PETRALE SOLE

STAR Panel Report

May 4-8, 2009
Northwest Fisheries Science Center
Hatfield Marine Science Center
2032 SE Oregon State University Drive,
Newport, OR 97365

Reviewers:
Robin Cook, Center for Independent Experts
Xi He, Southwest Fisheries Science Center
Jean-Jacques Maguire, Center for Independent Experts
Theresa Tsou (Chair), Scientific and Statistical Committee (SSC) representative

Advisors:
John DeVore, Pacific Fishery Management Council (PFMC) representative
Dan Erickson, Groundfish Management Team (GMT) representative
Brad Pettinger, Groundfish Advisory Subpanel (GAP) representative

STAT Team Members present:
Melissa Haltuch, Northwest Fisheries Science Center
Allan Hicks, Northwest Fisheries Science Center

Overview

A draft assessment of the coastwide petrale sole (*Eopsetta jordani*) off the U.S. west coast was reviewed by the STAR panel during May 4-8, 2009. This assessment used the Stock Synthesis platform version 3.03a and incorporated a variety of data sources into the candidate base model. Data from commercial trawl fisheries included landings, discards, and age and length composition data. Abundance indices used in the model were a standardized CPUE index of the Oregon trawl fleets from 1987-1997 from Sampson and Lee (1999), the triennial shelf trawl survey (1980-2004), and the NWFSC shelf/slope trawl survey (2003-08). Biological information collected from both trawl surveys was also included.

Petrale sole was last assessed in 2005. Significant differences in data sources and model configuration between the 2005 and current assessment include:

- A coastwide model instead of separate north and south assessments in 2005;
- Reconstructed historical catches from California and Washington;
- An updated ageing error matrix;
- Incorporation of the NWFSC shelf/slope survey;
- Direct inclusion of discard information from Pikitch et al. (1988) and from the West Coast Groundfish Observer Program.

Multiple model runs were conducted and reviewed to examine model assumptions and structure, and to identify uncertainties in the assessment. The panel noticed that the estimates of B_0 and 2009 biomass are very sensitive to the assumption of the stock recruitment relationship and the 2008 NWFSC survey data. While the current stock status with reference to B_0 is notably different among model runs, the B_{MSY} estimate remains consistent. The panel is concerned that the 25% B_0 minimum stock size threshold (MSST or overfished threshold) proxy is highly uncertain because both B_0 and $B_{CURRENT}$ are highly uncertain in this assessment. Therefore, the panel recommends that reference points based on MSY are investigated as an alternative MSST. . The Panel notes that catches since 1951 have been fluctuating around MSY. The spawning biomass has largely been in the precautionary zone since about 1958 with the exception of a few years above B_{MSY} in the mid-1970s, and a series of years below B_{MSY} between the late 1980s to mid-late 1990s.

The STAR panel concluded that the petrale sole assessment was based on the best available data, and that this new assessment constitutes the best available information on petrale sole off the U.S. west coast. The STAR panel thanks the STAT team for their willingness to respond to panel requests and their dedication in finding possible solutions to difficult assessment problems.

Analyses requested by the STAR panel

1. **Split the triennial survey due to changes in starting date.**
   Rationale: The difference in the timing of the surveys, approximately one month later since 1995, is expected to result in a change in catchability of petrale sole because of its seasonal onshore-offshore migrations.

Response: Splitting the survey improved the fit marginally and the resulting catchability coefficients (q) were 0.51 for the early time series of the survey and 0.71 for the later time series of the survey. The selectivity curves for the NWFSC shelf/slope survey also changed marginally.

