Lingcod and Boccacio STAR Panel Report
July 12 – 16, 1999
Davis, CA

Introduction

The STAR and STAT panels met July 12-15, 1999 on the U.C. Davis campus to discuss the 1999 lingcod *Ophiodon elongatus* and boccacio rockfish *Sebastes paucispinus* assessments. STAT panel members presented a lingcod assessment for the INPFC Eureka, Monterey, and Conception areas and a boccacio rockfish assessment for the INPFC Monterey and Conception areas. The attached agenda (Appendix 1) was reviewed and adopted. STAR panel objectives and the outline for stock assessments referred to in the PFMC terms of reference were reviewed. The review of the stock assessments was an iterative process which began by having authors review draft documents and results. STAR panel members discussed the assessment and then asked the STAT panel to conduct additional analysis. These analyses were then reviewed and, when necessary, additional analysis was conducted. Both STAR and STAT panels arrived at a consensus on these assessments.

The following individuals participated in the STAR panel review of STAT panel assessments:

STAR Panel		
Jerry Ault	U.Miami	ault@shark.rsmas.miami.edu
Jim Golden	ODFW	Jim.Golden@hmsc.orst.edu
Joe Hightower	N.C. State Univ.	jhightower@ncsu.edu
Peter Leipzig	GAP	ppl2@axe.humboldt.edu
Gilbert Sylvia	SSC	gil.sylvia@hmsc.orst.edu
Dave Thomas	GMT	dthomas@dfg2.cagov

STAT Panel		
Peter Adams	STAT Lingcod NMFS	Pete.Adams@noaa.gov
Alec McCall	STAT Boccacio NMFS	Alec.MacCall@noaa.gov
Steve Ralston	STAT/Boccacio NMFS	Steve.Ralston@noaa.gov
Erik Williams	STAT Lingcod NMFS	erik.williams@noaa.gov

In addition to members of the STAR and STAT panels, the following interested public were present:

Other Attendees:		
Jennifer Bloeser	PMCC	jbloeser@pacifier.com
Frank Henry	CDFG	fhenry@dfg2.ca.gov
Pete Kalvass	CDFG	

Lingcod

Technical Evaluation of Assessment

The southern lingcod assessment was presented by STAT panelists Pete Adams and Erik Williams. Pete provided an overview of the fishery and data used in the model. Erik presented a description of the model and results.

The previous assessment of lingcod was conducted in the northern area in 1997 for INPFC Columbia and Vancouver areas. Due to an inadequate time series of data, those authors did not include southern area. The present STAT team expressed concern with conducting this assessment with only two more years of information, particularly when a coastwide assessment is planned for 2000. Notwithstanding this concern, STAT and STAR panelists recognized the need for a southern assessment to ensure that recent actions reducing northern and southern ABC's were justified, and to provide information for a lingcod rebuilding plan which must be completed in 1999.

The first draft of the lingcod assessment was incomplete according to the Outline for Groundfish Stock Assessment Documents. A checklist of missing elements was provided to the authors. Most of these elements were completed as the review progressed during the week.

STAR and STAT panel members discussed MRFSS data and asked STAT Panel members why California recreational data were not used. MRFSS data were used as they include private boat as well as charter boat catch and effort. CDFG data is restricted to measuring party boat catch and effort. STAR and STAT panel discussed, but did not resolve, the high data points in MRFSS data series for years 1980-81.

Dave Thomas, GMT STAR panel member indicated additional recreational catch data were recently made available but noted the data were not included in the lingcod assessment. The STAT panel agreed to make use of the new data and incorporate it into the assessment.

Generally, recreational and trawl CPUE data, and triennial trawl survey data all consistently indicated a downward trend in stock size.

In order to account for fishery size selection for rapidly growing fish, this assessment used a novel length-based approach, which calculated individual trajectories for growth to characterize length at age in the population. Bivariate distributions of $L\infty$ and K were used to create a transition array of length, age and a probability distribution of possible growth increments. These were done external to the model and then supplied to the AD model builder model to estimate length distributions.

The primary concerns with the assessment were the short time series of data and what appeared to be a mis-specification of the growth and possibly selectivity parameters. The

residuals, or differences in estimated and observed length and age, showed consistent patterns in lack of fit, indicating a systematic bias.

Another concern was with the method the model used to remove fish from the population. The traditional Baranov catch equations were not used to allow for size-selective removals. Removals were done once a year at mid-year. Some STAR panel members felt this may be unrealistic and may cause problems with the way data really present themselves (eg continuously throughout the year). STAT panel could not model different time periods for fish removals as it would have consumed too much time to alter the model.

