Cowcod
Stock Assessment Review (STAR) Panel Report

NOAA Fisheries, Southwest Fisheries Science Center
110 Shaffer Road
Santa Cruz, California, 95060

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Overview

The Cowcod STAR Panel (Panel) met in Santa Cruz, California during 5-9 August 2013 to review a draft stock assessment of cowcod (*Sebastes levis*) in the Southern California Bight (SCB), prepared by the cowcod stock assessment team (STAT). Tom Jagielo (Panel Chair) welcomed participants, reviewed the Pacific Fishery Management Council's (PFMC) *Terms of Reference for the Groundfish Stock Assessment and Review Process*, and discussed logistics for the Panel meeting. Dr. Kevin Piner agreed to serve as rapporteur.

The draft assessment document and extensive background material (previous assessments, previous STAR Panel reports, etc.) were provided (via the PFMC FTP site) to the Panel two weeks in advance of the Panel meeting. The FTP site was also used for common access to all presentation material and the additional model runs that were conducted during the course of the Panel meeting.

Dr. E.J. Dick led the presentation of the draft assessment document, and together with Dr. Alec MacCall presented subsequent analyses carried out during the week. For this assessment the modeled stock was restricted to the SCB as was assumed in previous assessments. Full stock assessments of cowcod were conducted in 1998 (Butler et. al. 1999), 2005 (Piner et. al. 2005), and 2007 (Dick et. al. 2007), with an update in 2009 (Dick et. al. 2009). Cowcod has been classified as an overfished stock since 2000 and has been subject to PFMC rebuilding plans since that time.

The 2013 stock assessment uses Extended Depletion-Based Stock Reduction Analysis (XDB-SRA) to estimate stock status, scale, and productivity; a Bayesian extension of DB-SRA (Dick and MacCall 2011) with all model parameters estimated in a fully Bayesian framework. The base model is fit to four time series of relative abundance (CalCOFI larval abundance survey, Sanitation District trawl surveys, NWFSC trawl survey, and NWFSC hook-and-line survey), and a single visual survey estimate of absolute abundance. A trip-based CPUE time series derived from Commercial Passenger Fishing Vessel logbook records was also evaluated but not included in the final base model.

The cowcod stock status, as indicated by the spawning stock biomass depletion ratio ($SSB_{2013}/SSB_0 = 0.34$), is more optimistic than that reported in the 2009 assessment update ($SSB_{2009}/SSB_0 = 0.045$). The principal reason for this difference in stock status is driven primarily by inclusion of fishery-independent surveys suggesting increases in stock abundance and exclusion of a fishery-dependent index (CPFV logbook) with a strong pattern of hyperdepletion.

A cowcod decision table, based on the posterior of the model and 12.5%, 50% and 87.5 % of the 2013 estimates, was recommended to represent states of nature.

The Panel concluded that this cowcod assessment was based on the best available data; the new assessment results constitute the best available information on stock status, and are suitable to serve as the basis for fishery management decisions and stock status determinations.

The Panel commends the STAT for their excellent presentations, well-written and complete documentation, their willingness to respond to the Panel's requests for additional analyses, and their dedication in finding possible solutions to difficult assessment problems. The SWFSC and

PFMC staffs are thanked for arranging the meeting facilities, hotel accommodations, and the FTP site containing the background materials.

Discussion and Additional Analyses Requested by the STAR Panel

Request 1: Investigate the influence of the delta model parameter prior on the model results by modeling a non-informative prior.

Rationale: To examine the influence of the delta model parameter prior.

Response: The STAT team presented models with the delta prior changed to an approximately uniform distribution. Results of the model indicated that the median of the new posterior is similar to that generated by the base model with little change in estimated dynamics. It was concluded that the prior had little effect on SSB and depletion. The STAT team proposed keeping the original prior and the STAR panel agreed.

Request 2: Investigate the F_{MSY}/M model parameter prior by 1) using a non-informative prior, and 2) using the prior based only on Sebastes data.

Rationale: To examine the influence of the F_{MSY}/M model parameter prior.

