PETRALE SOLE

STAR Panel Report

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

STAR Panel members:

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Martin Dorn (Chair), Alaska Fisheries Science Center, SSC
Ray Conser, Southwest Fisheries Science Center, SSC
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Kevin Piner (Rapporteur), 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:

Han-Lin Lai, Northwest Fisheries Science Center
Jason Cope, University of Washington

Overview

The petrale sole assessment was initially reviewed by the flatfish Stock Assessment Review Panel (STAR) in April 2005. The assessment divided the stock into a northern component in the Vancouver and Columbia INPFC areas, and a southern component in the Eureka, Monterey and Conception areas. The STAR Panel did not approve the northern area assessment for management because new age data were given to the STAT team during the meeting and there was insufficient time during the meeting to evaluate and incorporate the data into the assessment. The STAT team agreed to prepare a revised assessment for the September wrap-up panel.

The southern area assessment was considered suitable for management advice by the April STAR Panel, but subsequent work to finalize the assessment raised questions about the convergence of the base model. The SSC recommended that the southern petrale assessment also be reviewed by the wrap-up panel to address these concerns. The SSC also wanted to be able to request southern model runs if issues raised in the review of the northern model were also relevant to the southern model. During the September wrap-up panel, the STAT team was represented by Han-Lin Lai and Jason Cope.

The STAR Panel and STAT teams agreed on base models and bracketing model runs to quantify uncertainty for both northern and southern components of the stock. Petrale sole in the north was estimated to be at 34% of unfished spawning stock biomass in 2005. In the south, the stock was estimated to be at 29% of unfished spawning stock biomass. Biomass trends were qualitatively similar in both areas, and also showed consistency with petrale sole trends in Canadian waters. Both stocks were estimated to have been below the Pacific Council's overfished threshold of 25% of unfished biomass from the mid-1970s until very recently. Estimated harvest rates were in excess of the target fishing mortality rate of F40% during this period as well. Petrale sole in both areas showed large recent increases in stock size, which is consistent with the strong upward trend in the shelf survey biomass index.

In comparison to previous assessments of petrale sole, this assessment represents a significant change in our perception of petrale sole stock status. For example, in the 1999 assessment, spawning biomass stock biomass in 1998 was estimated to be at 39% of unfished stock biomass. The current assessment now estimates biomass in 1998 to have been at 12% of unfished stock biomass. An extended period of low stock abundance followed by a rapid increase was a consistent feature of model results regardless of geographic area, model configuration, or selection of input data. Nevertheless, this pattern of extreme stock dynamics is difficult to reconcile with the long-term stability of the petrale sole fishery, and the Panel recommends exploration of this issue in future assessments.

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

Northern area model

Analyses requested by the STAR Panel

1) Provide a plot of the proportion of positive tows in the data used to generate the fishery CPUE indices

Reason: The CPUE indices in the model did not include the binomial component of the delta GLM due to convergence problems. The CPUE time series was based on only the GLM model for the positive tows.

Outcome: The proportion of positive tows showed an upward trend after 2000. Had it been possible to include the binomial part of the delta GLM, the upward trend in the CPUE index would likely have been magnified, and would be more consistent with the shelf survey biomass trend. The increase in the proportion of positive tows may be a result of changes in fishing practice due to management restrictions. The Panel concluded that it would not be appropriate to use the GLM analysis for positive tows in the model.

2) Develop a simplified model for petrale sole

The Panel requested a simple model with the following characteristics: a) all fisheries should have the same selectivity pattern, b) all selectivity patterns should be asymptotic, c) all length data should correspond to one of the fisheries, d) super years should be removed and year specific composition information should be maintained, e) each length composition should be given an equal effective sample size, f) the age data and the mean size at age data should be removed, g) the model should be a combined sex model, h) the 2004 survey data should be used to estimate growth parameters which should then be subsequently be fixed in the model, i) the original four CPUE time series and the shelf survey should be used in the model, j) the retention component of the model should be removed and zero discard should be assumed and k) recruitment deviations should be estimated over the entire modeled period, and the standard errors of the recruitment deviations should be used to determine which years had information to allow estimation of recruitment. A second model run was requested where recruitment deviations were estimated only for the period for which there is information to inform the model.

Reason: In the draft assessment there were many issues concerning the modeling of multiple fisheries with dome-shaped selectivity patterns using sex-specific age data from different agencies. These issues had not been resolved in the draft document, and were unlikely to be resolved in the time available for review. Model convergence was slow and erratic, suggesting that the model may be overparameterized given the quality and quantity of available data. The complexity of the assessment model was an impediment to understanding the model's basic properties, and the Panel hoped that radical simplification of model structure would help clarify matters.