Analysis Requested by STAR Panel

1. STAR panel asked for STAT panel to develop an alternative growth model. The new model to characterize female growth uses Jagielo's estimates from the 1997 assessment and a user supplied K based on observed length at age data in southern assessment. Males used an adjusted $L\infty$ and K modified to conform to older ages.
2. In addition to the changes in the growth function, the STAR panel asked STAT panel to partition trawl selectivities into two time periods 92-94 and 95-97. This request was an additional analysis to account for the size limit change which was implemented in 1995. The STAR panel believed that a time-variant selectivity might also result in a better fit to length and age data.
3. After the changes in growth function and time-variant selectivities were explored, the STAR panel asked for additional changes. A new base model was selected, utilizing the new growth function but retaining original selectivities.
4. The STAR panel requested a sensitivity analysis of non-trawl and triennial survey selectivities by varying inflection point parameters $\pm$ 25%. The STAR panel also requested a final run using the base run modified by alternative M's ranging from 0.1 to 0.35 in increments of 0.05. These runs were used as a basis of expressing the range of uncertainty in the assessment.
5. The STAR panel requested STAT panel to also sample recruitments assuming a lognormal distribution using at least 500 replicate random selections using the base run with M=0.25. CV's from sampled recruitments were examined to determine stability vs sample size. Recruitment data will be used to express range of recruitments and form the basis for calculating unfished spawning potential by calculating the product of recruitment times SPR.
6. Finally, the STAR panel requested that the STAT panel use the randomly sampled recruitments to project forward projected yields based on F100%, F35%, F40%, and F45%

Results and Discussion

Anomalies in fit to length distributions were addressed by re-specification of the growth function and re-estimation of transition arrays. While the new growth model resulted in an improvement in fit, little improvement was seen with time specific selectivities In addition, runs using time-specific selectivities caused recruitment estimates to be strongly

perturbed and there was no evidence that the new pattern was correct. In addition, the ratio of spawning biomass between 1973 to 1998 seemed unrealistic given trends in fishery. Thus, the STAR and STAT panels agreed to retain the new growth function but not the time variant selectivities.

Exercise of inflection points $\pm$ 25% of non-trawl selectivites did not improve the fit. Similar changes in the inflection points of triennial trawl survey selectivity parameters had virtually no effect. All of these runs used time variant selectivities for the commercial trawl fishery.

The STAR and STAT panels were in agreement with final model results and concluded recent actions to reduce ABC were consistent with apparent stock status. Furthermore, both panels were in agreement that the southern stock of lingcod appears to be overfished. Trawl catch per unit effort, the MRFSS data, and triennial trawl surveys consistently pointed to a downward trend in stock size. In addition, exercise of base model parameters reflecting uncertainty did not result in estimates of biomass more optimistic than that of a stock in an overfished condition.

Recommendations for Future Research and Data Collection

1. The STAR panel had questions regarding existing sampling levels and data quality. With the current low level of spawning biomass, sampling opportunities are likely to be reduced along with reduced catches. If nearhore initiatives allow increased sampling in California – the STAR panel recommends that some funds be used to review and improve sample design for lingcod. The Council, state and federal managers may need to consider alternative management approaches if data are inadequate to provide a clear picture of stock status.
2. The STAR panel recommends improving estimates of growth parameters by additional sampling of younger, and perhaps older fish. The STAR panel also recommended developing methods to estimate growth parameters and associated transition array within the model.
3. If nearshore management and research initiatives increase sampling opportunities, the STAR and STAT panels recommend development of fishery independent surveys for lingcod.
4. The STAR panel recommended that STAT panels evaluate data more formally including a spatial analysis of fishery and fishery independent data. Such analysis should focus on at least two products. First, the statistical structure of the data should be examined with the goal of improving sampling design. Second, models should be reviewed and modified to more accurately reflect distribution of the resource, and the distribution of the fishery in time and space. For lingcod, areas of particular concern is sexual dimorphism, separation of sexes and sizes by area and impacts these population features

may have on sampling and interpretation of sampling products in the modeling process.

5. STAT panel should include recommendations for additional approaches to modeling that might improve assessments. In particular, exploration of alternative model variance structures [multinomial vs multivariate] was identified as one possible area of fruitful research.

Boccacio

Technical Evaluation of Assessment

The southern boccacio assessment was prepared by STAT panelists Alec MacCall, Steve Ralston, Don Pearson [not present] and Erik Williams. Alec provided an overview of the fishery and data used in the model as well as a description of the model and results.

The first draft of the boccacio assessment was incomplete according to the Outline for Groundfish Stock Assessment Documents. A checklist of missing elements was provided to the authors. Most of these elements were completed as the review progressed during the week.

The previous assessments of boccacio was conducted in the southern area by Ralston et al. 1996, Bence and Rogers 1992, and Bence and Hightower 1990. The present assessment and all previous assessments indicate boccacio stocks have been declining since 1969. Only the INPFC Monterey and Conception areas were included in the present assessment. The authors intent to provide an only an update of the 1996 assessment was expressed at the pre-assessment workshop and re-iterated at the STAR panel review. On the basis of the 1996 assessment, boccacio was declared overfished and a rebuilding plan is being prepared. The rebuilding plan will make use of the population projections estimated by the current assessment.

