

SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON  
PACIFIC SARDINE ASSESSMENT, HARVEST SPECIFICATIONS, AND  
MANAGEMENT MEASURES – FINAL ACTION

The Scientific and Statistical Committee (SSC) reviewed the 2022 stock assessment update for the Northern Subpopulation (NSP) of Pacific Sardine, and the SSC Coastal Pelagic Species Subcommittee (CPSSC) review report on the assessment. Dr. Peter Kuriyama, National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC) presented the 2022 stock assessment update. Drs. Emmanis Dorval (SWFSC) and Kevin Hill (SWFSC) were available for questions. Dr. André Punt (CPSSC Chair) gave a summary of the assessment review conducted on March 2, 2022 via the RingCentral platform.

The stock assessment update was based upon the February 2020 benchmark assessment and included:

- new Acoustic-Trawl (AT) survey index data for Spring 2021 and index and age data for Summer 2021 ;
- updated (re-aged) age data for the AT survey for 2016;
- updated catches for model-year semesters July-December 2019 and January-June 2020;
- new catch data for July-December 2020; and
- new catch and age data for January-June 2021 and July-December 2021), along with an assumption about fishing mortality to estimate 1+ biomass for 1 July 2022.

The uncertainties in this assessment update are the same as discussed for the 2020 benchmark and 2021 catch-only projection reports, especially the uncertainties related to the amount of nearshore biomass and the proportion of northern subpopulation in the catches off Ensenada, Mexico. The estimated catch for the MexCal season 2 fishery (Mexico, Southern California, Central California) and the associated fishing mortality rate (F), which is estimated at the maximum allowed by the software (4), remain a concern. This F value was also assumed to be constant in the forecast as was done in the previous assessments.

The SSC agrees with the CPSSC that the 2022 update to the 2020 sardine assessment satisfies the Terms of Reference for update assessments. The results are consistent with the previous assessment given the new data, and hence represent the best scientific information available for management of the NSP Pacific Sardine. The SSC recommends that the assessment be designated as category 2 based on the uncertainties related to the Mexican catch of NSP Pacific sardines and the observed retrospective pattern. The harvest guideline is 0 mt for 2022 based on the forecast age 1+ biomass of 27,369 mt, which is below the 150,000 mt management threshold.

The stock assessment team (STAT) has concerns about their ability to properly address the most substantial uncertainties discussed above as part of a 2023 benchmark assessment. There may be insufficient time to reprocess catch and survey data before the data deadline. The SSC recommends that the STAT focus on stock structure, how to compute catches and abundance indices for use in assessments, and improvements to estimates of abundance based on surveys (acoustic trawl

method, nearshore acoustics, and aerial survey estimates) rather than conducting an assessment that will have the same concerns as the last benchmark assessment. Delaying the full assessment to 2024 and conducting a methodology review based on work conducted during 2022 would seem warranted. This would allow for discussions concerning potential improvements to the structure of the assessment as well.

## **Coastal Pelagic Species Subcommittee of the Scientific and Statistical Committee Review of the 2022 Stock Assessment Update for Pacific Sardine**

Dr. Peter Kuriyama, National Marine Fisheries Service (NMFS), Southwest Fisheries Science Center (SWFSC) presented the 2022 stock assessment update for the Northern Subpopulation (NSP) of Pacific sardine on behalf of the Stock Assessment Team, and Dr. Emmanis Dorval (SWFSC) presented information on double reading and re-ageing of the 2016 age data that were used in the 2020 benchmark assessment. Drs. Kevin Hill (SWFSC) and Juan Zwolinski (University of California Santa Cruz) also participated in the discussion and answered questions about the assessment.

The stock assessment update that estimated 1+ biomass for 1 July 2022 was based upon the February 2020 benchmark assessment and included:

- new Acoustic-Trawl (AT) survey index data for Spring 2021 (model-year semester 2020-2) and index and age data for Summer 2021 (2021-1);
- updated (re-aged) age data for the AT survey for 2016 (2016-1);
- updated catches for model-year semesters July-December 2019 (2019-1) and January-June 2020 (2019-2);
- new catch data for July-December 2020 (2020-1); and
- new catch and age data for January-June 2021 (2020-2) and July-December 2021 (2021-1), along with an assumption about fishing mortality for model year-semester 2021-2.

While some of the catch values were previously updated for the catch-only projection that was reviewed by the Coastal Pelagic Species Subcommittee of the Scientific and Statistical Committee (SSC-CPSSC) during early 2021, that projection was rejected for use in management because a change in recruitment deviation parameters resulted from, and was necessary to achieve, the fit to the new catch data, and such changes are outside the Terms of Reference (TOR) for catch-only projections.

The 2016 AT age data did not match the patterns of recruitment estimated in the 2020 assessment based upon other age data. The new analysis and double reads of the AT 2016 age data found that the original age reader for the 2016 age structures estimated ages that were biased high. Therefore, all structures were re-read and a new age composition was produced. New ageing error matrices were produced for the 2016 AT survey age data and for ages read in 2021.

