Pacific Sanddab

Stock Assessment Review (STAR) Panel Report

NOAA Fisheries, Southwest Fisheries Science Center
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Overview

The Pacific Sanddab STAR Panel (Panel) met in Santa Cruz, California during 5-9 August 2013 to review a draft stock assessment of Pacific sanddab (*Citharichthys sordidus*) off the U.S. west coast, prepared by the Pacific sanddab stock assessment team (STAT). Tom Jagielo (Panel Chair) welcomed participants, reviewed the Pacific Fishery Management Council's (PFMC) *Terms of Reference for the Groundfish Stock Assessment and Review Process*, and discussed logistics for the Panel meeting. Dr. Beatriz Roel agreed to serve as rapporteur.

The draft assessment document and extensive background material (previous assessments, previous STAR Panel reports, etc.) were provided (via the PFMC FTP site) to the Panel two weeks in advance of the Panel meeting. The FTP site was also used for common access to all presentation material and the additional model runs that were conducted during the course of the Panel meeting.

Dr. Xi He led the presentation of the draft assessment document, and together with Dr. John Field presented subsequent analyses carried out during the week.

This is the first stock assessment for Pacific sanddab. The assessment was conducted using Stock Synthesis (SS, version 3.24O, April 2013) (Methot and Wetzel 2013). The assessment assumes a single stock and four fisheries: 1) two commercial trawl fisheries, 2) one recreational fishery, and 3) one trawl fishery for mink food. Survey and index data included: 1) the Northwest Fisheries Science Center (NWFSC) triennial bottom trawl survey (split in two periods), 2) the NWFSC bottom trawl survey, and 3) a California Commercial Passenger Fishing Vessel (CA CPFV) fishery catch-per-unit-effort (CPUE) index. Multiple model runs were conducted and reviewed to examine model assumptions and structure, and to identify uncertainties in the assessment.

This first assessment of Pacific sanddab represents an extensive modeling effort; however, it did not result in a quantitative estimate of depletion as a measure of stock status. During the STAR Panel meeting, it was not possible to reconcile the extremely high discrepancy between swept area and model-based biomass estimates. Thus, the STAT team and STAR Panel could not be confident in model estimates of biomass. It is noteworthy, however, that all model scenarios presented indicated a healthy stock status. Further, if the survey estimates of biomass and historical catches are correct, the stock is lightly exploited.

The Panel commends the STAT team for their presentations, willingness to respond to the Panel's requests for additional analyses, and their dedication in finding possible solutions to difficult assessment problems. The SWFSC and PFMC staffs are thanked for arranging the meeting facilities, hotel accommodations, and the FTP site containing the background materials.

Discussion and Additional Analyses Requested by the STAR Panel

Request 1: Compare growth differences between Arora (1951) and Lefebvre (2013) or simply compare mean length-at-age.

Rationale: Noteworthy differences in size-at-maturity were reported in the two studies. The STAR panel wanted to examine the possibility that size-at-age may also have changed with time.

Response: A definitive comparison could not be carried out since the ageing methodology is not comparable: Arora (1951) used scale widths to age sanddab while Lefebvre (2013) used otoliths. Thus, the mean size-at-age data may not be directly comparable. There is no strong evidence of a dramatic difference in growth between the two studies with the exception of ages 1 and 2. However, the smaller length-at-age in ages 1 and 2 may be explained by differences in timing of sampling.

Request 2: Run a new base model with: 1) the new recreational CPUE index, 2) the revised mink food fishery catches, 3) a retention time block at 2011, 4) empirical discard estimates for recent years, and 4) the 2003 OR/WA discard rate estimate removed. All additional exploratory analyses should use this base model.

Rationale: These data changes are technical fixes to the model and, in the case of the 2003 discard rate estimate, provide a better fit to the discard estimates. Approximately 100% of the 2011-2012 trawl fishery was observed; therefore, model-estimated discard rates should not apply.

Response: the new candidate base model was modified as requested. A change regarding the use of empirical discard estimates was implemented for both 2011 and 2012; however, it was necessary to base the discard rate for 2012 on 2011discard rates.

Request 3: Conduct a sensitivity run for the pre-1930s CA catch history by doubling and halving the CA trawl catches prior to 1930.

Rationale: Explore model sensitivity to uncertain historical catches.

Response: The STAT team presented results for doubling and halving the pre-1930s CA catch. For the double catch runs, the results indicated higher R0 and M values compared to the base model; further, the SSB trajectory was scaled up and depletion increased. Reducing the catch by half did not make much of a difference. Apparently, the model needs to increase the biomass substantially to be able to accommodate the composition data.

Request 4: Clarify that the mesh size study data used in the model (Wallace et. al. 1996) were filtered adequately to inform fishery discard rates and catch composition.

Rationale: Justify whether these data are appropriate to be used in the assessment.

