# Petrale Sole – Southern Stock

## STAR Panel Report
## Northwest Fisheries Science Center
## Seattle, WA
## 18-22 April 2005

**STAR Panel Members:**

David Sampson, STAR Chair and SSC representative, Oregon State University
Robert Mohn, Center for Independent Experts
Jon Volstad, Center for Independent Experts
James Ianelli, NMFS, AFSC, Seattle, WA

Groundfish Management Team Representatives:

Michele Culver, Washington Department of Fisheries, Montesano, WA
Brian Culver, Washington Department of Fisheries, Montesano, WA

Groundfish Advisory Subpanel Representative:

Peter Leipzig, Fishermen's Marketing Association, Eureka, CA

**STAT Team Members Present:**

Han-Lin Lai, NMFS, NWFSC, Seattle, WA
Melissa Haltuch, University of Washington, Seattle, WA

*NOTE*:
The STAR Panel chair did not receive a copy of the revised assessment until 29 August 2005 and was unable to fully review the revised document prior to the September Briefing Book deadline.

## Preamble

Petrale sole off the U.S. West Coast were assessed as separate northern and southern stocks. This STAR Panel reviewed draft assessments for both stocks but the assessment for the northern stock was withdrawn during the STAR Panel review (details below) and will be reviewed during the mop-up STAR Panel in late September 2005. This report focuses on the assessment for the southern stock. The final base model for the southern stock was not determined until the last day of the STAR week and the assessment was not completed until much later.

## Introduction

This stock assessment review (STAR) panel was assembled to review new assessments for US West Coast stocks of English sole, petrale sole, and starry flounder. All three assessments used the new Stock Synthesis 2 software (SS2, version 1.18) for their analyses. Several significant changes in the forecasting module were made to SS2 during the weeks just prior to the STAR panel review (upgrades from version 1.16 to 1.18). Consequently, the STAT teams were using a program that they were not fully familiar with, which sometimes impeded their ability to develop the model reformulations, alternate runs, and forecasts requested by the Panel. Furthermore, in light of the newness of the software, the Panel and STAT teams sometimes had difficulty interpreting results and model diagnostics. This problem should not be a factor in the future as the software stabilizes, and user familiarity improves. In general, the SS2 program is a major improvement over its predecessor and its author, Rick Methot, has done an excellent job at developing, documenting, and revising this software. Also, the STAT team members are to be commended for forging new ground with SS2, while operating under considerable pressure from scheduling deadlines.

### General comments on the flatfish assessments

The STAT teams undertook considerable effort to reconstruct the catch histories for petrale and English sole. The catch histories were taken much further back in time than had ever previously been considered in assessments for these stocks. The Panel felt that this was useful because starting from zero or very small catches seemed to provide more consistent estimates of unexploited spawning stock biomass ($B_0$), which is an important reference point for management purposes. However, analyses requested to evaluate sensitivity to the longer catch time series (detailed below) indicated that the catch reconstructions apparently had little effect on current status. In general it might be useful to conduct sensitivity analyses that vary the start-years for the catch time-series to confirm that assessment results are robust to variation in assumed or estimated historical catches.

Where model (SS2) estimates of $B_{MSY}$ were available, these tended to indicate that the Council's default reference points were more conservative, with the default minimum stock size thresholds (MSST; 25% of $B_0$) being much larger than the MSST values corresponding to the estimated $B_{MSY}$ levels. For example, the English sole assessment estimated that MSY occurs at a relative

biomass level of only 19% of $B_0$, which implies that this stock would be declared overfished (under current procedures) if it were reduced to the level that produces MSY.

The Panel found that the current projection capabilities of the SS2 software were limited in how future harvest levels could be specified. This became particularly apparent when compiling the decision tables for English sole, where it would have been useful to have had the facility to specify that the catch level in a single year should be the minimum of the 40-10 optimum yield (OY) catch or the average recent catch. Further, the software requires the user to input the future stream of landed catch, whereas the total catch (landings plus discards) is the more relevant quantity for management.