2. **Plot the biomass trends from the 1999, 2005 and current assessments to compare the differences.**
   Rationale: This is a standard request to put the results of the current assessment in the context of previous ones. This was seen as particularly important for petrale sole given the changed perception in stock status.
   Response: The biomass trajectories in the 1999, 2005 and the current assessments for 1980 to 2000 period are very similar and the confidence intervals for B_0 estimates in the 2005 and current assessments overlap. The 1999 and 2005 assessments suggested that biomass was increasing at the time of each assessment; while the current assessment indicates that biomass peaked in 2005 and has been decreasing since. The ratio of $B_{current}$ to B_0 (depletion) was higher in the 1999 assessment because the estimate of B_0 was smaller, largely due to the fact that historical catches back to 1976 were incorporated in the 1999 assessment and historical catches back to 1876 were incorporated in the 2005 and current assessments. The estimated 2005 depletion from the 2005 assessment is within the confidence interval of the estimated 2005 depletion from the current assessment.

3. **Remove all data related to 2008 NWFSC shelf/slope survey.**
   Rationale: The objective of this request was to evaluate the influence of the 2008 NWFSC survey data.
   Response: Removing the 2008 NWFSC survey data significantly increased the estimate of current biomass, decreased the estimated recruitment strength of the 2005 year class, and increased the recruitment strength of the three previous year classes from lower than average to average recruitment by losing the signal for the 2005 year class. The estimated current depletion changed from 0.14 to 0.24 due to a higher estimated 2008 biomass.

4. **Use a Ricker stock and recruitment relationship.**
   Rationale: The Beverton-Holt stock recruitment curve is the standard choice for most assessments but there is no specific evidence to support this model over others for petrale sole. This species is an ambush predator and it could be hypothesised that the habitat available for young petrale sole to settle could become limited at high adult stock size. There is a high potential for density dependence, though no direct evidence for it. This request is to test and evaluate the influence of the assumed stock-recruitment relationship.
   Response: Assuming a Ricker relationship provides a very similar fit to the Beverton-Holt assumption for the 1954 to 2008 time period, but the B_0 estimate is substantially lower. Because of the lower B_0, the ratio of $B_{current}$ to B_0 was higher. MSY estimates were very consistent under both stock-recruitment assumptions.

5. **Start assessment in 1939 and estimate initial F/depletion.**
   Rationale: Catch estimates prior to 1939 are more uncertain than those since. Size information is scarce before the 1960s and reliable fishery-independent abundance estimates start in 1980. Also, 1939 was the earliest reliable estimate for catches in Washington.
   Response: Three ways of doing this were explored: 1) start with an equilibrium catch and estimate initial equilibrium Fs; 2) start with an equilibrium age structure and estimate a multiplier on initial recruitment; and 3) start at a virgin, equilibrium state. All 3 options showed similar trends. The panel concluded that the current biomass trends were similar and MSY estimates were robust across these assumptions. Because the starting year did not make a difference in the results, the panel decided to initiate the assessment in 1876 when the first historical catches of petrale sole were documented.

6. **Allow selectivity functions to deviate without assuming blocks.**
   Rationale: The panel wanted to evaluate patterns and / or trends in fishery selectivity over time rather than using blocks.
   Response: Allowing smooth changes in fishery selectivities using annual blocks seemed to chase recruitments. The panel initially thought that time blocks on fishery selectivities were not necessary, but, under a no-time block structure, patterns in residuals appeared worse and the Hessian matrix did not invert. The panel finally decided on ten-year blocks starting in 1973. Results from a five-year blocking structure starting in 1973 were more variable and less parsimonious.

7. **Profiling on the length at minimum age.**
   Rationale: The panel wanted to test the influence of size at minimum age and investigate the effects of external estimates of growth.
   Response: The model-estimated length at minimum age seemed to explain the data better. Externally-estimated L_{MIN} resulted in a larger B_0 estimate and a lower current depletion of 4%. The model fit was degraded and the data did not support externally estimated parameters.

8. **Plot summer fishery CPUE and NWFSC survey biomass on same graph.**
   Rationale: The panel requested this plot to make it easier to directly compare these indices.
   Response: When plotted on the same graph and scales, the correspondence was seen to be very similar in recent years, especially for the Washington portion of the catch. There was a slight time shift in the peak values for Oregon and California fisheries CPUE compared with the survey. The panel concluded that future exploration of the Summer CPUE series as an index of abundance may be warranted.