Response: the STAT team clarified that no discard rate data from the mesh size study were used. The STAT team revised the base model by dropping two rows of composition data for 1990 (OR and WA). The STAR Panel supported this change in the base model. Dropping the data resulted in 1) substantial changes in R_0 (which increased from 11.4 to 12.28) and 2) larger uncertainties in biomass estimates. The STAT team indicated they will further investigate the effects of these changes.

Request 5: Justify why only triennial survey index data were removed in the sensitivity run, but not the length composition data. Explore removing the length composition data as well.

Additionally, provide a sensitivity run removing the early triennial survey index and composition data.

Rationale: To explore the overall influence of the triennial survey.

Response: Justification was presented for retaining the triennial survey composition data in the base model. The STAT team indicated that the composition data are less influenced by sampling designs, gear, etc. while it provides important information to the model. Further, that they are the only sex specific length composition for years prior to 1995. Results were presented for Run 5a where both the index and the composition data for the early period were removed. This resulted in a somewhat higher SSB with much larger uncertainty. For Run 5b, where both series were removed (early and late), the results showed similar trends to the base model although the uncertainty was reduced. It appears that there is an interaction between the two sets of triennial survey data which was not explained at this point.

Request 6: Test the influence of the fishery age composition and survey conditional age-at-length data by 1) removing the age composition data, 2) fixing growth parameters from the base model and removing conditional age-at-length data, and 3) fixing growth parameters from the base model and removing all of these data, to explore reasons for the variable scale of the SSB.

Rationale: Examine the influence of the age composition data on the estimated SSB.

Response: The STAT team provided the results from three runs that illustrated the impact of the age composition data on the results. Removing the conditional age-at-length data makes a big difference to the population scale; however, removing the marginals does not.

Request 7: Profile on $\ln(R_0)$ with each likelihood component (by fleet, survey, and data component).

Rationale: To understand which components are most influential on the estimated scale of SSB.

Response: This request was deferred until an acceptable base model is developed.

Request 8: Simple production model to test R0 scale.

Rationale: to explore the impact of age and length composition data on the model scaling.

Response: An age structured production model (where recruitment is deterministic) resulted in a small scaling change, and a change in the timing of the decline in recent years. Depletion increased compared to the base model.

Request 9: Using the new base model (incorporating the provisions from Requests 2 and 4, and using the 2011 trawl discard rates for 2012 for both CA and OR/WA fleets), provide a run exploring a Lorenzen M or some other modeling structure to allow higher Ms for younger fish. Show the total likelihood, including the number of estimated parameters.

Rationale: This is consistent with the NMFS Natural Mortality workshop recommendations and allows exploration of how this modeling treatment affects the scale of the population.

Response: The survey catchabilities for the Wednesday base were provided for reference, The values of Q were: 1) NWFSC 19.4, and 2) Triennial 4.8 (early); 13.6 (late). A set of runs were carried out assuming a Lorenzen M reference age from 1 to 5 (R1 to R5). The results indicated that SSB and R0 increased as reference age increased, as expected. This exercise did not resolve the discrepancy between the NWFSC trawl survey and the model estimated biomass estimates of population scale.

Request 10: Provide a sensitivity analysis that allow dome-shaped selectivity for all surveys except for one fishery (which selects for the largest fish), which should remain asymptotic. M should be fixed according to the new base model. Provide fits to the composition data aggregated across all years. Show the total likelihood, including the number of estimated parameters.

Rationale: This analysis may provide a better understanding of the role of asymptotic selectivity on biomass scaling.

Response: The following runs were carried out:
Run10: dome-shaped allowed for all fleets and surveys except for the CA fleet.
Run10a: dome-shaped allowed for all surveys, all fisheries asymptotic
Run10b: dome-shaped allowed for all surveys and fleets.
The results indicated that Runs 10 and 10a had similar SSB trajectories. Run 10b resulted in much higher biomass. Examination of the resulting selectivity curves suggested that the there is little information in the data indicating a dome shape selectivity. Selectivity in this case was functionally asymptotic; R0 went up but this is likely to be because of M being high (0.7). The STAR panel noted that trying to concurrently estimate all dome shape selectivities and M resulted in parameter confounding.

Request 11: If requests 9 and/or 10 do not result in significant changes to model results, provide these runs with removal of conditional age-at-length (fix growth parameters according to the new base model).

Rationale: This will provide better insight into the parameters affecting biomass scale.

Response: the STAT provided the results from 3 model runs; the resulting catchabilities for the NWFSC and triennial (early and late) surveys are provided under Q as follows:
Run11a (Run9-R1, Lorenzen M, R1): Q=12,2, 4.5, 9.5; ln(R0)=15.0,
Run11b (Run10: dome shape selectivity except for CA) Q=5.21, 2.58, 4.58
Run11c (WedBase): Q = 4.2, 1.9, 3.7, M = 0.70, 0.81; ln(R0) = 15.21; h= 0.8.
Run 11c made a noteworthy difference to the SSB (scaling it up substantially), while run 11b resulted in an intermediate result between 11a and 11c. The STAR Panel concluded that the conditional age-at-length information appears to have a disproportionate effect on the population scale in the model.