Response: The STAT team presented results of models that used 3 alternative priors: 2 versions of an uninformative prior (a uniform prior and a lognormal prior with a larger sigma) and a *Scorpaenid*-based lognormal prior. The lognormal priors allowed for smaller values but constrained the higher values of F_{MSY}/M than the base prior. The uniform prior did not result in a large shift. The central tendency of the *Scorpaenid*-based prior was shifted to smaller value of F_{MSY}/M. Model results using all priors were slightly more depleted stock with a higher estimated M. The STAT preferred to keep the original prior and the STAR Panel agreed.

Request 3: Investigate the use of a more informative prior for the model parameter B_{MSY}/B_0 based on the life history of cowcod by modeling the data-moderate panel prior.

Rationale: To examine the impact of a more informative B_{MSY}/B_0 prior.

Response: The STAT team presented results of a model that changed base prior from a mean=0.5, sd=285; to a mean=0.4, sd=0.15. Results using the new prior showed that median spawning biomass and depletion levels were not greatly affected but uncertainty may be somewhat reduced. STAT team indicated that the original uniformed prior better represents our true understanding of uncertainty in productivity. STAR Panel agreed.

Request 4: Plot the proportion positive in the CPFV index (in log and arithmetic space), by region and year (trips with rockfish present), to see if there are spatial changes over time.

Rationale: To investigate possible hyperstability.

Response: The STAT team presented CPUE results that included only trips that caught more rockfish than all other taxa as a rocky habitat proxy (~70,000 trips). Results of standardizing the 1) n-1 cowcod filtering and 2) rockfish trips filtering is similar with a bit more hyperstability in the n-1cowcod data. STAT team also noted an unreliable drop in CPUE in 1998 and 1999 due to

changing fishery behaviors. (See Request 9). The STAR Panel agreed that dropping 1998 and 1999 may be reasonable pending a new standardization.

Request 5: Plot the proportion positive (for the n-1 dataset) in log and arithmetic space of the cowcod-only trips in CPFV regions using the dataset in the base model index.

Rationale: To investigate possible hyperstability.

Response: The STAT provided plots of CPUE. The CPUE estimates show serial depletion based on distance from shore. The presence of serial depletion may be indicative of hyperstability in the cowcod only trips.

Request 6: Plot the number of CalCOFI larvae by tow and the number of tows by station using the five-year time block stratification.

Rationale: To better understand the quality of the data behind the binomial model and validate the binomial model used to represent abundance.

Response: The STAT team presented the number of larvae captured and the proportion positive by station and year. 80% of the positive stations are 1 larva and 13% are 2 larvae. The proportion of stations with positive observations are also quite low (average 1.8% positive).

Request 7: Profile on the q prior (range from 0.375-1.5) for the visual survey.

Rationale: To determine the influence of the estimated q for the visual survey, as a sensitivity analysis.

Response: The STAT team provided results based on alternative priors for q. When the q prior is large (i.e. 1.5), the data prefer a smaller q. When the q prior is small (i.e. 0.375), the prior and posterior are similar. The q prior affects population scale and increasing the median of q affects the model results. This was sensitivity analysis request, and did not provide a motivation to change from the historical base model prior.

Request 8: Provide sensitivity runs of historical catch uncertainty (recreational: pre 1981; commercial: pre 1969) by doubling and halving the catches in these years. Do these runs with and without the CPFV index included.

Rationale: To determine how historical catch uncertainty influences the production model.

Response: The STAT team provided the results of model runs that altered historical catch and either used or dropped the CPFV index. Use of the CPFV index in the model affected the scale of the population. Higher historical catches leads to higher levels of B0 and higher depletion in 2013. The converse is true for low historical catches. Changing the historical catch did not greatly affect estimates of current biomass. Use of the CPFV index has influence on depletion for higher historical catch likely due to the rejection of implausible runs at very low biomasses. It is evident that the model is sensitive to assumptions about historical catch (and inclusion of the CPFV index). These results led to Request 10 (below).

Request 9: Based on the findings of Request 4, continue filtering the data informing the CPFV index based on rockfish trips only (with further filtering criteria explored by the STAT) and

including regions and seasons in the CPFV dataset to produce new delta GLM estimates of CPUE.

Rationale: To explore a potentially more representative CPUE dataset for cowcod.