One of the main differences between the two assessments was a re-estimation of the catch history. Improvements were made in use of sampling data to fill in for missing estimates of rockfish species compositions used to estimate the historical catch of boccacio in the commercial fishery. In addition, more recent estimates from MRFSS databases were used to estimate recreational catch. Estimated catch from the commercial fishery increased over the time series while the recreational catch estimates were lower compared to those used in the previous assessment.

A length based stock synthesis model was used. Authors cited conflicts with age and length data. Age data were only used to establish initial growth parameters in the pre-review model.

Model components included the NMFS triennial trawl survey and recruitment survey index, MRRFS based recreational fishery CPUE, and trawl fishery CPUE. CalCOFI larval recruitment data were not used as it is currently undergoing review.

Length data from the commercial trawl, set net, hook and line fisheries and the recreational fisheries were used along and incorporated modeling of the effective sample sizes for each data set.

A Bayesian approach was used to estimate M using a prior of M =0.15 and standard deviation of 0.03.

The base run resulted in a posterior M of 0.2. Fits to triennial trawl survey data were poor due to high variability in survey estimates. Fits to recruitment surveys, recreational CPUE and trawl fishery CPUE were generally good. Recruitment trends based on survey observations were consistent with the previous assessment. The authors cited problems with the model "crashing" due to numerically running out of fish. Initially this was solved by use of artificially high lower bounds on recruitment that produced an upward bias in ending biomass estimates. During the review, changes in the estimation procedure allowed the lower bounds on recruitment to be much smaller, improving the likelihoods of the fits and the accuracy of the results.

Observed vs estimated length compositions indicated a poorer fit and several alternative selectivity patterns were tried with only marginal improvements in fit.

The STAR panel had concern with the Baysian approach toward estimating M . Some STAR panel members felt that an M of 0.2, while improving overall fit, may not reflect biological reality given the longevity of bocaccio rockfish (arguing for a lower M), while other members felt that the strong improvement in log-likelihood argued for a higher natural mortality rate.

STAR and STAT panel members discussed the lack of fit to length data. The STAR panel felt that size at age might be mis-specified in the model. Author Alec MacCall indicated growth was not estimated by the model. The STAR panel also felt that some of the problems may have been associated with strong year-classes moving through the fishery. STAR panel members also expressed concern over differences in fisheries during higher abundance and stronger recruitments vs periods of low abundance and poor recruitment, suggesting some of the lack of fit may be due to changes in growth and / or selectivity between different time periods. Finally, the STAR panel thought that estimates of unfished biomass might be unreliable as the model uses a longer time series of catches, but tunes to more recent trend data (surveys, etc.).

Analysis Requested by STAR Panel

1. The STAR Panel requested plots of residuals of observed vs. estimated length distributions.
2. The STAR panel asked the STAT panel to examine growth curve assumptions and to conduct a base run allowing the model to estimate the growth parameters.
3. The STAR panel asked the STAT panel to model effects of cutting off the time series of catch data so that the model uses a shorter time series (1976-98) assuming an average catch equal to the 10 year average catch between 1967-77, prior to1976.

4. The STAT panel was asked to conduct a sensitivity analysis on M ranging from 0.05 to 0.25 in increments of 0.05.
5. For purposes of projecting future harvests, it was recommended recruitments be sampled to generate a recruitment range and estimates of unfished biomass via product of SPR and recruitment. Harvest modeling was to be estimated by projecting catch and harvest for policy F's of F40%, F45%, F50%, and F100%.

Results and Discussion

Improvements were seen in base run results when growth was allowed to be fit by the model. New parameter estimates were incorporated into the model. Fits to length were somewhat improved and some effects of strong year-classes were still noted. The STAR panel felt fits were reasonable and, excepting effects of strong year-classes, residuals did not indicate systematic bias.

Running the model with the alternate time series from 1976-98 had no effect on results.

The cap on F in the model was set at 0.4 and was responsible for crashes when R was set at low levels. Model stability was achieved by resetting the cap to 1.0, thus allowing the exploration of lower recruitment levels. Population values stabilized with R set to 0.001. Using the new growth parameters and new minimum value for R, natural mortality rate was varied between M = 0.15 and 0.25 and model runs were compared to the previous base model over the same range of natural mortalities. The model runs produced similar results, although the latest modifications resulted in improved likelihood values and reduced spawning out.

The STAR and STAT panels discussed the consequences of having spawning output reduced to less than 4% of the spawning potential under unfished conditions. Current stock status would indicate exploitation rates have exceeded policy F40% since the late 1970's and that a sustainable fishery could only be achieved with a harvest policy that would result in more than 74% of unfished biomass remaining (F74%). Extremely low or exploitation rates or a 0 fishing mortality rate required for rebuilding do not seem feasible without precluding fisheries altogether.

