COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON PACIFIC SARDINE ASSESSMENTS, HARVEST SPECIFICATIONS, AND MANAGEMENT MEASURES – FINAL ACTION

The Coastal Pelagic Species Management Team (CPSMT), Coastal Pelagic Species Advisory Subpanel (CPSAS) and the Scientific and Statistical Committee (SSC) jointly received a presentation from Dr. Peter Kuriyama of the Southwest Fisheries Science Center on the 2021 Pacific sardine catch-only projection (Agenda Item E.4, Attachment 1). The CPSMT appreciates the efforts made by the stock assessment team (STAT) to construct a catch-only projection during difficult circumstances.

The assessment schedule for the northern subpopulation of Pacific sardine includes an update assessment two out of every three years, but due to COVID-19 restrictions that prevented the Acoustic-Trawl (AT) Survey from being conducted in 2020, the STAT conducted a catch-only projection to inform management for the 2021-2022 fishing year. After reviewing the results, the SSC did not endorse the catch-only projection. The SSC is instead recommending the use of the 2020-2021 biomass estimate from the February 2020 benchmark assessment but with a change to Category 3 designation (data-poor assessment) for the purposes of calculating the acceptable biological catch (ABC) value. The CPSMT concurs with the SSC and supports their decision to use 5,525 mt as the overfishing limit (OFL) for the 2021-2022 fishing year.

In using the 2020 assessment biomass estimate of 28,276 metric tons (mt), the stock remains below the CUTOFF value of 150,000 mt, which per the CPS fishery management plan (FMP) precludes the primary directed Pacific sardine fishery. Hence, the primary directed fishery for sardine will remain closed for a seventh consecutive year. Additionally, the biomass estimate remains below the 50,000 mt minimum stock size threshold (MSST) established for Pacific sardine (CPS FMP, Amendment 8) and is consequently in an overfished condition. Biomass below MSST does not prohibit allowing exempted fishing permits (EFP), incidental catch, minor directed catch, or catch from live bait, recreational, and tribal fisheries.

The P* value represents the probability of exceeding the overfishing limit (OFL) and is required to be less than 0.5 under National Standard Guidelines. The Council has chosen to utilize a P* value of 0.40 for the last 10 years. Over the last few years, the CPSMT has debated if recommending a change to 0.45 may be the best decision. The CPSMT understands that part of the rationale of originally using a P* value of 0.40 for sardine over a decade ago was the uncertainty in the stock assessment. However, uncertainty in the stock assessment is captured through assessment category assignment (Tier 1-3) and the corresponding sigma value. The CPSMT recommends a P* of 0.40 at present, although the CPSMT may recommend a P* of 0.45 in the future.

Table 1 below presents the OFL and the range of ABC values based on various P* values. The CPSMT offers Table 2 below, which utilizes a P* value of 0.40 for use in setting harvest specifications. The resulting sigma from Category 3 status and a P* value of 0.40 applied to the 2021-2022 OFL of 5,525 mt produces an ABC of 3,329 mt. This ABC value is 959 mt less than

the ABC adopted by the Council for 2020-2021. The CPSMT sees this as an appropriate reduction in the ABC given the uncertainties inherent in utilizing the 2020-2021 biomass.

The CPSMT recommends setting the annual catch limit (ACL) equal to ABC, and an annual catch target (ACT) of 3,100 mt for the 2021-2022 fishing year (Table 2). This will afford opportunity to CPS fisheries and EFPs, while avoiding restricting non-CPS fisheries that may incidentally harvest sardine, since attaining the ACL could result in the prohibition of take in all fisheries. The CPSMT also recommends accountability measures as listed below, to prevent exceeding the ACT and ACL. The CPSMT notes that all sources of catch including any EFP research set-asides, the live bait fishery, and other minimal sources of harvest, such as incidental catch in CPS and non-CPS fisheries, and minor directed fishing, will be accounted for against the ACL.

Table 3 summarizes the levels of sardine catch in CPS and non-CPS fisheries since the primary directed sardine fishery was closed. Live bait harvest numbers prior to the 2019 calendar year are estimates based on voluntary logbooks. The California Department of Fish and Wildlife (CDFW) instituted mandatory electronic fish tickets for live bait catch beginning with the 2019 calendar year (midway through the 2018-2019 fishing season), which has decreased management uncertainty for California live bait catch. However, COVID-19 restrictions that began in March 2020 almost certainly resulted in a significantly reduced harvest of live bait due to the limited recreational fishing opportunity and the resulting lack of market. Therefore, the tonnages harvested in the 2019-2020 and 2020-2021 seasons are likely underrepresenting the needs of the fishery that would typically be present in a year without these restrictions even though the reported catch is now more accurate.