Response: The STAT team filtered the CPFV trip logs by 1) rockfish trips (>50% rockfish), 2) the number of rockfish per angler, and 3) no-groundfish catch; to produce a new candidate dataset of rockfish trips. The data were further subdivided by non-rockfish species thought to co-occur with cowcod (~59,000 trips). Only trips with lingcod were consistently caught with cowcod, which further reduced the number of observations (5,270 trips). This resulted in only 1088 positive cowcod trips, which was only a small fraction of the trips taking cowcod. The STAT team presented the results from a delta-GLM using the reduced dataset. The binomial portion of the index indicated a decline in the number of locations taking cowcod through time. The CPUE of the positive observations were relatively stable for the dataset. The STAT team concluded that using positive cowcod only trips likely produced a hyper-stable index. The STAT team recommends not using the CPFV index in the assessment model due to the difficulty of getting a representative subset of CPFV observations. The STAR Panel accepted this decision.

Request 10: Provide a table of all likelihood components for alternative historical catch scenarios.

Rationale: To get a better understanding of model fits to these alternative catch scenarios.

Response: The STAT team presented the distribution of total and component likelihoods for models fit, assuming the base level of historical catch and 0.5x and 2x levels of catch. There were essentially no differences in the fit to the data for each of the catch series indicating that the trends estimated by the model are not sensitive to the magnitude of historical catches.

Request 11: Examine the sensitivity to the assumption of time-lagged (i.e., knife-edge at age 11) maturity and selectivity in the base model, by using 8-year and 14-year time lags.

Rationale: To explore the sensitivity to a reasonable range of time lag assumptions.

Response: The STAT team presented SSB and depletion from models with alternative time-lagged maturity and found it did make a difference. A shorter time lag resulted in SSB that was smaller and less depleted, and the converse was true for the longer time-lag. Depletion was 39%, 33%, and 29%; for the 8 year, 11year (base), and 14 year age-at-maturity assumptions, respectively. The STAT team recognized that the model results are sensitive to this assumption but noted that the current assumption is consistent with the available data. The STAR Panel agreed with keeping this assumption for the base model.

Discussion

The STAT and STAR panel discussed 1) the results presented in the draft 2013 assessment document, and 2) those that followed from the series of analyses requested (above). The STAT team recommended, and the STAR Panel agreed to, a base model that was the same as the original model except for the removal of the CPFV index. The final base model includes the following likelihood components:

1. Visual (submersible) Survey of Cowcod Conservation Area (CCA)

2. CalCOFI larval abundance index
3. NWFSC Trawl, fraction positive index.
4. NWFSC Hook and Line Survey
5. Sanitation District Trawl survey

Request 12: Present the new base model with a 10-year projection, assuming an annual catch of 3 mt. Provide the full diagnostics, especially the fit to the indices. Present a series of sensitivity runs with each index included as the only index in the model.

Response: The STAT team presented the runs requested. The model results appear to best fit 1) the NWFSC Trawl and 2) the NWFSC Hook and Line survey indices. Model fits to individual time series resulted in different final depletions, ranging from <25% to >40%. The catch time series appeared to determine trends prior to the 1990s.

Description of Base Model and Alternative Models Used to Bracket Uncertainty

The new base model for cowcod represents a move from a Stock Synthesis (SS)-based age-structured production model (Methot and Wetzel 2013) to an Extended DB-SRA (XDB-SRA) model (Dick and MacCall 2011). The STAT team reported the results of several analyses designed to provide a bridge between the previous model and the new modeling platform. The STAT team preferred the XDB-SRA modeling platform because they thought it better characterized uncertainty in productivity given the assumption of deterministic recruitment. It was the STAT team's opinion that the assumption of the Beverton-Holt spawner-recruit curve in the previous assessment overly constrained the shape of the production function. Further, the STAT team indicated there was not enough information in the compositional data to estimate year-class strength. The STAR panel had no particular preference for a modeling platform, but felt that the XDB-SRA platform was a reasonable approach given the available data.

In the new 2013 base model, the values assumed for biological parameters, and the historical catch time series (with minor changes in the recent period) were the same as those used in the 2009 stock assessment update.

