Cowcod

STAR Panel Meeting Report

NOAA Western Regional Center
7600 Sand Point Way NE
Seattle, Washington 98115
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Overview

A STAR Panel (Panel) met at the NOAA Sand Point facility from July 16-20, 2007 to review a draft assessment of cowcod rockfish. The assessment was conducted with SS2 using information from a visual survey in one year, and a recreational fishery (CPFV) logbook data series. A full assessment was previously conducted in 2005 and was subsequently updated in June of 2007. The 2007 update revealed errors in the 2005 assessment. Given the extent of the changes required to correct the error, the SSC recommended that a full assessment and review should be conducted in the (limited) remaining time in 2007.

The main error in the 2005 assessment was that fishery selectivity had erroneously been set to female fecundity. When corrected, this apparently caused a very large difference in estimated harvest rates. The Panel requested a fuller exploration of what was causing the differences and it was found that the comparison presented to the SSC was misleading. There had been another error in the 2005 assessment which had exaggerated the apparent difference. When consistently defined harvest rates were compared between the corrected and uncorrected runs they were similar.

The CPFV time series was constructed using a GLM analysis which used non-cowcod rockfish catch as an explanatory variable. The Panel was concerned that: 1) the GLM approach does not allow "errors in variables" (i.e., explanatory variables must not be random variables), 2) the use of non-cowcod catch as an explanatory variable could remove a valid signal in cowcod abundance, and 3) rockfish catches may vary widely from year to year while cowcod habitat does not. The STAT, while acknowledging these concerns, preferred to retain non-cowcod rockfish catch as an explanatory variable (as a proxy for cowcod habitat) and demonstrated that the CPFV time series is not sensitive to this decision.

A set of recently discovered CalCom landing sample records increased the estimated historical landings for cowcod considerably during the 1980s (and in earlier years because the cowcod proportion in these samples is applied to total rockfish landings). The plausibility of the historical catch series caused much discussion, but the assessment results were robust to the range of catch history assumptions explored.

Natural mortality and steepness were the primary dimensions of uncertainty explored at the meeting. The assessment results were generally insensitive to the assumed values of these parameters. Assessment results were much more sensitive to the inclusion or exclusion of the CPFV and visual survey data sets, which were the only abundance data in the model. The visual survey (conducted in one year only) and a prior on its catchability coefficient suggest current cowcod biomass is at a higher abundance level (approximately 23% depletion) than the much longer CPFV data series which suggests lower abundance (approximately 4% depletion). The base model includes both data sets but the CPFV time series dominates the model resulting in low estimated depletion levels (and high exploitation rates in the late 1980s).

Additional data (visual surveys, NWFSC bottom trawl survey data, or other types of information for current and recent years, see below) are required to better characterize current cowcod biomass and depletion levels. It is crucial that new data are collected to enable the effective monitoring of cowcod abundance.

The STAR Panel encouraged the STAT to conduct an MCMC analysis to better quantify uncertainty in the assessment. The STAT team made good initial progress, but did not complete a full MCMC analysis in time for review at the meeting. The STAT offered to keep working on this, and noted it could be included as an Appendix in the final assessment document. The Panel agreed, and recommended that the next full assessment should include a full MCMC analysis. The simple model structure for cowcod makes it an ideal case for MCMC approaches.

The final assessment represents the best information currently available for management purposes, but it is not an ideal assessment. The base model is unsatisfactory in terms of lack of abundance data for recent years, the plausibility of estimated exploitation rates during the late 1980s and in the apparent contradiction between the CPFV time series and the visual survey estimate. Also, the assessment uncertainty is not adequately captured by the three presented runs. A full Bayesian assessment would be preferable for this stock but it was unable to be produced within the given timeframe.

The Panel recognized that the assessment was changed from an update to a full assessment at the Council's request in June, which allowed very little time for the STAT to prepare an exhaustive full assessment. The Panel commends the STAT for their excellent documentation, presentations, and work during the STAR Panel meeting.

Discussion and Requests Made to the STAT during the Meeting (Note: names of particular scientists in the original notes were replaced by their affiliation in this section of the report).