Outcome: The simple model fit the data nearly as well as the more complex model. Fits to the fishery length composition appeared adequate. The fit to the shelf survey time series was excellent, but the fit the post-2000 fishery CPUE indices was poor. However, the reliability of post-2000 CPUE index is questionable due to changes in fishing practices. Biomass trends were similar to the complex model. It appeared reasonable to begin estimating recruitment deviations in 1940.

3) Do a likelihood profile over the CV of ageing error for the complex model
Reason: The Panel wanted to investigate the effects of the ageing error matrix on model performance. The Panel noted that the current ageing error matrix was based upon a comparison between surface ages and break-and-burn ages, which is an inappropriate measure of ageing precision for ages produced with a single ageing method. There were large and unexplained differences between agencies in the standard deviation of ageing error.
Outcome: The results of the profile indicate that ageing error had little influence on biomass estimates. The current ageing error matrix used in the model resulted in poorer model fits than the runs with a constant CV for ageing error. Based on advice from the STAT team and the results of the likelihood profile, the Panel recommended that an ageing error matrix based on an assumed CV of 10% be used for all data sources.

4) Estimate the growth model using combined male and female data
Reason: The simple model with combined sexes had used the female growth parameters.
Outcome: The combined sex growth model appeared to be nearly linear. The estimates of K (0.09) are smaller and Lmax (57.4 cm) larger than that female growth parameters.

5) Add discard to the total catch rather than attempting to model it separately
Reason: The data on discard of petrale sole are sparse and the historical records are of uncertain quality. The STAT team suggested that a discard rate of 10% in summer and 5% in winter were reasonable assumptions. This approach had been adopted for the southern area model at the previous STAR Panel
Outcome: The Panel and STAT team agreed that this was appropriate but alternative methods should be explored in future assessments.

6) Run both complex and simple models using the CPUE time series from the previous assessment and incorporating the requests 3, 4 and 5.
Reason: The CPUE time series in the previous assessment was derived from a GLM analysis that used all the data including zero tows, and the index ends in 1997 prior to the management restrictions that may have changed fishing practices.
Outcome: Panel and STAT team agreed this was appropriate.

7) Include sex-specific growth and sex-specific length composition data in the simple model.
Reason: This was based upon a recommendation from the STAT team. There is a 10 cm difference in maximum length between males and females and the STAT team wanted to capture this biological difference.
Outcome: The simple split-sex model converges and model fits indicate this is a reasonable base case. Surprisingly, the fits to the length composition were not noticeably better than the combined sex model.

8) Prepare decision table showing the consequences if stock biomass is higher or lower than the base case

Details about how the decision table was developed are described below.

Final base model and quantification of uncertainty

The base model is a split-sex model developed using Stock Synthesis 2. The model begins in 1908, a generation prior to the first substantial catch. Recruitment deviations were estimated starting in 1940. Four fisheries were modeled (Oregon summer and winter and Washington summer and winter) with the fishing year beginning November 1. Data used to fit the model included the fishery CPUE time series from the previous assessment (ending in 1997), and the shelf survey biomass time series (1980-2004) with the fishing year beginning November 1. The fishery CPUE series was taken from the previous assessment and ended in 1997. Length composition data from each fishery (1960-2004) and the shelf survey (1986-2004) were also used.

The model used a single asymptotic selectivity pattern for all fisheries and sexes. Length composition data from the different fisheries were treated as replicate observations with the same fishery selectivity (without super years). The shelf survey was also modeled with an asymptotic selectivity pattern. Discard was treated as a constant fraction of catch (10% summer and 5% winter) and included with the catch. Growth was fixed in the model based on estimates from the 2004 shelf survey length-at-age data. Natural mortality and recruitment variability (σ_R) were fixed, but stock recruit steepness (h) was estimated.

The Panel and STAT team agreed to bracket uncertainty using models with high and low spawning biomass in 2004 that were plus and minus 1.25 standard deviations from the base model spawning biomass. After some experimentation, it was found that the 2004 estimate of the shelf survey 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 since attaining the OY is considered unlikely.

Southern area model

Analyses requested by the STAR Panel

During the meeting the STAT team noticed that the base model had an inappropriate prior for survey catchability and that recruitment deviations were being estimated at a later phase than is optimal. Changing these model configurations removed the discrepancy in the likelihood profile that was the primary source of unease about the southern area assessment.

1) Estimate recruitments deviations only for the time period when there is information about recruitment strength
Reason: The original assessment estimated recruitment deviations from the start of the model in 1876. There is no information about recruitment strength until the 1950s.
Outcome: The standard deviation of the recruitment residuals indicated that data were informative about recruitment strength during the period 1956-2004. The Panel and the

STAT team agreed that estimating recruitment residuals during this period was appropriate.

