Lingcod

STAR Panel Report

July 27-30, 2009
Deca Hotel
Seattle, WA

Panel Reviewers
Dr. Vidar Wespestad, STAR Chair and SSC representative
Dr. J.J. Maguire, Center for Independent Experts
Dr. Stephen Smith, Center for Independent Experts
Dr. Jim Ianelli, National Marine Fisheries Service Alaska Fisheries Science Center

STAR Panel Advisors Present:
Ms. Joanna Grebel, California Department of Fish and Game, GMT Representative
Mr. Dan Platt, GAP Representative
Mr. John DeVore, PFMC Representative

STAT:

Dr. Owen Hamel, National Marine Fisheries Service Northwest Fisheries Science Center
Ms.Suresh Sethi, School of Aquatic and Fisheries Sciences, University of Washington
Mr. Thomas Wadsworth, Moss Landing Marine Laboratories, Moss Landing, California
Dr. Hamel was present and presented for the STAT

Overview

A draft assessment of lingcod (*Ophiodon elongatus*) off the west coast of the United States, from the U.S.-Mexico border to the U.S. Canadian border was reviewed by the STAR panel during July 27-31, 2009. The assessment was conducted as two separate assessments of (1) Lingcod off of Washington and Oregon (the North stock), and lingcod off of California (the South stock).
For each stock, two fisheries are modeled: the commercial fishery and the recreational fishery (four fisheries). Landings are included from 1928-2008, with equilibrium landings estimated for the commercial fisheries prior to 1928. Since the fishery off of California developed earlier, the equilibrium catches there are an order of magnitude higher.
The previous assessment was conducted in 2005 in SS2. The current assessment utilizes SS3, extends the catch series, commercial discard rates from 2002-2007; Triennial survey indices for the years 1980-2004; NWFSC survey indices for the years 2003-2008; commercial logbook CPUE indices for the years 1976-1997 (North) or 1978-1997 (South); PSMFC Dockside (recreational) boat survey index 1980-1989, 1993-1997 (South); Commercial length composition data for 1965-2008 (North) or 1978-2008 (South); Commercial discard length composition data for 2003-2007 (North) and 2004-2007 (South); Recreational length composition data for 1993-2008 (North) or 1987-2008 (South); Triennial length composition data for 1986-2004 (North) or 1989-2004 (South); NWFSC length composition data for 2003-2008.

Age data was available and used in sensitivities but not in the base models due to issues with outliers and possible aging bias. Removing the age data significantly changed the recruitment time series- scaling it down and redefining recruitment strength in the early 1970s. The effect on the south model was clearly less significant, which was expected given the lack of age data in the south.

The current assessment indicated that the stock has recovered when assessed from a coastwide perspective as well as when assessed separately as substocks off of Washington and Oregon, and off of California. Overfishing last occurred in 2003, although there was some dispute about the magnitude of recreational fishery catch off of California for that year. The Base Model results for the depletion ratio of the spawning biomass at the start of 2009 were 61.9% for the North, 73.7% for the South, and 67.0% coastwide.

The STAR panel concluded that the lingcod assessment constitutes the best available scientific information on the status of lingcod 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 members for their thorough preparation and willingness to respond to panel requests.

Analyses requested by the STAR Panel

1. The original base case models started estimation of recruitment in 1970 but the residual pattern for the commercial length compositions from the Northern stock indicated that there were strong signals for one or more year-classes moving through the fishery between 1966 and 1971 that were not being fit well by the model (Figures 70 and 71). The panel asked for a sensitivity run with the estimation of recruitment starting in 1950 for the Northern stock. Relatively large numbers of fish were sampled from a few trips in

the mid-1960s and the panel recommended that input N be calculated as 3.5 times the number trips in this early period — half the average conversion used for the more recent years.

The new model set 1950 as the initial year for estimating recruitment in the northern model and resulted in a better fit to the length compositions in the 1960s and hence reduced the associated residuals as well as picking up the large recruitment in 1964 which had not been so for the original base case. Depletion was estimated to be 47% compared to 62.1% for the original base case. These results suggest that the final base case should start estimating recruitment at least as early as 1950.

