

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

Dr. Kevin Hill (SWFSC) presented the 2019 sardine update assessment ([Agenda Item E.3, Supplemental REVISED Attachment 1](#)) to the Scientific and Statistical Committee (SSC). As with the 2017 full assessment ([Agenda Item G.5.a, Stock Assessment Report, April 2017](#)) and the 2018 update assessment ([Agenda Item C.5, Attachment 1, April 2018](#)), the Stock Assessment Team (STAT) provided a model-based (ALT) and an acoustic-trawl survey-based (AT) assessment approach in the 2019 update assessment document. The ALT assessment model was the approach used in the 2017 full assessment and the 2018 update assessment to inform management, and therefore the 2019 update of the ALT approach was evaluated for use to inform management for the upcoming fishing year (2019/20). The SSC Coastal Pelagic Species Subcommittee (CPSSC) reviewed a draft of the 2019 update assessment on March 28, 2019 (report appended). The CPSSC and the SSC review focused on two main questions:

- 1) Does the assessment meet the criteria of a stock assessment update?
- 2) Can the results of the update assessment form the basis of Council decision-making?

The SSC agreed that the 2019 update to the 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 available science for management of the northern subpopulation of Pacific sardine.

The projected stock biomass for the 2019/20 management period is 27,547 mt for July 2019, which is below the minimum stock size threshold (MSST) of 50,000 mt. As in 2018, the update assessment is designated as a category 2d assessment, for 2019 this would be associated with a sigma of 1.0 for calculating the acceptable biological catch (ABC) buffer. This assignment was due to the following major uncertainties:

- recent recruitment estimates show a strong retrospective pattern, although this is reflective of new data updating estimates of recruitment based on the stock-recruitment relationship in the presence of declining (and below average) recruitment;
- the most recent recruitment is taken from the stock-recruitment curve rather than being estimated;
- the population age structure is particularly uncertain because a large proportion of the estimated population is composed of recent recruits; and
- the lack of recent fishery age composition data now spanning four years.

The SSC endorses the 2019/20 Pacific sardine overfishing limit (OFL) of 5,816 mt, which is shown in Table 15 of the assessment document.

The 2020 assessment will be a full assessment, and the SSC provided the STAT with suggestions for its development.

SSC CPS Subcommittee Report to the SSC on the 2019 Assessment of the Northern Subpopulation of Pacific Sardine

General

Drs. Kevin Hill (SWFSC), Paul Crone (SWFSC), and Juan Zwolinski (UCSC) presented the 2019 update assessment of the Northern Subpopulation (NSP) of Pacific Sardine to the SSC CPS subcommittee on March 28th, 2019, via webinar. As with the 2017 full assessment (Agenda Item G.5.a, Stock Assessment Report, April 2017) and the 2018 update assessment (Agenda Item C.5, Attachment 1, Stock Assessment Report, April 2018), the STAT provided a model-based (ALT) and an acoustic-trawl survey-based (AT) assessment approach in the 2019 update assessment document. The ALT assessment model was the approach used in the 2017 full assessment to inform management, and therefore the update of the ALT approach was evaluated for use to inform management for the upcoming fishing year (2019-20). The SSC CPS subcommittee expresses appreciation to the STAT for a complete and well-documented update assessment.

New data included in the 2019 update proposed by the STAT include: 1) updated landings data for 2017, with preliminary landings data for model year 2018 (which includes catch data for the second half of calendar year 2018); and 2) a corrected ATM biomass index and associated age composition for summer 2017 and a new ATM biomass index and associated age composition from the summer 2018 survey. There was no spring survey (or associated spring abundance estimate) for sardine during 2018. The methodology used to calculate acoustic-trawl survey biomass in 2018 was the same as in the 2017 full assessment. The 2017 summer ATM biomass index originally was calculated without restriction to the depth range where sardine were present. This error was discovered after the completion of the 2018 update assessment and its use for management, and did not occur with any other survey analyses.