AT survey catchability  $q$  is set at values less than 1.0 from 2015 forward to account for nearshore sardine biomass missed by (e.g., inshore of) the AT survey sampling grid, as observed by an aerial survey of sardine in the nearshore. Three recent aerial surveys with timing concurrent with AT surveys were used for this analysis, in Summer 2019 (2019-1), Spring 2021 (2020-2), and Summer 2021 (2021-1). Comparing the acoustic estimates to the sum of the acoustic and aerial estimates, results in identical values of 0.733 for  $q$  for both summer surveys, whereas the spring survey results in a  $q$  of 0.589. However, larger discrepancies are observed in the spring survey when the AT surveys are treated as separate surveys of the “Core” and “Nearshore” areas to reflect differences in survey methods, timing, and spatial coverage for each. If the aerial survey is used instead of the

nearshore AT data to represent the biomass inshore of the core area AT survey in the nearshore area due to the greater water area observed inshore of the AT core area, the  $q$  value for the spring 2021 survey changes substantially, from 0.589 to 0.071 given the low value of the biomass observed in the core area (1,409 mt). The AT nearshore estimate is also higher than the aerial estimate for Spring 2021, which raised additional concerns, although differences in the methodologies, and overall variability, could explain these differences. Concerns were also expressed that combining the results of the nearshore AT survey estimates with those of the core area AT survey as if they reflected a single survey, and then calculating  $q$  for the nearshore estimate from the aerial survey would result in redundant accounting for biomass inshore of the core AT survey area. Work should be undertaken to better understand the relationship of the AT and aerial surveys in the nearshore areas and in spring vs. summer before the next assessment, in particular to evaluate areas that are surveyed by both survey techniques.

The SSC-CPSSC requested four additional model runs to correct an input error (and create a revised base model) and to explore the effect of different assumptions about how to use the data for the AT and aerial surveys in the nearshore to compute survey  $q$ . These included (1) correct the AT  $q$  values to match those in Table 2 of the update (New 2022 update (AT total)); the revised base model); (2) use the ratio of nearshore AT survey to total AT survey estimates to calculate Core AT survey  $q$  (Scen 1); (3) use only Core AT survey data along with aerial survey data to estimate  $q$  (Scen 2); and (4) take the annual average nearshore biomass values from Scens 1 and 2 (e.g. average the nearshore AT and aerial survey estimates; Scen 3). The estimates of 1+ biomass from these model runs are shown in Figure 1. While the time series of estimated biomass changed somewhat for these scenarios, the biomass for July 1, 2022 varied little.

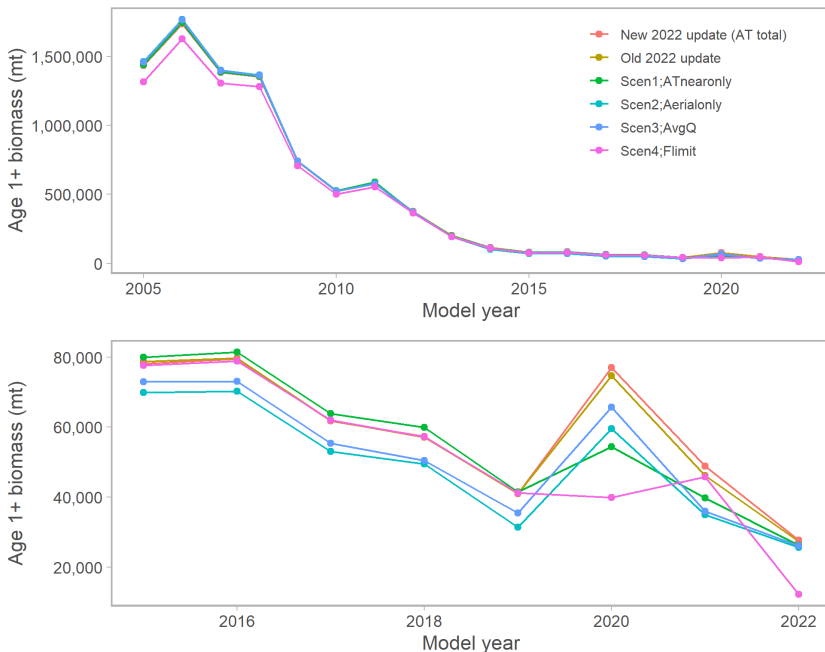


Figure 1. Complete and recent biomass trajectories from alternative model runs requested during the Sardine Assessment Update Review Meeting. See text for specifications of each run.

The method for estimating the catch of the NSP in the MexCal fishery depends on an analysis of the temperatures for which each of two substocks of Pacific sardine occur. This results in estimates of over 33,000 mt in model year-semester 2019-2, and over 48,000 mt in 2020-2, which is also assumed for 2021-2. Given the large catch of sardine (from both subpopulations) in Mexico, any overlap, uncertainty or error in the temperature used to split the Mexican catch to the two subpopulations could result in substantial errors in the estimated catch of the NSP. The NSP Mexican catch estimates are driving the results of the assessment. Alternative methods or approaches for assessing and managing this stock may need to be explored given this uncertainty. The SSC-CPSSC requested an extra model run where the catch values for model year-semester 2 for the MexCal fleet for the past five years and the projection be capped at 10,000 mt (Figure 1; Scen4). This resulted in a decrease in the estimate of current biomass. However, the estimated fully-selected fishing mortality for those semesters remained at the upper bound of 4, due to changes in model estimated recruitment and biomass.

Figures 3 and 4 in the assessment update report show a substantial retrospective pattern that indicates the assessment may be providing an underestimate of current biomass. While there are certainly other concerns with the assessment that should be addressed, the effect of the retrospective pattern should be considered in management decision making.

The SSC-CPSSC agreed that the 2022 update to the 2020 sardine assessment satisfies the TOR for update assessments. The results are adequately consistent with the previous assessment given the new data, and hence represent the best scientific information available for management of the northern subpopulation of Pacific Sardine.

PFMC  
04/09/22