LINGCOD

STAR Panel Report

Alaska Fisheries Science Center
Seattle, Washington
September 26-30, 2005

STAR Panel members:

Steven Berkeley, University of California Santa Cruz, SSC
Martin Dorn (Chair), Alaska Fisheries Science Center, SSC
Ray Conser, Southwest Fisheries Science Center, SSC
Owen Hamel, Northwest Fisheries Science Center, SSC
Robert Mohn (Rapporteur), Center for Independent Experts
Kevin Piner, Southwest Fisheries Science Center
Stephen Ralston, Southwest Fisheries Science Center, SSC

John Devore, Pacific Fisheries Management Council, GMT representative
Peter Leipzig, Fishermen's Marketing Association, GAP representative

STAT Team Members present:

Thomas Jagielo, Washington Department of Fish and Wildlife
Farron Wallace, Washington Department of Fish and Wildlife

Overview

Lingcod has been designated an overfished stock by the Pacific Fishery Management Council and is currently being managed under a rebuilding plan. The assessment divided the stock into a northern component in the Vancouver and Columbia INPFC areas (LCN), and a southern component in the Eureka, Monterey and Conception areas (LCS). The lingcod assessment was initially reviewed by a STAR panel in August 2005. The STAR Panel did not approve the assessment for management advice because of unresolved questions about the LCN model's estimates of a large increase in stock size in recent years. The Panel had difficulty seeing the foundations in the data for estimates of two strong year classes (1999 and 2000 year classes) that apparently were responsible for the increase in abundance. The STAT team agreed to examine the evidence more carefully and present their findings to the September wrap-up panel. During the panel meeting, the STAT team was represented by Tom Jagielo and Farron Wallace. The STAR panel primarily focused on this issue, and did not conduct a full review of the lingcod assessment.

The data used in the lingcod assessment received extensive scrutiny, and a number of sensitivity runs of the LCN model were performed. The Panel found that the commercial age composition, the survey age composition in 2001 and 2004, and the survey biomass estimates in 2001 and 2004 provided at least some support for stronger than usual 1999 and 2000 year classes. Data from the recreational fishery did not support strong 1999 and 2000 year classes. While these data collectively suggest that these two year classes are above average, their absolute magnitude remains uncertain, and it is not unusual for initial estimates of exceptionally strong year classes to drop down as more data become available.

Sensitivity runs indicated that the LCN stock would rebuild strongly even if the 1999 and 2000 year classes are considered average in size. In this scenario, strong rebuilding occurs because of the relatively high productivity of lingcod and the substantial catch reductions in the northern area in recent years. In contrast, catches have not been reduced to the same extent in the southern area, and rebuilding has been much slower. Based on these analyses and sensitivity runs, the Panel accepted the both LCN and LCS models. The models were unchanged from the earlier STAR Panel and are considered to be adequate for management advice. Spawning stock biomass was estimated to be 87% of unfished biomass in 2005 for the northern component, and 24% of unfished biomass for the southern component. The coastwide spawning stock biomass was estimated to be 64% of unfished biomass in 2005.

The Panel is grateful to the STAT team for their cooperation during the meeting. Furthermore, the Panel agreed that both LCN and LCS assessments constituted the best available science and were now acceptable use in management.

Analyses requested by the STAR Panel

1) Provide a sensitivity run with at least one asymptotic selectivity pattern

The Panel was concerned that the model was estimating high proportion of cryptic biomass (i.e., unseen in catch or surveys). The female selectivity pattern for the commercial fishery was considered a good candidate since it was already nearly asymptotic. Sensitivity runs were produced for both LCN and LCS models by assuming an asymptotic selectivity pattern for females in the commercial fishery. In LCN model, the starting biomass fell about 30%, which is consistent with the reported proportion of cryptic biomass presented at the pervious STAR Panel. In LCS model, the run with asymptotic selectivity reduced biomass by about 10%. The Panel did not consider the proportion of cryptic biomass to be excessive.

2) Provide two retrospective analyses. First, remove the shelf survey data for 2004, and then remove both 2004 and 2001 (remove both age composition data and biomass indices). Second, step back through the commercial composition data removing data in 2004 to 2001, sequentially and cumulatively.

It was unclear which data sets were contributing to the estimates of the strong 1999 and 2000 year classes. The retrospective analyses indicated that data from both the 2001 and 2004 shelf survey provide support for the estimates of strong recruitment of the 1999 and 2000 year classes. The commercial age composition data also support estimates of strong recruitment. Somewhat unexpectedly, the LCN stock shows strong rebuilding even with the 2001 and 2004 survey data removed and the 1999 and 2000 year classes assumed to be average. The stock will still rebuild in this scenario because of the relatively high productivity of lingcod and the substantial catch reductions in recent years.