Table 1. Sardine harvest formulas for 2021-2022 based on biomass from the 2020 benchmark stock assessment (Kuriyama et al. 2020).

Harvest Control Rule Formulas									
OFL = BIOMASS * E_{MSY} * DISTRIBUTION; where E_{MSY} is bounded 0.00 to 0.25									
$ABC_{P\text{-}star}$ = BIOMASS * $BUFFER_{P\text{-}star}$ * E_{MSY} * DISTRIBUTION; where E_{MSY} is bounded 0.00 to 0.25									
HG = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION; where FRACTION is E_{MSY} bounded 0.05 to 0.20									
Harvest Formula Parameters									
BIOMASS (ages 1+, mt)	**28,276**								
P-star	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
ABC $Buffer_{(Sigma\ 0.607)}$	0.93228	0.86817	0.80653	0.74631	0.68635	0.62523	0.56083	0.48914	0.39938
ABC $Buffer_{Tier\ 2}$	0.88191	0.77620	0.68023	0.59191	0.50942	0.43101	0.35472	0.27761	0.19304
ABC $Buffer_{Tier\ 3}$	0.77777	0.60248	0.46272	0.35036	0.25950	0.18577	0.12582	0.07707	0.03726
CalCOFI $SST_{(2017\text{-}2019)}$	15.9965								
E_{MSY}	0.224584								
FRACTION	0.200000								
CUTOFF (mt)	150,000								
DISTRIBUTION (U.S.)	0.87								
Harvest Control Rule Values (MT)									
OFL =	**5,525**								
$ABC_{(Sigma\ 0.607)}$ =	5,151	4,796	4,456	4,123	3,792	3,454	3,098	2,702	2,206
$ABC_{Tier\ 2}$ =	4,872	4,288	3,758	3,270	2,814	2,381	1,960	1,534	1,067
$ABC_{Tier\ 3}$ =	4,297	3,329	2,556	1,936	1,434	1,026	695	426	206
HG =	**0**								

Table 2. 2021-2022 Age 1+ Biomass, SSC-recommended OFL, CPSMT-recommended P* Buffer, ABC, ACL, and ACT.

Biomass	28,276 mt
OFL	5,525 mt
P* Buffer	0.40
$ABC_{Tier\ 3}$	3,329 mt
ACL	3,329 mt
ACT	3,100 mt

List of CPSMT-Recommended Accountability Measures

1. Incidental landing limit in CPS fisheries of 20 percent.

2. If landings in the live bait fishery attain 1,800 mt, a per-landing limit of one mt of Pacific sardine per trip will apply to the live bait fishery.

3. If the ACT of 3,100 mt is attained, a per trip limit of one mt of Pacific sardine applies to all CPS fisheries.

4. An incidental per-landing allowance of two mt of Pacific sardine in non-CPS fisheries until the ACL is reached.

Table 3. Pacific sardine landings (mt) by fishery and harvest specifications for previous sardine fishing seasons (July 1-June 30).

Fishing Season	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**	**2019-2020**	**2020-Mar 2021[5]**
CPS Incidental[1]	165	517	275	272	249	105
Non-CPS Incidental	1	1	11	12	4	1
EFP[2]	-	-	-	470	728	855
Live Bait[3]	2,097	1,614	1,894	1,694	1,008	1,035
Tribal	66	85	0	0	0	0
Minor Directed[4]	N/A	N/A	10	57	70	68
Total	2,329	2,217	2,190	2,505	2,059	2,064
ACT	n/a	n/a	n/a	n/a	4,000	4,000
ACL	7,000	8,000	8,000	7,000	4,514	4,288

[1]Incidental Pacific sardine limited to 40% landed weight in CPS fisheries and was reduced to 20% incidental starting in the 2019-2020 season
[2]Exempted Fishing Permit (EFP) take (PFMC April 2018, PFMC April 2019, and PFMC November 2020)
[3]Based on voluntary logbook submission through 2018 and based on electronic fish tickets since 2019.
[4]Minor directed fishery allowed under CPS-FMP Amendment 16 beginning March 2018
[5]2020-2021 data as of March 31, 2021 and subject to change