A. Determine how measures of harvest rate were calculated in Figure ES-4 (and in SS2).

   Reason: Figure ES-4 in the draft compared estimated annual harvest rates for the 2005 assessment to show the impact of erroneously using the fecundity curve instead of the maturity curve for the selectivity in the last assessment. There was considerable change in annual harvest rates and questions were raised about how the harvest rate is calculated in SS2.

   Response: In SS2, harvest rates are calculated as landings/vulnerable biomass while fishing intensity is reported as either 1) catches over summary biomass or 2) 1-SPR where SPR = equilibrium spawning output per recruit under fished conditions / spawning output per recruit under no fishing.

   Discussion: The panel opted to use catch over summary biomass during the meeting to standardize the metric for comparing between models.

B. Compare biomass estimates from the three assessments on the same basis, i.e., female spawning stock biomass and base model plus plots of exploitation rate from each model on a comparable basis.

Reason: Given the change in landings data from previous assessments and the correction for the selectivity curve used in the 2005 assessment, the Panel needed to see how the estimates from the current model compared to those from previous assessments.

Response: Plots of total biomass trajectories were presented with the 2007 model using landings based on assumptions that h=0.6 (expectation of prior from meta-analysis) and cowcod made up 6.425% by weight of total rockfish landed in historical L.A. hook-and-line fishery. Plots of harvest rates expressed as total catch / summary biomass (ages 9+, ~38 cm) were also presented.

Discussion: The impact of the revised CALCOM landings for 1969 to 1985 based upon the 611 recently discovered market samples for 1983 to 1985 was evident in the increased biomass estimated in the 2007 assessment for those years. Overall the annual harvest rates from all three assessments did not differ greatly in trend. The main difference between the annual harvest rates was the higher rates estimated for the 1980s in the 2007 assessment.

C. Contact the Southwest Fisheries Science Center regarding access to CalCOFI data with the intent of looking at the time series again to see if it can provide information for the recent years for monitoring recovery of the stock.

Reason: The previous STAR Panel (May 9-13 2005) for cowcod had recommended not using the CalCOFI catch of cowcod larvae as an index of abundance because the index was: 1) extremely variable, 2) affected by variability in environmental conditions and 3) cowcod larvae are extremely rare in the catches. No data were presented in the current assessment that could be used to estimate trends in biomass since 2002 or to corroborate model estimates for this period and the CalCOFI data may be a qualitative indicator of recent stock conditions.

Response: Messages were left to determine if recent CalCOFI data are available.

Discussion: The Panel is not trying to reverse the previous panel's recommendation concerning use of CalCOFI data in modelling. It is possible that this index (and potentially other data sources) may be informative on the current conditions of the stock (at least in a qualitative sense), and thus should be presented.

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D. Obtain more details on the recovered CalCom data with respect to whether or not the data were representative of landings in general or were more restricted with respect to species, etc.

Reason: Insufficient information was available to the Panel on the features of the 611 new market samples with respect to the distribution of the landings by port, gear and market category each year.

Response: A histogram of the distribution of landings by market categories for all three years in total was presented along with an indication of how the sample coverage was used to estimate the landings.

Discussion: While the histogram did not indicate anything pathological in the distribution of samples with respect to market categories, no information was presented on the distribution by year for ports, gear and market category.

E. Further investigation of the GLM analysis of CPFV requires more models to be run. In particular, models for no Log rock fish catch and log rock fish catch for binomial model only. Compare annual trends for predicted CPFV from all three models.

Reason: Concerns were expressed about the inclusion of rockfish catch (excluding cowcod) in both the binomial and lognormal GLM models for the CPFV data. Based on model results, the STAT hypothesized that 1) rockfish catch is an indicator of rockfish habitat, which indicates a higher probability of a positive (non-zero) catch of cowcod in the binomial model and 2) high rockfish catches would depress cowcod catch because of bag limits in the lognormal model.

Response: Predicted CPFV catch rate for the original model, model with log rockfish catch only in the binomial part of the model and a model without log rockfish catch were presented.