9. **Provide the actual catch values for the big tows in NWFSC survey.**
   Rationale: The panel wanted to get an appreciation for the magnitude of petrale sole tows during the survey.
   Response: The STAT presented the top ten tows in the surveys, which ranged from 76 to 747 kg resulting in density estimates of 4 357 to 53 085 kg/km^2.

10. Provide the data informing the length at maturity relationship.

Rationale: The panel wanted to get an appreciation for how well the maturity model from Hannah et. al (2002)[1] fitted the macroscopic and microscopic observations of maturity.

Response: The panel was satisfied that the data supported the length at maturity relationship used in the model.

11. Provide the historical Washington catch data used to interpolate historical catches during the 1930-1950 period.

Rationale: The reconstruction of historical Washington catch estimates is one of the reasons for the difference between the 2009 and the 2005 assessments. The panel wanted to see if different interpolations could have been possible.

Response: The data were presented and the panel concluded that sensible catch interpolations had been done.

12. Plot the catch series used in the 2005 and current assessments.

Rationale: The panel requested these plots for direct comparison of catch histories used in these assessments.

Response: The panel could not evaluate the catch data directly; however, it was concluded that the new catch series should be used.

13. Check the maximum length in surveys and compare with the maximum length in the winter fishery.

Rationale: The commercial length frequencies seemed to show more larger fish than captured in trawl surveys and this could have implications for estimated fishery selectivities.

Response: A plot of the proportions at lengths greater than 50 cm showed that the maximum lengths in the surveys and winter fisheries were similar.

14. Reduce effective sample sizes for survey data.

Rationale: The panel wanted to see the effect of giving less weight to survey data.

Response: Reducing the effective sample sizes of survey data by half did not significantly affect selectivities nor other results.

15. Provide the estimated growth parameters from other studies or assessments.

Rationale: The panel was concerned that estimated growth parameters in the model and fishery selectivities could potentially be confounded, i.e. it could be growth rather than selectivity that varied over time..

Response: Estimated growth parameters from other studies were provided and were similar to those estimated in the model. The panel therefore concluded that there was no reason to assume alternative growth functions from other studies.

---

[1] Hannah, R.W., S.J. Parker and E.L. Fruth. 2002, Length and age at maturity of female petrale sole (Eopsetta jordani) determined from samples collected prior to spawning aggregation. U.S. Fish. Bull. 100:711-719.

16. **Explore the areal expansion used to expand survey results to estimate biomass.**
    Rationale: The panel was concerned that the areal expansion may have included areas where petrale sole are not found.
    Response: The habitat areas used by petrale were not available. The petrale sole densities are therefore expanded to the entire area surveyed which may contain habitats that are not suitable for petrale sole.

17. **Plot recruitment deviations in log space without error bars since 1939 for the base model and under requested sensitivity runs (i.e., no time blocking of fishery selectivities and start the fishery in 1939).**
    Rationale: The panel wanted to see how the various runs compared to understand the sensitivity of recruitment estimates to assumptions regarding time-varying fishery selectivity and the historical catch prior to 1939.
    Response: This graph was provided for all requested runs and showed a similar pattern of recruitment deviations, especially from 1970 to present.

Description of base model and alternative models used to bracket uncertainty.

The final base model uses data from the beginning of the fishery in 1876. The model estimates separate selectivity curves for 1876 to 1972, 1973-1982, 1983-1992 and 2003-2008, splits the triennial survey in 1995 into two series and assumes a Beverton-Holt stock recruitment relationship. A sensitivity run assuming a Ricker stock-recruitment relationship showed very similar trends in biomass estimates from the early 1950s to 2008, but a substantially smaller B_0. This resulted in a higher ratio of $B_{current}$ to B_0. A second sensitivity run excluded the 2008 NWFSC survey data, which resulted in a markedly higher biomass estimate for 2008 and, consequently, a higher $B_{current}$ to B_0 ratio. A final sensitivity run assigned half the effective sample size to the survey length composition data, which resulted in no significant change to the base model results.

