English Sole

STAR Panel Report

Northwest Fisheries Science Center

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STAT Team Members Present:

Ian Stewart, NMFS, NWFSC, Seattle, WA

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

English sole were assessed as a single stock ranging from Conception to the Canadian border. The stock had not been assessed since 1993 and never on a coastwide basis. The assessment reconstructed historical catches bask to the early 1900s and used assumed values to 1880 to begin the simulated stock from an unfished state. More than half of the cumulative landings of English sole had been taken prior to 1960. For data analysis purposes the stock was divided into two areas, north and south, split at the boundary between the Eureka and Monterey INPFC regions, with the bulk of the catch coming from the north area. The only abundance data used in the assessment was the triennial shelf bottom trawl survey index, which generally has been increasing since 1980 and increased markedly for 2004 for both the north and south areas. Due to strong recent recruitments the current status of this stock is estimated to be very healthy, about 90% of the virgin biomass. Although the stock was beneath the overfished threshold (25% of B_0) for a few years around 1990, this appeared to be mostly due to natural variation and not fishing pressure.

I. Analyses Requested by the STAR Panel

Note: all requests were fulfilled to the satisfaction of the STAR Panel.

First Round of Requests

1. Plot curves showing “early” and “recent” female growth, including some observed length-age data. Also show early and recent size at 50% maturity on this graph.
2. Plot base-case and sensitivities with M = 2 * M' and M = M' / 2 where M' is the base-case scenario of fishing rate versus spawning stock biomass in the terminal year.
3. Do a run with an aggregated survey rather than separated by north and south.
4. Plot survey biomass along with model estimated survey biomass.
5. As a retrospective analysis, plot past assessments results with the north segment results from this new assessment.
6. Tabulate over time (and projected if possible) what fraction of the mature stock is say, age 8 and older.

   The rationale for this is to evaluate how much of the spawning stock in the near term comprises recent recruitments (compared to some average value under no fishing). Given the strong 1999 year class the results indicate that the projected distribution of ages comprising the spawning biomass was fairly broad, in which case there will be a number of ages that contribute importantly to the spawning biomass in the near term (rather than a large fraction consisting of the 1999 year class).
7. The decision table should include a low catch sequence (such as the recent 3-yr average), and a high sequence (the OY 40-10 rule) and a median sequence (e.g., two times the recent 3-yr average).

Follow-up requests

8. Include in the decision table a new “state of nature” that encompasses the lower bound of the uncertainty from the base-case and include a table that lists likelihood components and key parameters associated with this new state of nature. This lower bound is based on a minimal variance (and hence the probability of this lower stock size is greater than indicated by the delta-method variance estimates for current (2005) spawning biomass levels). One approach suggested for generating this new state of nature is to constrain recent recruitments to tend toward their expected values. The intent is simply to approximate the uncertainty range, because a full Bayesian posterior was unavailable. Note that for the purposes of evaluating risk of depleting the spawning biomass, only the lower bound was explored.
9. Conduct a sensitivity analysis on the period of poorly determined catch by increasing those estimates by 50%, in case significant discarding or under-reporting had occurred.
10. Include estimates of depletion levels and spawning biomass in the decision table.

Other issues

11. Compute the proportion of the stock in the north as $qN / (qN + qS)$ for qualitative comparison of the northern (ODFW) flatfish survey from 1977. The results from this

exercise were encouraging in that this flatfish survey estimate, which was not used in the model, fell close to the model prediction.

12. Run a sensitivity analysis with aggregated survey data included and produce a table so that the resulting trade-offs in likelihood components can be evaluated.
13. Include error bars in the phase plot that show the uncertainty with the base-case.

II. Comments on the Merits or Deficiencies of the Assessment

The data and analyses presented in the assessment all indicate that the English sole stock is currently growing robustly and could sustain higher levels of harvest than it has experienced in recent years. There has been a period of strong recent recruitments, including a strong 1999 year-class. The results indicate that the projected distribution of ages comprising the spawning biomass was fairly broad. A number of cohorts will contribute to the spawning biomass in the near term and the forecast of continued stock growth does not rely solely on a single year-class.