Discussion: There were differences in the three time series in the early 1960s with the log rockfish catch only in the binomial part of the model indicating a higher level of biomass than the other two models. However, there was little difference in the annual trends for the three series and in the most recent period there was very little difference between predicted catch rates. Details presented on model fits suggested that the binomial model was driving the trend in the predicted catch rates for all three models.

F. Plot LPUE data from CPFV series over time by region.

Reason: The GLM model did not include an interaction term between year and region and therefore the model assumed that catch rates by region were parallel over time although they may differ in scale. However, the general pattern of

nearshore areas being fished out first suggested that there might be such a pattern in the data.

Response: Plots of LPUE data from the CPFV series were plotted by region over time.

Discussion: These data are quite noisy but there appears to be some evidence that trends do differ for some of the regions. However, the patterns are complex and could not be easily modelled in the time available.

G. Plot selectivity curve against the commercial length frequencies.

Reason: The assessment had compared the selectivity curve (assumed the same as the maturity ogive) against the length compositions from the commercial fishery. The Panel was interested in seeing the selectivity curve compared with the length frequencies from the net and hook and line fisheries.

Response: Plots for the two commercial fishery length frequencies were presented.

Discussion: The length frequencies were derived by pooling data of varying sample sizes over years. The Panel recommended that there should be more work on estimating commercial selectivities for the next assessment.

H. Present background information on visual survey including copy of paper to appear in the Canadian Journal of Fisheries and Aquatic Science.

Reason: The Panel requested background information on this survey given that the assessment model appeared to be highly sensitive to the inclusion or exclusion of this abundance index.

Response: A draft of Yoklavich et al. (in press) was distributed and a brief summary of the survey and how it was used in the 2005 assessment was presented.

Discussion: It was difficult to evaluate the fit of the model to this index and more information on the distribution of the prior and the final estimate were requested.

I. Contact Observer Program re: CPFV observer data from charter boat on species composition.

Reason: The observer data were suggested as a possible source of monitoring information that may provide data on recent trends.

Response: A reply to this query indicated that there may be information; the STAT will follow up.

J. Determine if NWFSC trawl survey in the area has any data on cowcod.

Reason: The trawl survey data was suggested as a possible source of monitoring information that may provide data on recent trends.

Response: Information was obtained and presented later (see below).

Round 2 requests:

K. Replace Figure ES-4 with the new figure on harvest rates (see item A above). Move original figure from the executive summary into supporting document and include explanation of issues with comparing harvest rates in this manner. Also, the exploitation axis in the phase plot in Figure ES-6 will need to be redefined according to the discussion in A.

Reason: The Panel wanted a clear presentation of historical harvest rates.

Response: The STAT presented a time series of fishing intensity, defined as total catch divided by the biomass of ages 11+ (chosen because predicted length at age 11 is approximately the length at 50% maturity specified in the model for the commercial fishery). There was little difference in fishing intensity between the 2005 model with the mis-specified selectivity curve and the corrected 2005 model. The STAT re-examined results related to harvest rates in the 2005 assessment and found that the 2005 assessment had an error in the definition of relative harvest rate. The relative harvest rate should be based on the estimated harvest rate at MSY. When this was done for the 2005 assessment with mis-specified selectivity; the relative harvest rates are shown to be 14 times the rate at MSY, which is more consistent with the results from the current assessment. The plot of exploitation history in the 2005 assessment (pg. 6, Piner et al. 2005) shows relative rates between 2.5 – 3 times the rate at MSY. This result is obtained if harvest rates are divided by the annual exploitation rate (yield / summary biomass) at target F, instead of the harvest rate at MSY. The units of the annual exploitation rate are not the same as that for harvest rate and it is inappropriate to define relative harvest rates with exploitation rate as the denominator. The Panel noted that it is inappropriate to compare annual harvest rates from the 2005 model and the 'corrected selectivity' model due to the change in gear selectivity. However, it now appears that the perception of cowcod exploitation history (relative harvest rates) was incorrect in the 2005 assessment due to an error in the choice of denominator when calculating relative harvest rates (HR / HR_{MSY}). Therefore, the selectivity error in the 2005 assessment was only partly responsible for the dramatic change in perception regarding exploitation history, as the STAT stated in the draft assessment document.