There were no fishery age-composition data for 2017 or 2018 in the update assessment because no directed fishery took place in those years, and the composition data from the live bait fishery or from CPS fisheries with incidental take of sardine sampled by the California Department of Fish and Wildlife (CDFW) were not included in the 2017 full assessment and thus including them within an update assessment would not be within the Terms of Reference.

Changes to model structure were within the Terms of Reference for update assessments, and included estimating one additional recruitment deviation and updating the recruitment bias ramp, both as a direct result of the additional year of data. The habitat model was also re-run to partition total 2018 landings to the northern subpopulation.

Total catch has generally been low in recent years, with the exception of relatively large estimated catches (~10,000 mt per year in 2017 and 2018) of NSP sardine off Mexico. This catch is partitioned from catches of SSP sardine using the environment-based approach described by Demer and Zwolinski (2014), from the Ensenada portion of the MexCal fleet during early 2017 and 2018. The corrected 2017 ATM survey biomass index was 24,349 mt (CV = 0.37, SE(ln(index)) = 0.36), while the summer 2018 ATM survey produced a biomass index of 35,501 mt (CV = 0.73, SE(ln(index)) = 0.65). Projected age-1+ stock biomass for the 2019/20 management period is 27,547 mt for July 2019, with an estimated CV of 0.617 ($\sigma=0.57$; based on estimated spawning stock biomass).

Recruitment

Retrospective patterns in estimated annual recruitment deviations continue to be apparent in the 2019 update assessment, as observed in previous sardine assessments, with recruitment

proving to have been overestimated based on subsequent information. However, there is a larger pattern in the model estimated recruitment deviations, showing eight years of positive recruitment deviations followed by seven years of negative (or zero) deviations. This is more indicative of climate regimes or some other driver in recruitment rather than systematic retrospective patterns within the assessment. During the forecast period (2019-20), recruitment was taken from the stock-recruitment relationship. The SSC supports this approach, noting that the retrospective pattern can be attributed to the model estimate of recruitment for the last year being updated given additional data; the first estimate of a recruitment is based on very little data.

Sensitivity analyses and areas for exploration during the 2020 benchmark assessment

The SSC CPSSC requested two additional model runs to inform on the potential magnitude of sensitivity in assessment outcomes associated with some of the key uncertainties. Other issues that should be examined during the 2020 benchmark assessment are listed in the notes.

1. Catchability

AT survey catchability (q) is estimated to be 1.17 in the 2019 update assessment (up from 1.15 in the 2018 assessment update). Although there are various factors, including acoustic target strength, that are uncertain and could cause q to be greater than 1.0, it is also true that the survey misses some portion of the sardine population, notably inshore of the survey area. In order to explore the sensitivity of the model to q , the CPSSC requested a model run with q fixed at 1.0 (Table 1; Figure 1).

2. Recent Catches of Northern Subpopulation of Pacific Sardine

Catch in the Ensenada (ENS) area of Mexico is apportioned to the NSP and the SSP based on the location of the port of landing and the oceanography at the time, indicating the likely geographic boundary between the two stocks. However, evidence suggests that vessels often fish far south of the northern Mexican ports, and therefore the partitioning by location of port of landing may not be correct. The very high exploitation rates estimated for the ENS fleets in the past two years (23-35 percent) are ten times the mean rates during 2005-2014 (2.8 percent; 2015 and 2016 had 0.0 percent exploitation rates). In addition, in forecasts, the 2019 and 2020 catches are assumed equal to those estimated for 2018. The CPSSC requested a run with estimated catches in ENS from 2017 and 2018 (and in forecasts) multiplied by 0.1, to reflect exploitation rates more consistent with those estimated in the recent past. Results of a run with 2017/2018 catches in the MexCal fleet multiplied by 0.1 (which achieves the aim of the sensitivity examination, since over 98 percent of estimated NSP landings by the MexCal fleet were from ENS in both 2017 and 2018) are shown in Table 1 and Figure 1.