2. The stock assessment includes catches from 1928 but with recruitment only being estimated from 1970 in the original base case, error estimates for recruitment in the early period were obtained directly from the stock/recruitment curve and underestimated the true uncertainty for recruitment and other associated parameters from this early period. The panel requested a sensitivity run with recruitment estimated starting in 1928 to evaluate the uncertainty associated with SB_zero.

   The standard deviation for SB_zero changed by 1.4 times for the northern model and by 3.28 times for the southern model. This difference seemed reasonable given that there was more data for the northern model and the standard deviations were considered realistic enough to have the new base case begin estimating recruitment starting in 1928.

3. Include estimates of uncertainty estimated in request 2 as well as for many of the other parameters presented in the sensitivity tables.

   The standard deviations for SB_zero and SB_2009 were included the new sensitivity runs requested but there was some question as to whether all of the uncertainty was actually captured. The STAR panel and STAT deferred on how to better capture all the uncertainty given the structure of the assessment.

4. Spawning output is expressed in terms of female spawning stock and ignores the importance of the nest-guarding by the males for successful reproduction. The panel requested that the annual trend in sex ratio by numbers for ages five-plus from 1928 to 2009 be investigated to determine if fishing may have resulted in significant changes in this ratio leading to changes in spawning success.

   The proportion of females in the catch varied between 70 and 80% in the northern with little evidence of trend while the proportion of females in the south has declined since 1980, dropping to 65 to 70% in the 1980s to mid-1990s and again in 2003 to 2005.

   in The higher proportion of males in the southern area is not really indicative of any trend; but the proportion of males in the catch during the period of nest guarding may factor into reproductive success and perhaps be used as an indicator and incorporated into evaluations of reproductive output.

5. Growth curves for both sexes in the northern area estimated a length of 20 cm at age 0 (Figure 48) which seemed too large given the data. In addition, it was not clear whether SS3 assumes that T_0 equals 0 when estimating k and L_infinity. The panel requested that the data and growth model fit presented in Figure 48 be verified.

   This analysis discovered that lengths-at-age in SS3 were actually beginning of year and not mid-year as previously assumed. Changes to bin size, etc., were tried but results were still not satisfactory. Given that the model actually uses beginning of year length-at-age, the associated dispersions for the lengths-at-age will need to be lined up properly. Other options for setting the length at age 0 will be explored for the final base case run.

6. There appears to be a large number of outliers in the length-at-age relationships for the commercial data in the northern area (Figs 7 to 10) that may be due to incorrect determination of gender for the sampled fish. The panel requested a model run with combined sex conditional length-at-age compositions to evaluate this possibility.

   Combined sex conditional length-at-age compositions did not appear to resolve the outlier issue and made little difference to the model fit or parameter estimates.

7. The STAT presented a sensitivity model with no age data and the panel requested that the recruitment estimates from this sensitivity run be compared with the base case recruitment estimates to provide insight into how the age data and outliers identified in request 6 maybe affecting the model.

   The age data results in lower recruitments since 2000 than estimated without ages for the northern model. In the south there was less of a consistent pattern for the recruitment series estimated with and without ages. These results suggested that the no age option should be retained as a sensitivity run for the final base case.

8. The Washington tagging data was not used in the current assessment having been criticized in the previous assessment. The panel requested that the trends from the tagging data be plotted against recruitment estimates from base case to evaluate if there could be any reason to use the index.

   There was insufficient time to address this request.

9. The 2003 NWFSC survey estimate of lingcod biomass was much higher than either the 2004 estimate from the same survey or the 2004 estimate from the triennial survey. The panel requested that the frequency distribution of catches per tow be tabulated for the NWFSC by year for North and South areas. In addition, the catches making up the 2003 estimate from the NWFSC survey should be investigated to determine if there are reasons why the estimate may not be reflecting actual abundance.

   Three large tows of lingcod accounted for 63.5% of the total lingcod catch in the 2003 NWFSC survey. The first of these tows there was adequately sampled while the second and third tows contained large catches of dogfish and were subsampled. The second tow

had only two lingcod in the subsample (one male and one female) that were scaled up to represent the overall catch. All three tows had large lingcod in them. There is really very little that can be done to develop a defensible estimate of the numbers caught after the fact when something like this happens and onboard procedures need to be in place to specify an adequate sample in these kinds of circumstances.