Future Assessments and Research Recommendations

The CPSMT notes the Terms of Reference for the Groundfish and Coastal Pelagic Species Stock Assessment Review Process for 2021-2022 indicates that a benchmark assessment should be completed the year following a rejected assessment. The CPSMT is concerned, however, that the current scheduled workload for the Southwest Fisheries Science Center, which includes a benchmark central subpopulation northern anchovy assessment and multiple surveys, may preclude a benchmark assessment for sardine in 2022. Instead, the CPSMT recommends that an update assessment that can incorporate data from acoustic and aerial surveys, EFPs, and fishery catch from 2021 is a better path forward. In making this recommendation, the CPSMT recognizes that the substantial uncertainties which led to the 2020 benchmark assessment being designated a Category 2 will remain. And, although the acoustic trawl (AT) surveys (spring and summer) are scheduled in 2021, it remains to be seen if the inclusion of 2021 survey results will resolve the issues identified in the 2021 catch-only projection model.

The CPSMT recognizes the emergent need for research to address gaps in information as put forward by the SSC (Agenda Item E.4.a, SSC Supplemental Report 1) and supports ongoing efforts to improve surveys and assessments. However, the CPSMT further recognizes that undertaking any one of these research topics constitutes significant work, and that it may not be possible to accomplish them, conduct methodology reviews if necessary, and have results that could inform a benchmark assessment in either 2022 or 2023. Nonetheless the CPSMT offers those that we see as near and longer term priority needs.

Near term:

Stock structure

In the near term, the CPSMT recommends a reevaluation of the current understanding of stock structure for Pacific sardine, which assumes a northern and southern subpopulation. Such a reevaluation should include geneticists and stock identification experts. Addressing the larger issue of stock structure along with the model(s) currently used to delineate the northern and southern subpopulation in one methodology type review may be the most efficient way to resolve the issues surrounding stock structure. The model(s) were developed during a time of higher abundance in US waters and it is possible that stock structure may vary with population size.

AT Survey

The AT Survey provides critically important data for assessments of CPS stocks. The scientists conducting the survey have done outstanding work and there have been substantial efforts through collaborative projects involving industry, state, and Federal agencies to expand their utility. The surveys have benefitted from two methodology reviews and progress in addressing the recommendations of those reviews has been made to date. However, the CPSMT encourages addressing those recommendations that still remain from the two AT reviews (2011 and 2018).

Longer Term:

Re-evaluation of Emsy

The CPSMT recommends evaluation of the E_{msy} term based on the California Cooperative Oceanic Fisheries Investigations (CalCOFI) temperature index because it no longer appears to adequately reflect sardine productivity. The value for the E_{msy} term applied to the OFL formula is capped at 0.25 which corresponds to the upper quartile of CalCOFI temperatures. This environmental proxy

was designed to reflect stock productivity, yet it has been near that upper cap for the last five years, while the most recent benchmark assessment stated that actual recruitments have been some of the lowest on record during that same time period.

Evaluation of other indices of abundance to inform benchmark assessments
Over the longer term the CPSMT also suggests that evaluating the use of other indices of sardine abundance may have value for use in assessments. Such an evaluation would likely necessitate a methodology review before any additional index could be utilized.

In addition to these research recommendations, the CPSMT again reiterates that CPS fisheries would benefit from international scientific cooperation.

Sardine Rebuilding Progress
In September 2020 the Council approved the Status Quo (Agenda Item G.1.a, PFMC 2020) Alternative put forth by the CPSMT for the sardine rebuilding plan required as a result of the northern subpopulation of Pacific sardine being declared overfished in July 2019. The National Marine Fisheries Service expects to formally approve this plan in late June or early July 2021. The Magnuson-Stevens Act requires approved rebuilding plans to be reviewed at routine intervals not exceeding two years "to determine whether the plans have resulted in adequate progress toward ending overfishing and rebuilding affected fish stocks (MSA section 304(e)(7))."

The CPSMT sees rebuilding plan reviews at this point as looking at assessment estimates, whether catches exceed the ACL, and if rebuilding expectations are changed due to new or unexpected information.

PFMC
04/08/21