3) Plot average age compositions for the survey and commercial fishery and then superimpose recent age composition

The results showed the 1999 and 2000 year classes were more prominent in comparison to the average age distributions in these data sets. There appeared to be some smearing of year classes in the commercial data, presumably due to ageing error.

4) As a sensitivity test, increase the CV's on the 1986 and 1995 shelf survey biomass estimates

The CV's on the 1986 and 1995 shelf surveys biomass estimates are very small and the panel thought that this may be affecting estimates of recruitment in subsequent years. This was not done due to time constraints.

5) Iteratively balance the model so that input and output sample sizes and standard deviations are similar

The Panel recommended that the abundance indices be balanced first and then the size and age composition data. The STAT team argued that further balancing was not needed since this had been done in the previous assessment model by dividing the input sample sizes by 10. Because the STAT team chose not to rebalance the model, the panel requested a diagnostic plot of effective sample sizes vs input sample sizes. These were presented and the practice of dividing by 10 looked roughly appropriate.

6) Prepare decision table showing the consequences if stock biomass is different than base case

Details about how decision tables were developed for the LCN and LCS models are described below.

Final base-cases models and quantification of uncertainty

The models for the two areas had the following fixed parameters in common:

Natural mortality: Females 0.18, Males 0.32
Recruitment variability: $\sigma_R = 1$
Stock-recruit steepness: $h = 0.90$
Von Bertalanffy growth curves were fitted outside the model. Separate curves were estimated for males and females and for northern and southern areas.

LCN model input data and selectivity patterns

Catch: 1956-2004

Abundance indices:
- Trawl CPUE 1976-1997
- Shelf survey 1977 – 2004

Length frequencies:
- Recreational 1981-1983
- Commercial 1975-1978
- Shelf survey 1986, 1989

Age frequencies:
- Recreational 1980, 1986-2004
- Commercial 1979-2004
- Shelf survey 1992 – 2004

Selectivity
- Commercial fishery – domed or asymptotic
- Recreational fishery - domed
- Shelf survey - domed

LCS input data and selectivity patterns

Catch1956-2004

Abundance indices:
- Trawl CPUE 1978 -1997
- Shelf survey 1977 – 2004

Age frequencies:

Recreational 1992-1998, 2000-2004
Commercial 1992-1998, 2000-2004
Shelf survey 1995-2004

Selectivity

Commercial fishery – domed
Recreational fishery - domed
Shelf survey - domed

For the LCN model, the Panel and STAT team agreed to bracket uncertainty with a single low biomass run obtained by removing the 2001 and 2004 survey data and fishery size and age composition data from 2001 onward. Removal of these data produce estimates of the 1999 and 2000 years classes equal to the long-term average.

For the LCS model, the Panel and STAT team agreed to bracket uncertainty using models with high and low spawning biomass in 2005 that were plus and minus 1.25 standard deviations from the base model. After some experimentation, it was found that catches could be perturbed to obtain the desired low and high spawning biomass levels. Stock forecasts used catches projected by the GMT for 2005 and 2006.

Technical merits and/or deficiencies in assessments

The STAT Team is commended for their effort in producing the large number of analyses before and during the STAR Panel review.

This Panel did not conduct a full review of the lingcod assessment. Examination of model diagnostics (sensitivities, retrospective analyses, residual patterns, etc…) was limited, especially for the LCS model.

Areas of disagreement

There were no significant areas of disagreement within the Panel nor between the Panel and the STAT team.

Unresolved problems and major uncertainties

Due to lingcod's preference for rocky reef habitat, the Panel considered dome-shaped selectivity patterns to be reasonable from a conceptual perspective. However, some of the estimated selectivity patterns were quite angular in appearance with very steep descending slopes. The Panel had concerns both about the biological plausibility of these curves and whether the selectivity parameters had been defined and estimated appropriately. Further evaluation of survey and fishery selectivity patterns was warranted, but the Panel was unable to do so in the time available for review.

Recommendations for future research

1) Considering the independent recruitment trends in recent years between LCN and LCS, an investigation into stock structure should be considered.

2) Generic recommendation: At modeling workshop prior to this year's assessment cycle, there was a general recommendation to use iterative reweighting of input sample sizes and index variances. As a result, there was much more extensive use of these procedures in the assessments conducted this year. Prior experience of West Coast assessment scientists with these procedures was limited, and in some cases reweighting procedures may have been applied uncritically. For example, reducing weights on a survey index and increasing the weight on fishery data seems difficult to justify on first principles. A workshop is needed to assimilate the experience gained from this year's assessments and to develop recommendations for future assessments. Other methodological issues, such as the use of priors in this year's assessments, could also be addressed in the workshop, or a separate workshop.