for stock structure decisions, such information may not be able to identify precise stock boundaries. In these situations, advice from resource managers should be requested to ensure that management measures are no more burdensome nor complicated than necessary.

From a management perspective, there are distinct advantages to restricting the assessment to California waters. Approximately 6% of the coastwide catch occurs between Cape Mendocino and Cape Blanco, while only approximately 1% of the coastwide catch is taken from the California/Oregon border to Cape Blanco. Ending the assessment at the California/Oregon border would allow Oregon to avoid being held to an extremely low harvest guideline that would need to be tracked with imprecise in-season catch estimates. California would not be required to enter into catch sharing agreements or allocation discussions with Oregon regarding bocaccio, although there would still be implications for the management of the California trawl fishery and trawl IQs. Given the uncertainties in stock structure and the low proportion of the coastwide catch north of Cape Mendocino, alternative model runs extending to Cape Mendocino, the California/Oregon border, and Cape Blanco could be presented to the Council for consideration in determining the geographic region that is managed using the assessment results.

Prioritized recommendations for future research and data collection

- The location of the northern and southern boundaries of this stock, and the extent to which it mixes with the Canadian and Mexican stocks, are major uncertainties in this assessment. Three approaches which might help reduce these uncertainties are otolith elemental analysis, parasitology, and co-operative research with Canadian and Mexican colleagues (e.g., evaluation of data from the Mexican analogue of the CalCOFI survey).

- The reliability of the recCEN index could be improved by an evaluation of the spatial distribution of fishing effort and fish size.

- The Panel endorses the continued processing of historical CalCOFI samples from the northern transects, which will produce additional data for this assessment.

- Neither the triennial nor the NWFSC shelf-slope surveys are well suited to bocaccio. Research to develop a survey methodology that is more appropriate for species like bocaccio could improve the assessment.

- SS3 implements new options for bias adjustment of stock recruit relationships that have been used with little or no peer review. Simulation testing is needed to confirm that bias adjustment is justified in all cases. Guidelines should be developed on how to configure bias adjustment settings to reflect the biological characteristics of the stock and the available assessment information.

- Develop methods to incorporate uncertainty in natural mortality and/or steepness in model configurations in which these parameters are fixed. The delta method for propagating uncertainty (McCall in prep.) is promising approach that warrants further evaluation.

- The Panel recognises the difficulty of developing a precise age estimation method for this species but notes that such a method could substantially improve the assessment.

- The Panel notes that there is no recent histology to confirm macroscopic staging for determination of proportion mature at length, but acknowledges that the assessment is not particularly sensitive to the values used.

Acknowledgements

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References

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