Comments on the technical merits

The current assessment and the 2005 assessment provide similar biomass and depletion trajectories, with overlapping confidence intervals and similar estimates during the 1980-2000 periods. The 2005 assessment suggested that biomass was generally increasing through 2005 while the current assessment indicates that the stock has been declining since the peak biomass in 2005. While the 2005 assessment indicated that the stock was not overfished in 2005 and that overfishing was not occurring it did show that the stock had been below the minimum stock size threshold (MSST) for much of the previous three decades and had only increased above the MSST during the previous 1-3 years. Both the current and 2005 assessments agree that that stock declined below the B40% reference point during the 1950s to an all time minimum stock size during the early 1990s, followed by increases in the stock up to 2005.

The petrale assessment was thorough, with no major flaws, and well investigated with all requested sensitivity runs provided. The document was clear and well written.

Explanation of areas of disagreement regarding STAR panel recommendations:

A. Among STAR panel members (including concerns raised by GAP and GMT representatives); and

There were no areas of disagreement among STAR panel members, though concerns were raised regarding the estimated *q* value for the NWFSC shelf/slope survey. The panel regards the *q* value as a scaling factor and noted that biomass was expanded to the whole survey area in the depths petrale occur while it is unlikely the whole area represents petrale habitat. Potential differences in growth between the northern and southern substocks may need further exploration given that the 2005 assessment estimated higher growth rates for the southern substock than for the northern substock. However, there are no recent age data available from California fisheries to better explore these potential differences.

B. Between the STAR panel and STAT team:

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

Unresolved problems and major uncertainties

The choice of an assumed stock-recruitment relationship is uncertain in the petrale sole assessment. While there are theoretical reasons to expect a Ricker stock-recruitment relationship, there is insufficient evidence to choose between Ricker and Beverton-and-Holt, and the panel defaulted to the more commonly used B&H relationship. Choosing a Ricker relationship, however, would result in a lower B_0 estimate and thus higher $B_{CURRENT}$ to B_0. The difference in perception is smaller if MSY – based reference points are used.

The q estimated for the NWFSC shelf/slope is approximately 6 times higher than that for the AFSC triennial surveys. Higher catch rates were observed in the NWFSC survey when compared to the Triennial survey, and even though some of the difference can be explained by gear design and the NWFSC survey ability to move around rocks, further investigation is needed

The model is sensitive to the 2008 survey data and removing the 2008 survey data results in a markedly higher 2009 biomass estimate.

While the STAT addressed aging errors, uncertainties in age-composition remain important.

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

The history of key management changes was provided and was useful in ground-truthing historical catch reconstructions and time-blocking fishery selectivities. The details regarding development of the fishery were provided and important events were identified.

Prioritized recommendations for future research and data collection.

- The comprehensive catch reconstructions currently underway in Washington and Oregon need to be completed. The mixing of U.S. and Canadian catches is of particular concern for the Washington fleet. The break-and-burn aging technique is recommended for determining petrale ages because it was estimated to be less biased than surface-read ages through a bomb radiocarbon age validation study.

- The current assessment platform (SS3) is structurally complex, making it difficult to understand how individual data elements are affecting outcomes. The panel recommends investigating simpler, less structured models, including statistical catch/length models, to compare and contrast results as data and assumptions are changed.
- Expand the stock assessment area to include Canadian waters to cover the entire biological range of petrale sole.
- The abundance vs. survey depth plot suggests that the highest summer densities of petrale sole are inshore of the survey area. Expanding the survey area inshore or implementing a new nearshore survey is recommended.
- A winter shelf/slope survey would be particularly valuable for a stock like petrale with seasonal onshore-offshore migrations.
- A management strategy evaluation is recommended for petrale sole because the estimates of B_0 and $B_{current}$ are sensitive to the assumed stock-recruitment relationship, making these reference points more uncertain, while B_{MSY} estimates are consistent among all the model run results. The usefulness of the Summer CPUE series as an index of abundance should be evaluated.