COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON PACIFIC SARDINE REBUILDING PLAN – FINAL ACTION

The purpose of this report is to briefly summarize the alternatives and choices before the Council for the sardine rebuilding plan. This report draws from the modeling work done with the Rebuilder tool presented in Hill et al. (2020) Pacific sardine rebuilding analysis based on the 2020 stock assessment (Agenda Item G.1.a, NMFS Report 1) and the Pacific sardine rebuilding plan preliminary environmental analysis (Agenda Item G.1, Attachment 1). The model runs that utilized the narrower range of data from 2010-2018 that resulted in an average SB_0 of 104,445 mt and an average SB_{msy} rebuilding target of 38,122 mt are not described below because the low biomass levels are not consistent with the objectives of the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP), even though the rebuilding times for those modeling results are shorter. Instead, the modeling results from the full range of 2005-2018 data are described below with the assumption of a constant fishing rate of 9.9 percent in Mexico on the northern subpopulation of sardine. The modeling for this state of nature resulted in an average SB_0 of 377,567 mt and an average SB_{msy} rebuilding target of 137,812 mt.

Two tables are presented here for reference. Table 1 summarizes the analysis done for both the sardine resource as well as the fishing industry and associated socioeconomic considerations in Agenda Item G.1, Attachment 1. Table 2 briefly outlines potential methods for picking timelines. These methods are examples from the modeling analyses; other non-model approaches may be possible.

The CPSMT again emphasizes the limitations of the Rebuilder modeling results for Council decision-making as discussed in Agenda Item G.1, Attachment 1 and given these, the Rebuilder modeling results should not be viewed in absolute terms. As previously stated, “the CPSMT concluded that while the model is useful, it certainly is not able to definitively provide probabilities for recovery in any given time frame, nor accurate and precise biomass estimates for future years for any of the alternatives under consideration.” The main issues common to one or more of the alternatives under consideration are highlighted here rather than being repeated in Table 1:

- The Rebuilder model results do not capture the full productivity range of this stock
  - Results are based on a 15-year data set, most of which are low productivity years, for a stock thought to be on a roughly 60-year boom and bust productivity cycle based on long-term scale deposits.
  - During the recovery in the early 1980s to mid-1990s the stock grew at a 30 percent annual rate, which included a small level of fishing (~2,000 mt) during the initial part of recovery, with increasing catches as the stock reached higher biomass levels.
- The model does not capture the actual removals that are occurring under status quo management, nor can it predict variables such as market forces that may affect future catches. Rather, it assumes that the entire amount of sardine that makes up the calculated quotas will be taken by fisheries, which has not happened under status quo and may not under Alternative 3 at higher biomass levels.

Errata

Finally, the CPSMT would like to correct and notify the Council of errors found in Agenda Item G.1, Attachment 1. In Section 4.2 on pages 17 and 18 the values for projected spawning biomass levels for Alternative 2 and 3 were inadvertently reversed. The last paragraph on page 17 that starts with “Alternative 2, the zero U.S. harvest alternative...” should later in that paragraph read, “The broader range of model results include some runs in which the projected spawning biomass may reach levels over 400,000 mt well before 2030 and more or less stabilizing around that level.” The first new paragraph on page 18 that starts with “Alternative 3, with its constant five percent harvest of total 1+biomass...” should later in that paragraph read “The broader range of model percentile results include some runs in which the projected spawning biomass may reach levels of nearly 300,000 mt well before 2030 and more or less stabilizing around that level (Hill et al. 2020, Figure 9).” Additionally, on page 6, section 1.4.3, it states that the annual average catch of NSP by Mexico for 2010-2014 was 136,500 mt. That should read 13,652 mt.

Table 1. Alternatives for management of northern subpopulation Pacific sardine (NSP) that were investigated and analyzed. The table lists the alternatives and summarizes the analysis for the sardine resource and the fishing industry provided in Agenda Item G.1, Attachment 1 Pacific sardine rebuilding plan preliminary environmental analysis. The effects of the alternatives on the ecosystem and protected resources are not summarized here. Details of the Rebuilder model referred to in this table can be found under Agenda Item G.1.a, NMFS Report 1. The model specifically referred to in the table utilizes the full range of data from 2005-2018 with an assumed constant harvest rate of the NSP stock of 9.9% in Mexico to provide a rebuilt target spawning stock biomass (SB_{msy}) of 137,812 mt. Other modeling results are not considered in this table.