Discussion: The Panel was satisfied with the explanation of the difference.

L. Follow up on the outfall and CalCOFI data. STAT should present these data in supporting documentation as being used historically.

Reason: These data had been used in past assessments of cowcod and while the associated abundance index will not be used in the model, the presence or absence of catches of larval cowcod may provide qualitative indications for the most recent period for which no commercial monitoring data is available.

Response: STAT will look into the possibility of obtaining recent outfall data. If possible, this data will be presented in the supporting documentation. The STAT will also attempt to obtain the CalCOFI data, but does not believe that a thorough analysis can be completed in time for presentation to the Panel. This index has the potential of providing information about progress in rebuilding and the STAT recommends this as a topic for future research.

Discussion: The Panel agreed that the data should be available and presented in future assessments, if only for qualitative use.

M. Need to know how many samples were taken in recent years versus what we see now with the recovered market samples. Construct a table of distribution of found samples by port, market category and year by gear. Do something simple to see how sensitive model results are to our concerns about the landings once a base model has been developed.

Reason: Follow-up on item D (above).

Response: Table of numbers of samples by gear, port complex and market category for 1983 to 1990 were presented as requested.

Discussion: There did not seem to be any obvious patterns in the distribution of the recovered samples from 1983 to 1985 compared to later years. The Panel did not see any reason to suggest that these samples were less representative of the fishery than samples in later years.

N. Would like to see a plot of the prior on the catchability for the visual survey and final estimate.

Reason: Follow-up on item H (above).

Response: The estimate of log(q) for the visual survey from SS2 was compared to the distribution specified for the prior distribution (normal distribution with mean equal to log(0.75) and CV equal to 0.50). The ML estimate for log(q) was in the far right tail of the prior at the 0.9988 percentile.

Discussion: The specification of the prior for log(q) for the visual survey had been arrived at during the 2005 STAR Panel for cowcod. The results from this

year's assessment suggest that the CPFV time series is contradictory to the visual survey estimate. An appropriate test for discordance between the prior and the final estimate would require using a Bayesian model for the assessment model using the MCMC option in SS2/ADMB.

O. Call from Observer Program. There may be observer data. Follow up.

Reason: See item I above.

Response: A preliminary query of the RecFIN database showed a very small number of cowcod in the RecFIN sample data. The STAT will follow up.

Discussion: The Panel recommended that a thorough investigation of these data be prepared for the next assessment of this stock.

P. NWFSC staff working on NWFSC survey and sending all tows in SCB. Follow up.

Reason: See J above.

Response: Data were provided from the West Coast Slope/Shelf Combination Groundfish survey, including the number and weight of cowcod caught during all tows in the SCB from 2003–2006. Trawl surveys are limited as indices of abundance for cowcod, in that they cannot access rocky, high-relief habitat. The survey caught a total of 45 cowcod over the 4-year period, between the depths of 127 and 288 meters. There were 141 tows between 50–300m. For each of these tows, the STAT calculated the number of cowcod per hectare of area swept by the trawl. For these years, the proportion of tows that caught at least one cowcod ranged from 7%–17%. The number of tows within the 50–300m depth range ranged from 30–41 per year. Given the short time series, the limitations regarding trawlable habitat, and the large number of zero observations, the STAT feels that this index is not suitable for modelling in the current assessment but agrees that it be re-evaluated in future assessments.

Discussion: The data are limited and no information was available, given the short notice, to plot out the tow stations to compare with cowcod grounds in the Southern California Bight area. While there appears to be an indication of a small increase in the mean number per tow of cowcod in the survey, the Panel agreed that these data should be reconsidered for the next assessment. Participants reported that there was a cooperative hook and line survey in the SCB for the last 4 or 5 years that may provide data on cowcod.

Q. Calculate harvest rate as total catch over summary biomass defined by 50% selectivity for the recreational fishery.

Reason: To date summary biomass had been calculated with respect to the selectivity of the commercial fishery where 50% selectivity corresponded to 11 years of age. The recreational fishery selected younger fish and therefore represented a portion of the population not vulnerable to the commercial fishery.