Recent Canadian flatfish assessments for British Columbia should be reviewed as a simple check on stock status; the possibility of integrating Canadian results into the current assessment should also be explored.

During reviews of the stock reconstruction tables Mr Peter Leipzig observed that the stock biomass estimates always fell during the initial years, even during periods when there were essentially no removals by fishing. The causes and interpretations of this phenomenon were discussed and explained. The initial stock size in the model is the equilibrium value that results from constant recruitment at the average level of annual recruitment, whereas during the modeled period, but prior to when the catch-at-age data have any influence, the recruitment each year is the median value, which is lower than the expected value due to the assumed lognormal recruitment variability. The modeled stock therefore undergoes a transition as it adjusts to the lower recruitment, even if there is little or no fishing. This highlighted a perceptual problem with presenting model output based on median levels for one period and expected values for other periods. The panel found that the important assessment results (e.g., the current spawning biomass relative to $B_0$) were calculated appropriately. Captions to the plots of biomass versus time should indicate that the initial stock size represents the expected value based on average lognormal recruitment.

Another scenario in which transient changes in biomass could occur, even though there are no changes in the rate of fishing, is if the fish growth rates changed over a period of time. For example, if growth slowed then stock biomass would decrease relative to the virgin level and fishing might be misinterpreted to be the cause of this "depletion". The issue of changing growth patterns and their impacts on stock reference points raises a general concern.

## Overview of the Assessment

The stock assessment for petrale sole off the U.S. West Coast treated these fish as two separate stocks, with a northern stock occupying the US Vancouver and Columbia INPFC regions and a southern stock occupying the Eureka, Monterey, and Conception regions. Both the northern and southern assessments separated the fishery data (landings and length- and age-composition) into distinct winter and summer fisheries to help account for the important seasonal trawl fishery that targets winter spawning aggregations of petrale sole. The primary tuning index for both assessments was the triennial bottom trawl survey, but trawl logbook CPUE indices were also included. For both the northern and southern stocks the survey and CPUE indices indicated significant upward trends in recent years. Both assessments used similar SS2 model configurations but the preliminary base model results initially presented to the Panel were quite

different in terms of stock trajectories and current status. The length- and age-composition data for the southern stock were much less complete than for the northern stock and discard data for the southern stock were only available for the most recent years.

During the week of the STAR review, petrale sole age composition data spanning the most recent six years (1998-2004) were made available to the STAT team by WDFW. It was not feasible for the STAT team to process these new data and incorporate them into the assessment model during the STAR review. Furthermore, a request to Oregon determined that otoliths from petrale sole landed in that state also were available and that about 1,500 structures could be read during the next few months. As a consequence, the assessment for the northern stock of petrale sole was withdrawn from the current STAR panel. It will be reviewed at the mop-up STAR panel in September 2005 after a revised assessment can be developed that uses the age-composition data from recent years. The current STAR panel developed a series of questions and recommendations for the STAT team to consider during its revision of the northern assessment.

**The Southern Assessment**

The southern stock of petrale sole has not previously been assessed. The 1999 assessment of petrale sole attempted to develop Stock Synthesis models for the southern fish (separate models for the Eureka and Monterey INPFC regions) but was unable to produce plausible models. The new assessment reconstructed historical catches back to the early 1900s and used assumed values to 1876 to begin the simulated stock from an unfished state. According to the reconstruction, more than 45% of the cumulative landings of petrale sole had been taken prior to 1960. The length and age composition data for the southern stock are limited and are unevenly distributed over time and space. The available biomass indices, from the NMFS triennial shelf survey and summer and winter CPUE indices from GLM analyses of trawl logbook data, all showed strong increases in recent years. The assessment estimated that the spawning biomass at the start of 2005 was 29% of the unfished level and had been below 25% since 1973 and reached lows of 6% in 1986 and 1993. Biomass increases in the most recent year were driven by an exceptional year-class in 1999 and strong year-classes in 1998, 2000, and 2001. The estimated MSY for the stock is about 1480 mt, well above the recent annual catches, which averaged 770 mt from 1981 to 2004. Recruitment since 1981, however, was below average during most years and the stock was unable to sustain the relatively small catches.