Conclusion

The SSC CPSSC agreed that the 2019 update to the 2017 sardine assessment satisfies the Terms of Reference for Update Assessments. The results are consistent with the previous assessment and 2018 update given the new data, and hence represent the best scientific information available for management of the northern subpopulation of Pacific sardine. The biomass estimate and management quantities for this model are shown in Table 15 of the assessment document. The SSC CPSSC recommends endorsing the 2019/20 Pacific sardine OFL of 5,816 mt in that table. If the assessment is considered to be a category 1 assessment, a sigma of 0.57 should be used to calculate the ABC buffer because the model-estimated uncertainty associated with the January 2020 spawning stock biomass estimate (middle of the fishing year; sigma = 0.57) is higher than the category 1 default (sigma = 0.50).

Table 1. Results of two sensitivities requested by the CPSSC. **Alt 2019 q=1** fixed AT survey q to 1.0. **Alt 2019 Recent Catch x 0.1** reduced estimated MexCal NSP catches in 2017, 2018 and forecasts by a factor of 0.1.

ESTIMATES	MODEL		
	ALT 2019	ALT 2019 q=1	ALT 2019 Recent Catch x 0.1
Stock-recruitment ($\ln R_0$)	13.8649	13.9622	13.8119
Stock-recruitment steepness (h)	0.304	0.313	0.302
Spawning stock biomass 2017 (mt)	39,848	35,612	32,819
Recruitment 2017 (billions of fish)	0.446	0.522	0.429
Spawning stock biomass 2018 (mt)	28,481	27,532	31,368
Recruitment 2018 (billions of fish)	0.851	1.021	0.947
Stock biomass peak (mt)	1,760,640	1,871,090	1,768,000
Stock (1+) biomass 2018 (mt)	25,642	33,945	39,657
Stock biomass (1+) 2019 (mt)	27,547	37,727	51,370

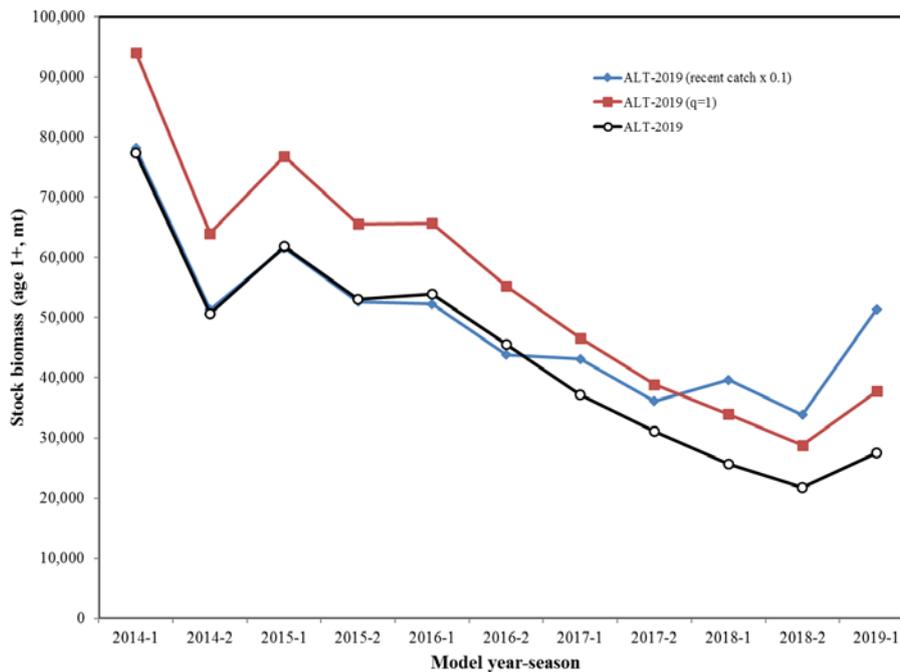


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