Response: Harvest rate was calculated for both the commercial fishery and the recreational fishery (50% selectivity corresponded to age 8) with the summary biomass defined appropriately for the respective selectivity.

Discussion: There was some confusion about what the total catch was in the previous calculations of harvest rate by the STAT during this meeting. Clarification that total catch was actually commercial catch lead to concern about the high (exceeding 0.6) and possibly implausible harvest rates presented for both the commercial and recreational fishery in the mid-1980s in preliminary runs. The Panel hypothesized that such high harvest rates might be implausible because of the nature of the fish and fishery. Sensitivity runs for different landing scenarios may provide insight into this issue.

R. Sensitivity runs for the abundance indices:
   a. Drop visual, keep CPFV
   b. Keep visual, drop CPFV
   c. Keep visual and CPFV add power term for CPFV.

Reason: Previous issues with the discordance between the prior for log(q) for the visual survey and the ML estimate suggested that the sensitivity of the model to this index and the CPFV needed further exploration. Residuals from the fit of the model to the CPFV index suggested that there might be a nonlinear relationship between CPFV and biomass.

Response: The different options given above were evaluated with respect to change in the depletion estimates. For case a, the depletion level was estimated to be 0.021 compared to 0.046 when both indices were included. Using only the visual survey (case b), the depletion level was estimated to be 0.243. Adding a power term to the CPFV relationship resulted in a small change in likelihood but estimated log(q) for the visual survey was now 0.468 which was in much closer agreement with the prior than the previous estimate. Depletion for the power model was 0.10 and the maximum harvest rate for the commercial fishery was less than 0.6.

Discussion: The visual survey is only one point in time and appears to scale the biomass estimate at a higher level than that predicted by the CPFV. By itself, the visual survey provides a more optimistic status for the stock biomass than the CPFV. The merits of either not using contradictory abundance indices in a model or including all data even though they may be contradictory were discussed without resolution. Further discussion was deferred until the Bayesian MCMC fit of the model had been completed.

S. Investigate the impact of different scenarios for the level of landings during the historical period in this fishery. Try runs of the model with one half and double (or some other factor at the STAT discretion) the landings from 1900 to 1968 using the case with both visual and CPFV in the model.

Reason: Sensitivity analyses for landings data are a standard component of a complete assessment.

Response: Runs of the model using two landing scenarios, halving the catch from 1900 to 1968 and 1.5 times the catch from the same period were presented. The scenarios were compared by using depletion level estimates. Halving the catch resulted in a depletion level of 0.051 (original series = 0.046) and 1.5 times the catch resulted in a depletion level of 0.04.

Discussion: While there were differences in the biomass estimates in the initial part of the series for these two scenarios and the run with the original landing series, they resulted in very similar estimates of depletion level. The Panel decided that there was little reason to pursue this line of investigation and the landings were accepted as is for this assessment.

T. The Panel requested an MCMC run on the full model with the following characteristics:

-Use Dorn's prior for h.
-M: Normal with 95% within 0.04 and 0.07.
-q: for Visual as before.
-Recruitment fixed, no recruit deviations (recdevs)
-R_0: uniform prior on log R_0
-Log(q): uniform for CPFV (bounds at author's discretion).
-Thinning, burn-in and total number of runs will be determined based on how much time this takes---author's discretion.

Response: The STAT presented two short exploratory MCMC runs for cowcod; the first as defined above, and the second with the visual survey dropped. In the first case, the posterior mean for M was close to the mean of the prior while the mean of the posterior for h was close to 1.0. Log(R_0) was higher than the ML estimate at around 5.5. However, the visual survey log(q) posterior mean was much closer to the prior mean than the ML results. In the second run, the posterior mean for h was close to the lower bound of 0.2 set for the prior.