## I. Analyses Requested by the STAR Panel

During the first days of the STAR Panel review the Panel and STAT team expected that the northern and southern assessments would be completed together and described in a single stock assessment document. Most of the requests below pertained to both assessments.

***Note***: all requests were fulfilled to the satisfaction of the STAR Panel unless otherwise indicated below.

1. Fit the southern area model using the same sigma(R) as found for the northern area model (and set lambda=1.0).
2. Tabulate the likelihood components for all the sensitivity runs (and give likelihood units, not percentage changes).

3. Plot how survey predictions change for the southern area model between sensitivity runs with retention fixed versus estimated. Large likelihood changes were indicated from preliminary results.

4. Include the 1:1 line in graphs showing output versus input effective sample sizes.

5. Change the phase plot figure to have relative SSB on the horizontal axis and some measure of F on the vertical axis. SPR is fine as the measure of F if expressed as (1-SPR) so that as numbers increase on the vertical axis, they imply more fishing.

   Also include a similar plot showing changes over time (with a new base model).

6. Concerns were raised that Table 11A (page 52 of the draft assessment) had incorrect values for the retained catches.

7. The selectivity curves were highly dome-shaped, with a sharp drop-off for male petrale sole. Are there other explanations for the apparent absence of males? Are they dead?

   How has the sex ratio changed over time (in the data and in the model estimates)? This may be included as a topic for future research, perhaps linked to an exploration of differences in mean body mass-at-age between the sexes.

8. Survey catchability coefficients are quite different between the northern and southern area models. Do a run with the southern area model that uses the estimate of survey selectivity and q from the northern area model. Plot the predicted survey values between these two results.

   Results indicate a somewhat counter intuitive trade-off between the survey index (fit improves when q is fixed) and size composition (fit degrades, as expected, when survey selectivity is assumed to be the same as that estimated from the northern assessment).

9. Construct a plot comparing break-and-burn and surface lengths-at-ages.

   Results were discussed at length by the Panel (see 11 below and other comments).

10. Revise Supplemental Table 2 with the correct numbers. How to construct the decision table will be decided later.

    Progress on this aspect requires a satisfactory base model run. Issues related to the retention curve need to be resolved. Issues related to summer versus winter fishery selectivity and coincident retention rates also need to be resolved.

11. Fix the standard deviation vector that specifies the age-reading imprecision, which currently is input as a CV. Try using a higher value for a sensitivity analysis, e.g., use the surface-ageing vector of standard deviations.

    The panel found no data for specifying whether the CV should be equal to 0.06 or 0.12 (the options that were considered) and recommended instead using as an approximation the vector of standard deviations used from the surface-ageing method (where data were available). This vector gave CVs that were somewhat higher for the younger ages (~20% for age 5) and smaller for older ages (~11% for age 20).

12. Conduct a retrospective analysis (with 1998 as the terminal year) that uses a diffuse prior on the stock-recruitment relationship (other than the most recent recruitments). The objective is to see how estimates of stock-recruitment productivity may have changed due to recent estimates of strong recruitment levels at lower stock sizes.

The initial runs with this effect resulted in unsatisfactory results in that large shifts in the estimated retention curve seem to have a confounding influence. It was recommended that the STAT team redo this analysis with the retention curve fixed at a reasonable value and that the stock-recruitment steepness be initially seeded at a value of say 0.6 (and then estimated freely).

The following requests were made near the end of the STAR Panel review and were specific to the southern petrale assessment.

13. Use the same general base-case model configuration as the northern area model but eliminate the early discard data for the southern area model.

    The rationale for this is that the data pertain to the northern area and there are known market conditions ("medium petrale") that are unique to the southern fishery. Based on this market difference, the suggested change to the retention curve in the southern area model is to make the retention L50 6 cm smaller than the L50 from the northern area model.