10. A dome-shaped selectivity pattern was estimated for the triennial survey in the north while the selectivity pattern was asymptotic for the southern area. Given that there was less data to estimate the selectivity pattern in the south and no reason to believe that selectivity patterns should differ between the two areas, the panel requested a model run for the south using the dome-shaped selectivity for the triennial survey.

    Use of the dome-shaped selectivity for the triennial survey from the northern model in the southern model resulted in a slight increase in biomass over the base case but stock status did not change appreciably. The panel recommended using the dome-shaped selectivity in the final base case for the southern model.

11. A number of extra abundance indices (e.g., PISCO scuba index, CENCAL index) were presented by the STAT for the southern area and evaluated in terms of improvement in fit for the abundance indices used in the base case. The panel requested that the fits of the south model to the abundance indices both with and without the extra indices be presented to fully evaluate the usefulness of these extra indices.

    The plots of the fits of the model to the abundance indices were updated as requested and showed that the extra abundance indices contributed little to improving the fit of the model.

12. Sensitivity runs presented by the STAT showed that removing the triennial survey from the southern model resulted in little change to stock status while removing the commercial and recreational CPUE data resulted in a much lower depletion level. The latter time series were only used up to 1997 to account for management changes in the more recent years and is was difficult to understand the reasons for the sensitivity results. The panel requested plots of the biomass trends from the sensitivity run for the southern model with either CPUE or the triennial survey indices removed.

    The biomass trends for the no triennial survey case were virtually identical to those of the base case while removal of the CPUE data resulted in lower overall biomass, especially in the most recent years. The possibility that the trends in the CPUE data relative to those in triennial survey prior to 1998 may compensate in the model for decline in the triennial survey after 1998 was discussed but it was not clear what the mechanism behind this behavior was.

13. The STAT presented sensitivity runs for the north model removing either the NWFSC survey, the triennial survey or the commercial CPUE. For any one of these runs, stock status changed little from the base case. The panel requested a sensitivity run with all of

the abundance indices and associated composition data removed from the Northern model to understand the influence of these indices on the northern model.

The removal of all of the abundances from the model resulted in little change in stock status from the base case model, probably reflecting the poor fit to the abundance indices, especially in the most recent years. Current trends appear to be a consequence of the trends in the length compositions.

14. The panel requested that the monthly distribution of catches be tabulated for both areas starting in 1981 to see if there have been seasonal changes in the monthly distribution of catches that might explain patterns observed in the length-at-age data.

    Catches appear to have increased in the May to July and August to October periods relative to the rest of the year since around 1997/98. Further investigation into the possible impact of this trend could be deferred to be a research recommendation.

15. The panel requested some preliminary runs on two new base case candidates:

    a. Estimate recruits starting in 1928, estimate L_1 and L_2 to be within a range of ages where adequate amounts of data were observed (e.g., ages 2 and 20, respectively) and use the selectivity estimated for the triennial survey in the north for the southern model.
    b. As above but remove all ages (checking to see if L_1 is still estimable).

    Initial results suggested that the outliers in the length-at-age data were affecting the models and the decision was made to go ahead with removing the age data for the base case. The new base run was compared to lower and higher assumed natural mortality rates in the north and south (M = 0.16 – 0.22, 0.18 base females; 0.285 – 0.39, 0.32 base males) and lower and higher values of assumed steepness (h = 0.7 – 0.9, 0.8 base). There was surprisingly little contrast in the results across this range of uncertainty.

Base Model Specification

The Panel agreed with the stock structure splits for north and south management units. For each region there are two fishing fleets. In the north three indices are used and in the south, there are four abundance indices. The model ranged from 1928 through 2008. In both models there was a single block for commercial selectivity and retention changes, occurring in 1998 (to present) reflecting the increased regulation and areal limitations which have come into place over that period. That same block is used to model changes in recreational selectivity, reflecting changes in minimum size limits. In the North, male and female selectivities are estimated separately for the recreational fishery, whereas data to do so is lacking in the South.

The modeled ages extended from 0 to the accumulator at age 20. The modeled length bins range from 10 to 128 at 2 cm intervals while the data extend from 28 to 110 cm. Growth is partially estimated, with max size estimated in N but not in S. The value of “L1” (length at age 1) is to be estimated.