The STAT team took the unusual step of incorporating changes over time in the parameter that determines the length at which 50% of the females attain maturity. Previous assessments of several West Coast flatfish species have noted apparent changes in the maturity versus length relationship but the previous versions of Stock Synthesis did not permit time-variation in the maturity-length curve. The STAT team had thoroughly reviewed reports on the historical and more recent studies and could find no reason to dismiss either set of results. However, if the maturation process is related to age rather than size, then estimates of the maturity versus length relationship could be biased, with the estimates of length at 50% maturity being artifacts of the population age-structure present at the time of the studies.

Because the English sole stock is currently very large, and growing, the fishery could remove extraordinarily large catches of English sole during the next ten years, but it seems implausible that there would be markets for such large landings of this species. As a consequence the decision table developed in the assessment is "one-sided" and only considers alternate states of nature that are less productive than the base case.

The STAR Panel accepted this assessment and noted its high quality, which was the result of exhaustive data preparations and analyses. The STAR Panel commends the STAT team for its excellent work and extremely cooperative attitude during the course of the STAR Panel review.

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 teams or other participants.

IV. Unresolved Problems and Major Uncertainties

The STAR Panel agreed with the STAT team's conclusion that the strength of the 1999 year-class was the greatest source of uncertainty about the current status of the stock and the stream of catches that the stock could sustain in the short term. If age composition data from recent years had been available, the uncertainty would have been greatly reduced.

Regarding the long-term productivity of the stock and the assessment's estimates of MSY and B_{MSY}, some members of the STAR Panel were concerned that the large reduction in the length at 50% maturity that was imposed in the model, and the corresponding change in growth estimated by the model, may not be real phenomena. The causes for such a large apparent shift in the maturity versus length relationship bear closer scrutiny. Also, if the maturity relationship in English sole should revert to its former state, in which the fish recruit to the fishery before they attain maturity, then there is much greater potential that current levels of harvest would result in overfishing.

Given that very large quantities of small English sole are caught and discarded (estimated by the model to range from 35% to 40% during the 1980s), the lack of good data on the length compositions of discarded fish, to indicate how the discard (retention) curve may have changed over time, is a large source of uncertainty in the assessment. Without such information it is essentially impossible to disentangle changes in retention from changes in the ascending limb of the fishery selection curve.

V. Recommendations for Future Research and Data Collection

1. A large number of English sole age-structures have been collected during the trawl surveys and from the fisheries, but the structures have not been aged. Future assessments of this stock would greatly benefit from having available more age composition and conditional age-at-length data. Age composition data from the trawl survey, in particular, could provide important evidence of year-class strength, which is generally lost from the fishery data because of the size-related discarding.
2. Estimates of the length compositions of discarded fish should be made available from observer programs and historical records, if available.
3. Collection and analysis of maturity data should be enhanced. The analyses should consider maturity as both a function of size and age to evaluate whether the maturity versus size relationship in English sole is subject to distortion when strong year-classes pass through the fishery.
4. Canadian assessments of more northerly English sole stocks should be reviewed as a simple check for comparative biomass trends. The possibility of integrating Canadian results into the US West Coast assessment should be explored.
5. Future assessments should explore alternative approaches for capturing uncertainties in estimates of current stock size (e.g., profile likelihoods or MCMC evaluations).
6. Habitat mapping data should be used to estimate the amount of English sole habitat area inside of 55 m for the southern and northern areas. Differences in the amount of available habitat in the south versus the north could provide a plausible explanation for the unusual result in the current assessment that the estimates of survey q in the southern area were lower than in the northern area.

7. Given the strong sexual dimorphism in growth of English sole, the next assessment for this stock should evaluate sex-specific natural mortality rates, as was done for starry flounder in the current cycle of assessments. Sexual dimorphism in natural mortality is an important life-history feature in many species of flatfish.