14. As a second base-case include a change in selectivity at 1985 in the winter fishery.

15. Conduct sensitivity runs (relative to base-case #1 and base-case #2):

    a. With q set to the base-case q from the northern area model; and

    b. With q set to halfway between the base-case from the southern area model and that of the northern area model.

The new runs for the southern area model corrected some issues and raised some new ones. Foremost of the new issues was the indication that the discard data were interacting in a pathological way with the age and length composition data. The group discussed at length approaches to correct this problem and noted that it would be preferable in this case to assume the very small discard rates based on limited observations and inflate the landings to reflect this level. This would eliminate the spurious interactions between the retention curve estimates and fits to length and age compositions.

The group made the following final specifications and requests for the southern area model:

16. Eliminate discards from the likelihood component, add the appropriate amounts to the landings, and fix the initial length selectivity parameter for the survey selectivity curve. In previous runs the value for the initial survey length selectivity parameter was fixed at a positive value that produced inappropriate residual patterns.

Following the STAR Panel Review the STAT Team pointed out that it was inconsistent to include a retention curve in the model if the assumed discards were also included in the input landings data. After consultation with the STAR Panel Chair it was decided that the final southern are model should not include any retention curve.

17. Do a sensitivity run with two periods of selectivity (as before).

18. Do a sensitivity run with a natural mortality coefficient that is different for males. Based on Beverton (1992) a flatfish species with similar longevity as petrale sole had values for female M ranging from 0.17 to 0.25 per year and values for male M ranging from 0.2 to

0.3. The Panel therefore suggested doing a sensitivity run with female M specified at 0.2 (the default value, which will provide some consistency in female spawning biomass in the base-case configuration) and setting the natural mortality for males at a value of 0.25. The rationale for this sensitivity analysis is to improve the interpretation of the highly domed-shaped selectivity curves currently estimated for males in virtually all model runs.

The runs for these requests were not completed during the STAR. The Panel did not fully review results from the final base model during the STAR.

For constructing the decision table the STAR panel requested that the petrale sole STAT use a similar approach as had been requested of the starry flounder STAT, with alternative states of nature based on the triennial trawl survey catchability coefficient (75% of q, base-case q, and 133% of q) and with the following alternative management actions: catches equal to the recent 3-yr average, catches equal to 2 (or 3) times the recent 3-yr average, and catches equal to the 40:10 OY values.

## II. Comments on the Merits or Deficiencies of the Assessment

This section will be completed after the Panel has had an opportunity to review the revised assessment document.

## III. Areas of Disagreement Regarding STAR Panel Recommendations

There were no major disagreements among the STAR Panel members nor between the Panel and the STAT team or other participants.

## IV. Unresolved Problems and Major Uncertainties

This section will be completed after the Panel has had an opportunity to review the revised assessment document.

## V. Recommendations for Future Research and Data Collection

- A number of age-structures have been collected during surveys but have not been aged. Prior to the next assessment, these structures should be inventoried and sampled appropriately for subsequent age determinations.
- The STAT team developed figures showing the relationship between surface and break-and-burn age but there should be further work to better quantify the relationship. Some large differences in mean length-at-age between the methods and areas were observed.
- The ageing-errors for the break-and-burn age data are currently based on surface age data. They should be evaluated separately for inclusion in the revised northern area assessment to be presented later in this assessment cycle.
- Factors influencing length-at-age of petrale sole should be investigated. For example, spatial and/or temporal factors may affect size-at-age differently and understanding these patterns will improve model implementation.
- Discarding practices may have changed in recent years and data are limited on where and when this may have occurred. Information on the size composition of discards should be collected and analyzed from the groundfish observer program.

- CPUE data used in the GLM analysis may have been affected by changes in regulations during the recent period. The CPUE data should be more thoroughly explored to better understand the effects of regulations.
- Future GLM analyses of CPUE data should use finer spatial cells and weight the cells by area. Vessel standardization should also be considered.