2) Examine the 2001 and 2004 shelf survey length data for evidence of strong year classes
Reason: The Panel was looking for support in the data for the model estimate of a strong 1999 year class.
Outcome: The STAT team presented figures of the survey and summer fishery size composition. There is some evidence of a mode corresponding to the 1999 year class, but it is not particularly compelling. The large survey biomass estimate in 2004 is evidently the primary signal that the model is responding to.

3) Provide a table of parameters identifying which parameters were estimated and which were fixed
Reason: The Panel was uncertain about how the model was configured
Outcome: The table was provided to the Panel.

4) Do a sensitivity run with the survey length composition removed
Reason: To determine if this data source is driving the estimated strength of the 1999 year class.
Outcome: Other data in the model tended to support the estimate of a strong 1999 year class, but the support was relatively weak and inconsistent.

5) Provide a model run that does not estimate recruitment deviations after 1998
Reason: To obtain a lower bracketing model to quantify uncertainty in the assessment.
Outcome: As expected this run did give a somewhat more pessimistic assessment result, but an alternative method to bound uncertainty was adopted (see below).

6) Compare predicted growth from the model and the mean length at age by sex from the 2004 survey
Reason: To evaluate whether the model estimates of growth are reasonable.
Outcome: This request could not be done at the meeting because the data were not readily available.

7) Prepare decision table showing the consequences if stock biomass is actually higher or lower than the base case
Details about how the decision table was prepared are described below.

Final base model and quantification of uncertainty

The base model is a split-sex model developed using Stock Synthesis 2. The model begins in 1874, approximately one generation prior to the first substantial catch. Recruitment deviations were estimated in 1956-2004. Two fisheries were modeled (winter and summer) with the fishing year beginning November 1. Data used to fit the model included two fishery CPUE time series (summer and winter), and the shelf survey

biomass index (1980-2004). Length composition data from each fishery (1962-2004) and the shelf survey (1980-2004) were also used.

Sex-specific domed-shaped selectivity patterns were used to model both the summer fishery and shelf survey. For the winter fishery, an asymptotic selectivity was assumed for females and domed-shaped selectivity for males. Discard was treated as a constant fraction of catch (2.5% in both summer and winter) and included with the catch. Growth parameters were estimated in the model. Natural mortality and recruitment variability (σ_R) were fixed, but stock recruit steepness (h) was estimated.

The Panel and STAT team agreed to bracket uncertainty using models with high and low spawning biomass in 2004 that were plus and minus 1.25 standard deviations from the base model spawning biomass. After some experimentation, it was found that the 2004 estimate of the shelf survey could be perturbed to obtain the desired low and high spawning biomass levels. Stock forecasts used the pre-specified OYs for 2005 and 2006 since attaining the OY in 2005 was considered likely by the GMT.

Areas of Disagreement

There were no areas of disagreement between the Panel and STAT team.

Technical Merits and Deficiencies

The Panel recognizes that that simple northern assessment model leaves out details that could significantly improve model fits to different data sources. Nevertheless the Panel concluded that the simple base model would provide reliable management advice until the data and modeling issues can be adequately addressed.

Unresolved Problems and Major Uncertainties

The Panel did not have time to consider alternative methods of including discard in the model. A simple assumption of a constant percent discard was agreed to by the Panel and STAT team, primarily because of concerns about the reliability of historical discard estimates. This relatively crude approach assumes that discard and landed catch have the same length distribution, but it is likely that discard is primarily market (i.e., size) based.

The comparability of data collected by different agencies was an issue in this and previous assessments of petrale sole. The initial approach to model Oregon and Washington fisheries separately seemed to accentuate the difficulties rather than to resolve them. Any real difference in the fishery or in the biology of the targeted fish is confounded with differences in sampling and ageing procedures.

Apparent shifts in ageing criteria (break and burn and surface ageing) and poor model fits caused the Panel to question the reliability of the age data. The Panel recommended that all age composition data be removed from the model, however this should be considered an interim solution that needs to be revisited in future assessments.

Recommendations

1) Appropriate comparisons are needed to estimate ageing error. Potential drifts in the ageing criteria over time also should also be examined.

2) Reanalysis of the fishery CPUE data should be attempted using models that can accommodate both zero and positive tows. Although the CPUE indices appeared consistent with shelf survey biomass trends, consideration should be given to the potential impact of management restrictions on fishing practice.

3) Petrale sole stock trends were similar in both northern and southern areas. A single coastwide assessment should be considered.