Description of Base Model and Alternative Models Used to Bracket Uncertainty

The final base model: 1) included the new recreational CPUE index, 2) used the revised mink food fishery catches, 3) put a retention time block at 2011, 4) assumed the discard rate in 2012 was equal to the discard rate in 2011, 5) removed the 2003 OR/WA discard rate estimate, and 6)

removed the Wallace (1996) mesh size study length composition data.

The model assumed the stock was in an unfished condition in 1888 and subject to exploitation by the four fisheries modeled in the assessment. Two sexes were used in the model given evidence of sexually dimorphic growth. The assessment also assumes sex-specific natural mortality and a sex-specific length-weight relationship. Natural mortality was assumed to be constant for all ages for each sex. Key assumptions in the base model included the following: 1) the Beverton-Holt stock-recruit function; 2) asymptotic, sex-specific, time-invariant selectivity functions for all fleets and surveys; and 3) time-invariant catchability coefficients (Qs) for all surveys. The assessment assumed that reported catches, by all commercial and recreational fleets, were accurate, especially in recent years, and that historical catches of Pacific sanddabs might not be well recorded.

The likelihood components included in the assessment model are: catches, discards, indices, length and age compositions, recruitment deviations, parameter priors, and parameter soft bounds.

Changes were made to the input data during the STAR panel, including the following:
  • the revised mink food fishery catches,
  • a 2011-2012 discard rate based on empirical discard estimates for 2011 (imposed by putting a retention time block in 2011);
  • removal of the 2003 OR/WA discard rate estimate; and
  • removal of the length composition data from the Wallace (1996) mesh size study.

The final base model estimated a very low stock biomass compared to the estimates from the trawl surveys. The difference between model and trawl survey estimates of biomass (almost an order of magnitude) triggered further investigation. Subsequent analyses (e.g., sensitivity analyses and likelihood profiles over recruitment at virgin biomass, R_0) were directed at identifying factors that could be influential in scaling this parameter.

Alternatives explored include:
  1. structuring the triennial survey as one continuous survey;
  2. selectivity functions allowed to be dome-shaped;
  3. an alternative model that changed the start year of the model to 1970;
  4. re-parameterizations that incorporated Lorenzen M;
  5. removing various compositional data and conditional ages; and
  6. models with an emphasis placed on the trawl surveys and an informative prior on survey Q.

Comments on the Technical Merits of the Assessment

The STAR panel lauded the STAT for a detailed analysis of input data and model performance. As the first stock assessment for this species, the selection and analyses of the input data were thorough and appropriate. The fit to the primary abundance index was good and fits to the compositional data were generally reasonable. The use of the conditional age-at-length data resulted in reasonable estimates of growth.

Areas of Disagreement

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

Unsolved Problems and Major Uncertainties

The major uncertainty in this assessment is the basic scale of the population; a critical uncertainty that was not resolved during the STAR panel meeting. Swept area biomass estimates (from fishery-independent sources) resulted in four to twenty two times the model estimates of biomass. Numerous sensitivity analyses were provided by the STAT team in an attempt to explain this discrepancy. The STAT team and STAR panel discussed potential mechanisms; however, a definitive reason was not found in the time allotted.

Concerns were expressed about the uncertain historical trawl catch data in the early 1900s. There is uncertainty associated with the assumed discard rate and size compositions used to construct historical removals.

There is great uncertainty whether this stock is subject to time-varying life history parameters. For example, evidence was presented indicating a 6 cm shift in the size at 50% maturity between the 1950s (Arora 1951) and the recent period (Lefebvre 2013). The model assumed the results from the Lefebvre (2013) study for the entire time series.

The STAT team underscored the point that a strong correlation existed between model parameters. The current model estimates steepness (h), natural mortality (M), virgin equilibrium recruitment (R_0), and growth. While steepness and natural mortality were estimated with informed priors, the STAR panel suggested that a more parsimonious parameterization might be advisable, given the confounding nature of these parameters.

Concerns Raised by the GMT and GAP Advisors During the Meeting

There were no concerns raised by the GMT and GAP advisors during the meeting.

Prioritized Research Recommendations

1. Exploration of the biomass estimates derived from trawl surveys, especially the NWFSC shelf/slope survey to address the discrepancy between survey- and model-based estimates of biomass.
2. Evaluate historical reconstructions of landings and discards.
3. Explore the possibility of time-varying life history parameters (e.g., regime shifts that potentially affect maturity, M, and growth).
4. Further explore the influence of the individual data sources on model results.
5. Explore ways to index the abundance of sanddabs in nearshore areas (i.e., waters shallower than 55 m) where the trawl surveys were not conducted.
6. Explore potential stock structure of this population, including the population in waters off Mexico and Canada.

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