<u>Indices of abundance.</u>

1. Submersible Survey of the CCA (2002). This is the same index used in the 2009 update assessment (altered to be biomass of spawners (>40cm)) which reduced the biomass estimate by 23 tons. This treatment is needed for the way the assessment treats fishable biomass (knife-edge at age 11). This is a short (one year) index.
2. CalCOFI larval abundance index (1951-2011). This was not included in the 2009 update assessment, but was included in cowcod assessments prior to the 2007 full assessment. This is a percent positive index. This is a long time series index, but data are binned into groups of years to create positive observations in each time block.
3. NWFSC Trawl, fraction positive index (2003-2012). This is a new index for this assessment. The STAT team removed data from shallower than 100 m and deeper than 250 m and stratified into large and small size groups. Only the small fish series was included in this index. This series was lagged four years (1999-2008).
4. NWFSC Hook and Line Survey (2004-2012). This is a new index for this assessment.
5. Sanitation District Trawl survey (1972-2012). This index was not included in the 2009 update assessment, but was included in cowcod assessments prior to the 2007 full

assessment. This is a proportion-positive index with a relatively long time series. Observations were binned into groups of years due to low sample sizes. Only the fourth quarter samples were used to construct the index for the LA district data.

Previous assessments of cowcod have incorporated a CPFV CPUE index. A new trip-based CPFV index was prepared and extensively evaluated in the present assessment, but was ultimately not included in the final base model. The proposed CPFV index was derived using only trips that caught cowcod as the sample frame. As an attempt to evaluate potential hyperdepletion in the previous CPFV CPUE index, the STAT team constructed several CPUE indices with alternative filtering of the input data. The STAT team identified properties of hyperstability in the new index, which were investigated by alternative data filtering to refine the definition of effective cowcod effort. The STAT team ultimately rejected this index since they were unable to resolve this concern. Model comparisons were made to examine the effect of using/omitting the CPFV index from the base model. The model was most sensitive to the inclusion of this index. The STAR Panel agreed with the STAT recommendation to remove this index.

Comments on the Technical Merits of the Assessment

The STAR Panel appreciated the extensive exploration of data sources and the analyses presented by the STAT team.

The original base model presented to the STAR Panel could not estimate B_{MSY}/B_0 well; however, the final base model resulted in a much better estimate of this parameter.

The XDB-SRA model is fully Bayesian. Given the relatively sparse data informing this assessment, a Bayesian approach allows incorporation of other sources of data in a statistically defensible framework. This approach also allows a fuller characterization of uncertainty, which was particularly useful.

Areas of Disagreement

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

Unsolved Problems and Major Uncertainties

The major uncertainty in the stock assessment was the quality of the data used. Historically, the most influential and internally consistent index was the CPFV CPUE index, which was removed from this assessment during the course of STAR panel deliberations.

Among the remaining indices, the CalCOFI index was the most influential in the estimated rate of rebuilding, abundance, and depletion. However, this index was based on relatively few positive tows with generally one cowcod larva per tow.

The CalCOFI and sanitation survey indices had large estimated additional variances.

The base model assumed knife-edge age-at-maturity at 11 years. The model was sensitive to this assumption.

The full consequences of the time-block data binning in the base model could not be fully evaluated during the STAR panel.

Historical catch uncertainty was high and the model estimates of virgin biomass were sensitive to assumptions used in reconstructing these catches.

The abundance and dynamics of the population of cowcod outside the SCB are uncertain. This portion of the population remains unassessed.

Concerns Raised by the GMT and GAP Advisors During the Meeting

There were no concerns raised by the GAP advisor during the meeting.

The GMT advisor raised a concern relative to not assessing the population north of 34º27' N lat. The GMT advisor and STAT discussed this concern to the satisfaction of the GMT advisor.

Prioritized Research Recommendations

1. Investigate the stock structure of cowcod in adjacent areas, especially the population in waters off Mexico.
2. Re-investigate the CPFV data to attempt to produce a CPUE time series to be used as an index of relative abundance. The CPFV data have a historical basis for inclusion and produce a time-series that has a smaller interannual variability than other indices.
3. Age-at-maturity and other life history parameters are inherently uncertain for cowcod and require further investigation. Future assessments should consider incorporating the uncertainty associated with age at 50% maturity.
4. Investigate methods to include uncertainty in historical catches in the modeling.
5. Evaluate the methods used to reconstruct historical catches of cowcod and other rockfish.
6. The STAT team expressed the most confidence in the NWFSC Hook-and-Line and visual surveys. The STAT team and STAR Panel recommend continuing these indices into the future and extending the NWFSC Hook-and-Line survey into the CCAs.
7. Priors for model parameters, based on rockfish, should be developed.

References Cited

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