Discussion: While only one chain was run for this analysis using the ML estimates as starting values, the trace plots did not indicate pathological behaviour with respect to the values being sampled. However, the autocorrelation estimates were high with long memory, suggesting that a large thinning interval (~1 in 1000) should be used for the final analyses. There was not time to evaluate any convergence diagnostics or the implications of the models in terms of biomass

and depletion estimates and associated credible regions. The STAT was reluctant to use this kind of analysis in this assessment to capture the uncertainty in the assessment because the results, especially for h and Log(R_0) differed from the ML version of the model. The STAT will include a more thorough evaluation of the Bayesian models runs which will be included in the supporting documentation as an appendix. The Panel recommended that the Bayesian analysis be used for the next assessment and that the preliminary Bayesian results should not be used by managers at this time.

U. STAT to provide summary of runs to date to establish the range of uncertainties to be captured with the base run.

Reason: The Bayesian analysis had been suggested as a means of trying to capture the uncertainty in this assessment. Given that this analysis will not be used, other means of trying to explore the dimensions of uncertainty with respect to h, M and abundance indices were needed.

Response: A series of runs of the model were made with h = (0.4, 0.6, 0.8) and M = (0.04, 0.055, 0.07) for each model including the visual survey and CPFV index, visual survey only and CPFV only.

Discussion: Depletion estimates were less than 10% for both models with the CPFV index included while depletion ranged from 18.8 to 30.5% for the model with only the visual survey. In the end the STAT set M=0.055 and profiled over h and the different models. The lower bound was set at h=0.4 for the visual plus CPFV model, the base was set at h=0.6 for the same model while the upper bound was set at h=0.8 for the visual only model. The STAT was confident that these runs would adequately cover the range of uncertainties for management. The Panel was not in total agreement that the range of uncertainties had been addressed.

Technical Merits and/or Deficiencies of the Assessment

- The cowcod assessment is suitable for use by managers and the best available information at this time.

- Reasons underlying the very high harvest rates in the mid-1980s were not adequately explored.

- The abundance indices used in this assessment, CPFV (1963–2000) and the visual survey (2002) do not provide recent information on the potential recovery of this stock. Other abundance indices such as the NWFSC trawl survey, observer data from the CPFV trips post-2000, SCB hook and line survey in addition to data series used in previous assessments (e.g., CalCOFI, outfall) could have been used on at least a qualitative basis to corroborate conditions after 2000.

- Uncertainties in the catch history were not fully explored.

- The use of rockfish catch as an explanatory variable in the GLM analysis of the CPFV data was not justified.

- An evaluation of why the CPFV index should be used as an indicator of abundance for cowcod was not fully explored.

Areas of Disagreement

A) Within the STAR Panel

- One Panel member expressed concern as to the validity of the landings series based on the fact that landings from 1916 through the 1920s were high compared to the landings from 1970s and 1980s. However, total rockfish landings from 1916 to 1920s and 1930s are comparable to the late 1960s in CDF&G Bulletin (No. 105, 1958). Overall it is difficult to evaluate the plausibility of these landings without any information on the number of vessels (or anglers) present, fleet capacity, markets, recreational fishing patterns, or the amount the effort expended during those time periods.

- One Panel member suggested that in the assessment document, the model estimates after 2002 (the last year with data) should be labelled "projections" and not described as "estimates" because readers may have a tendency to mistakenly interpret the slight increasing trends in model results after 2001 as evidence of positive changes in the stock. The rest of the STAR panel members noted that all numbers in model outputs, including projections, are "estimates" and that proper uncertainty calculations would be sufficient to describe the change in uncertainty during 2000-2001.

B) Between the STAR Panel and the STAT

- The STAR Panel and the STAT team disagreed regarding the CPFV log book data index used in the final base model to estimate trends in abundance. The STAR panel noted that 1) rockfish catch should not be used as an independent variable in modelling because this could remove a valid signal in cowcod abundance and 2) measurement errors in rockfish catch violate modelling assumptions. The STAT team pointed out that 1) rockfish catches may be a measure of habitat for rockfish (for proportion positive models) or bag-limit effects (for the size of positive catches), 2) rockfish model parameters were statistically significant, and 3) similar approaches have been used in published studies. The STAR panel expressed doubt about rockfish catches as a habitat measure because rockfish catches may vary substantially from year to year, probably in response to rockfish abundance rather than changes in habitat. Rockfish catches likely include substantial measurement errors that violate assumptions about independent variables in the model and it is likely that the

measurement errors in rockfish and cowcod catches are correlated. The Panel was not concerned about the consequences of this disagreement with the STAT because the effects of these assumptions on estimated trends for the fishery as a whole were minor.