The age data were omitted from both models since these data showed a poor residual pattern that was apparently due to data outliers. Also, at early ages there appears to be mis-aging that was not captured appropriately. Results using the length frequency data alone significantly changed the recruitment time series- scaling it down and redefining recruitment strength in the early 1970s. The effect on the south model was clearly less significant, which was expected given the lack of age data in the south. The Panel and author agreed that the results were an improvement and resolved a number of fit issues and residual patterns. In particular, the poor residual pattern noted in Figure 71 of the draft assessment was resolved.

The estimates of triennial survey selectivity for the northern stock are to be used for the southern stock since the original selectivity estimates were unreasonable.
The underlying model is dis-aggregated by gender in order to capture the sex-specific differences in natural mortality (set to 0.18 yr-1 for females and 0.32 yr-1 for males). Data on gender-specific composition data were available. Recruitment is to be estimated from 1928 (to better capture historical uncertainty in stock size) and the steepness parameter is fixed at 0.8. Other details for the base model were agreed and are as specified in the document (i.e., Tables 13-15).

Technical merits of the assessment

This was a very thorough assessment that explored a number of sources of uncertainty. The STAR Panel agrees with the STAT view that there was inherent uncertainty that was not included in the model that may be important such as the degree of connection between the two lingcod stocks and also between the northern stock and the stock off British Columbia; the effect of the PDO, ENSO and other climatic variables on recruitment, growth and survival of lingcod.

The STAR Panel found that the STAT base model is the best available results given the uncertainties regarding surveys and age and growth data addressed above. The sensitivity results showed high uncertainty in age data. A base model was selected based on extensive model testing and an attempt was made to balance the sources of uncertainty. In addition, an attempt was made to make the North and South models as equivalent in as possible.
The Panel recommends that the next lingcod assessment be an update rather than a full assessment. Given the problems event in the age and growth data and problems in survey availability the STAR Panel does not recommend another full assessment until the data issues are addressed.

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

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

Unresolved problems and major sources of uncertainty

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

There were discussions regarding near shore surveys and the potential need to look at existing area closures that may improve access to lingcod by near shore fisheries. The GMT will be examining these issues as part of their management review.

Prioritized recommendations for future research and data collection

1. Investigate the effect of the year when recruitment is estimated on the estimates of B0 and of current status, since this may have an effect the estimated level of depletion.

2. Investigation of the large survey estimate for lingcod in the 2003 NWFSC survey showed that catches from only three tows made up 63.5% of the total lingcod catch in the survey. The second and third large tows also had large catches of dogfish and the catches were subsampled for counts and detailed sampling. As a result only 2 lingcod were actually measured in the second largest tow (one male and one female) but these measurements were expanded to the whole catch. It is difficult and inappropriate to try to correct such estimates after the fact during the assessments. Instead onboard sampling procedures need to be developed to ensure that a proper and informative subsample of fish be measured during the survey.

3. The sensitivity run with no abundance indices produced a similar fit to the base case suggesting that there was little trend information in the abundance indices used in the base case. Can it be determined if the NWFSC survey is fishing in the right places for lingcod? Are there other survey techniques that can be used (e.g., longline, combined lingcod/sablefish pot survey, trap surveys)?

4. Investigate the suitability of using catches of lingcod in the IPHC survey as an alternate abundance index.

5. Re-examine the usefulness of the Washington tagging data for next assessment.

6. There was confusion over whether SS3 was using mid-year or beginning of year length at age resulting in larger than expected mean length at age for age 0 and 1. The method for setting the correct mean length at age for the younger ages needs to be clarified before the next assessment.

7. Further investigation of the age and length data needs to be done to understand if seasonal or area differences or some other causes are behind the outliers observed in the length-at-age data.

8. Look at environmental covariates for recruitment and time-varying growth and availability inshore.

9. The fact that lingcod males (and cabezon) are nest-guarders was ignored when determining reproductive output. A cursory look at the proportion of sex ratio in the catch did not appear to indicate any serious changes for either species in recent years. However, we do not know what kind of change in sex ratio would indicate a serious change in reproductive success. The impact of nest-guarding on reproductive output should be investigated.

Acknowledgements

The Panel thanks Dr. Jim Hastie and staff at the NWFSC for their exceptional support and provisioning during the STAR meeting.