Analysis Topic	Alternative 1: Status quo management	Alternative 2: Zero U.S. harvest	Alternative 3: 5 Percent U.S. harvest of 1+Biomass
Sardine Resource and Rebuilding Times	• Maintains existing OFL and ABC harvest control rules (HCRs) • By design, rebuilding capacity is implicit in the CPS FMP's HCRs and other management measures • Has limited harvest of NSP sardines to an average of 2,200 mt/year since the directed fishery was closed • Rebuilder Model o Stock not projected to rebuild at > 50% probability by 2050 at median values o At lower probability levels the stock may rebuild to a SB of roughly 200,000 mt before 2030	• Zero U.S. fishery harvest until stock rebuilds • Leaves the most sardine biomass in the water for reproductive purposes to rebuild stock • Unclear if stock will rebuild faster than other alternatives given that stock is thought to have remained at low biomass levels for relatively long periods even in the absence of fishing in the past • Rebuilder Model o Projects stock to rebuild at > 50% probability in 15 years based on median values o At lower probability levels the stock may rebuild to a SB of roughly 400,000 mt before 2030	• Fixed 5% U.S. harvest of total 1+biomass was designed to ensure lower U.S. harvest levels of NSP than Alternative 1 until stock rebuilds • Potentially leaves more sardine biomass in the water than Alternative 1 • Allows more US harvest of sardine than Alternative 2 and less than Alternative 1 until stock rebuilds • Rebuilder Model o Projects stock to rebuild at > 50% probability in 26 years based on median values o At lower probability levels the stock may rebuild to a SB of roughly 300,000 mt before 2030

Fishing Industry and Socioeconomics	• Least restrictive alternative at all biomass levels • Within the constraints of the OFL/ABC HCRs, maintains the Council's ability to consider fishery needs on an annual basis in conjunction with the status or trends of the sardine resource • Non-sardine CPS, groundfish, minor directed CPS, live bait CPS fisheries continue to operate • Median modeled catch values are projected to decline below current levels after peaking in 2021	• Eliminates sardine harvest in the live bait and minor directed fisheries, and curtails other fisheries that catch sardine incidentally • Could have far-reaching negative socioeconomic effects on various user groups, including non-sardine CPS, groundfish, minor directed CPS, live bait CPS fisheries, and recreational fisheries • These fisheries would not be able to resume until the stock rebuilds • Implementing a true zero U.S. harvest is not practicable for both socioeconomic and logistical reasons	• ACLs fixed at five percent of the total 1+ biomass • If biomass stays at or below 50,000 mt, existing fisheries would be restricted to levels of harvest below those occurring since the directed fishery was closed • Non-sardine CPS, groundfish, minor directed CPS, live bait CPS fisheries would continue to operate with more restrictive harvest levels than Alternative 1, but a longer period of higher catches is projected based on median modeling results

Table 2. Presented here are three model-based methods for setting timeline rebuilding reference points T_{min}, T_{max}, and T_{target} based on the rebuilding analyses. The method used to determine each is described for the corresponding T_{min}, T_{max}, and T_{target}. The target rebuilt spawning stock biomass (SB_{msy}) for all these methods is 137,812 mt. This SB_{msy} value comes from Rebuilder modeling results for the 2005-2018 time period modeled (see Hill et al. 2020, Agenda Item G.1.a, NMFS Report 1). The CPSMT is currently determining which of these methods is most appropriate/applicable or if methods outside of the model results could be utilized.

Method	$\mathbf{T_{min}}$	$\mathbf{T_{max}}$	$\mathbf{T_{target}}$
F=0 (both international and US)[1]	8 years	10 years	Council to choose value between T_{min} & T_{max}
US F = 0[2]	15 years	18 years	Council to choose value between T_{min} & T_{max}
US F= 0[3]	15 years	30 years	Council to choose value between T_{min} & T_{max}

[1]This method for determining T_{min} and T_{max} assumes zero harvest of sardine, both in the U.S. and internationally. No action by the Council can achieve zero harvest in another country. It is unclear if the Magnuson-Stevens Act (MSA) specifies an assumption of zero international harvest for determining timeline reference points for a transboundary stock for which there are no international harvest agreements. There were no model results that included a rebuilding time between the T_{min} and T_{max} values using this method to determine T_{max}.

[2] This method assumes zero U.S. harvest and a 9.9 percent harvest rate of NSP sardine in Mexico. While the U.S. harvest rate can be implemented for U.S. fisheries, the harvest rate of NSP sardine in Mexico is only a modeled assumption. Tmax is determined by adding the mean generation time to T_{min} as per the National Standard 1 (NS1) guidelines. There were no model results that included a rebuilding time between the T_{min} and T_{max} values using this method to determine T_{max}.

[3] This method assumes zero U.S. harvest and a 9.9 percent harvest rate of NSP sardine in Mexico. While the U.S. harvest rate can be implemented for U.S. fisheries, the harvest rate of NSP sardine in Mexico is only a modeled assumption. T_{max} is determined by doubling T_{min} as per the NS1 guidelines. There is evidence that even in the absence of fishing the stock can remain at low levels for long periods of time. Analysis of those data found an average 22-year time to rebuild to population levels that would support the commercial directed sardine fishery. Rebuilder model results provide a median value of 26 years to rebuild for one of the alternatives.

PFMC
09/01/20