STAR and STAT panels also discussed the difficulty of estimating meaningful unfished biomass and stock productivity levels given the high variability in recruitment. As one panel member put it 'for bocaccio, recruitment is everything'. It was suggested that boccacio may have strong community interactions during periods when biomass was higher and during good environmental conditions that may lead to lower than average recruitments. In later years, with poor environmental conditions and low population sizes, recruitment may be reduced as well. Some suggested partitioning recruitments into a box type model that accounts for stock size and environmental conditions.

STAR and STAT panel members also discussed ways of effectively help the resource through a meaningful rebuilding plan. Concern was expressed over the effects of present fishery harvest policies which treat areas of high and low productivity as homogenous units. If recruitment comes out of a few productive areas, one way to reduce stock impacts and encourage rebuilding would be to selectively reduce F in areas of high spawning population abundance.

On the brighter side, there appears to be a strong incoming year-class in 1999 along the California coastline. Recruitment to the fishery is not expected to take place for 2 or three years and would not likely result in rebuilding plans in the short term. It was also pointed out that the fishery has been in existence for at least two decades prior to the beginning of the time series used in this model. Bocaccio have not continued to produce strong year classes and the 1990s have produced a long string of failures. Previous to that, even the strong year classes have been simply proportional to the spawning output. The 1999 spawning, which we cannot yet calibrate is the only exception. It appears that the stock has not lost the capability to produce a strong year class.

Recommendations for Future Research and Data Collection

1. STAR panel member Dave Thomas (CDFG) indicated that more length data for earlier years may be available and should be included in future assessments.
2. STAR panel and STAT panel members agreed that it would be important to look at the long time series of power plant larval fish impingement data to see if a pre-recruitment index could be developed.
3. STAR panel members felt that environmental data and recruitment patterns should be examined for trends. Research should include exploring the possibility of community interactions along with environmental coupling in an effort to develop alternative models that more accurately affect the population dynamics of this species.
4. STAR and STAT panels recommend continuation of fishery independent methods of monitoring the boccacio resource, and development of additional fishery independent methods of sampling. Anticipated low future harvest levels under a rebuilding plan may reduce or eliminate sampling opportunities needed to track recovery of the stocks.

5. STAR and STAT panel members agreed that it would be important to look at the CalCofi to look at the CalCOFI data set when it becomes available. By extending the model back into the 1950s and 1960s, it may be possible to calibrate stock productivity to the colder conditions during those years as opposed to the warm conditions that have prevailed since the mid-1970s.

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July 12-16, 1999
U.C. Davis, California

Agenda

1. Introductions and sign-in.
2. Review Goals and Objectives.
3. Review STAR Panel Objectives (terms of reference)
   - Review draft stock assessment documents and other pertinent information including previous assessments – determine if documents are sufficiently complete according to outline of assessments – using consensus of STAR panel members.
   - Work with STAT Panel to ensure necessary revisions are made. Provide instructions to STAT that are clear and in writing.
   - STAR Panel instructed on using a risk neutral approach in deliberations and in report. This was taken to mean represent uncertainty in assessments either through statistical uncertainty from model outputs or through differences in alternative models.
   - Towards end – review summaries of stock status prepared by STAT team.
   - Accommodate discussions and input by all interested parties, and document discussions. Document areas of disagreement between STAR and STAT Panels.
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4. Review Outline for Completed Groundfish Stock Assessment.
5. Review Lingcod Assessment
   - Presentation by Lingcod STAT
   - STAR Review of Groundfish Stock Assessment (Checklist)
   - STAR Comments on Assessment.
   - Public Comment Period
   - Instructions to STAT Team by STAR Panel
6. Review Boccacio Assessment
   - Presentation by Lingcod STAT
   - STAR Review of Groundfish Stock Assessment (Checklist)
   - STAR Comments on Assessment.
   - Public Comment Period
   - Instructions to STAT Team by STAR Panel
7. Review of STAR/STAT work on Lingcod.
   - Response by Lingcod STAT
   - STAR Comments on revisions.
   - Public Comment Period.
8. Review of STAR/STAT work on Boccacio

- Response by Boccacio STAT
- STAR Comments on revisions.
- Public Comment Period.

9. Summary of Stock Assessments
   - STAR Panel Summary – consensus and/or minority views,
     Final instructions to STAR Panel (Review Assessment Checklist)
     Review Summaries of Stock Status for SAFE Document
   - STAT Panel Response
   - Public Comment Period

10. Final Instructions to STAR Panel and or STAT Team
- Draft STAR report by end of meeting.
- Follow-up (Chair) if work not completed during meeting.