Unresolved Problems and Major Uncertainties

- Recently recovered port sample data for 1984-1985 show surprisingly high proportions of cowcod in California commercial landings, particularly for trawl landings in the Santa Barbara region and hook and line landings in the Los Angeles region. Application of these proportions to historical years is problematic.

- Uncertainty about whether CPFV catch rates should be used as an index of abundance. Questions about the use of these catch rates were also raised at the 2005 Star Panel for cowcod.

- The video survey currently consists of a single year of data and would benefit from validation through replication.

- Models used to standardize CPFV data and estimate trends in cowcod abundance assumed that trends in cowcod abundance over time were the same in every region (no interactions between region and time) although differences in trends were evident in data plots. Modelling results should not be taken as evidence that trends in abundance of cowcod were similar in all regions.

- As in other West Coast groundfish assessments, there is considerable uncertainty associated with fixed and estimated parameters, including natural mortality and steepness.

- CPFV and visual data sets may be contradictory and, if so, should not be used in the base model. Resolution of this problem would help to reduce uncertainty in final biomass estimates.

- The runs of this year's model limiting uncertainty to a range of h and combination of abundance indices does not fully capture uncertainty about current stock conditions. Base case estimates for 2003 to the present are driven entirely by assumptions about the spawner-recruit relationship and current low catch levels.

- As with many West-Coast assessments, stock structure remains a major uncertainty.

Concerns raised by GMT and GAP representatives during the meeting

The GAP and GMT representatives raised no major issues of concern during the meeting.

Research recommendations

For the next assessment

- Present and consider all available data potentially relevant to abundance trends in recent and historical years (e.g., outfall surveys, CalCOFI data, NWFSC bottom trawl data, observer data, and hook and line survey data). Data for recent and current trends are important in tracking progress towards rebuilding. Historical data may be useful in corroborating trends in CPFV logbook data.

- Enhance modelling procedures for standardizing CPFV data, particularly in representing potential interactions between year and region.

- Provide reviewers with complete sets of model diagnostics for standardized abundance indices based on CPFV and other types of data.

- Conduct additional video surveys to provide direct measures of current cowcod biomass and to facilitate interpretation of the existing video survey data. Ideally, video sampling should be carried out both inside and outside the Cowcod Conservation Areas so that extrapolation to the entire stock is not required.

- Reconstruct the cowcod rockfish catch history using all available data including catch by gear and by region. The reconstruction should include an envelope of high and low values to set bounds for exploration of alternative catch histories. As has been recommended previously by a variety of STAR Panels, the reconstruction of historical rockfish landings needs to be done comprehensively across all rockfish species to ensure efficiency and consistency.

- A preliminary query of the RecFIN database showed a very small number of cowcod in the RecFIN sample data. The Panel recommended that a thorough investigation of these data be prepared for the next assessment of this stock.

- Re-examine the assumption that commercial selectivity at length is the same as maturity at length.

- Conduct a full Bayesian assessment if possible. Cowcod are an ideal potential case because of the simple model structure and uncertainties about key model parameters and data.

General or long term

- Develop surveys that track trends in abundance of cowcod. The NWFSC bottom trawl shelf and slope surveys should, in particular, be evaluated for cowcod.

- For the historical and recent fisheries, evaluate the relative capacity of fishing fleets and markets for cowcod to determine how much catch might have

reasonably been taken during historical periods and whether relatively high fishing mortality rates during the late 1980s are plausible.

- Evaluate the hypothesis that CPFV indices are nonlinear measures of stock biomass.

- Assessment and review work would have been enhanced if the STAT had consisted of more than one person and if more time had been available to carry out the assessment.