OCEANA | Protecting The World's Oceans
99 Pacific Street, Suite 155C
Monterey, CA 93940
831.643.9266
www.oceana.org

October 13, 2011

Mr. Dan Wolford, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220-1384

RE: Agenda Item F.2. Pacific sardine harvest specifications for 2012

Dear Chairman Wolford and members of the Council:

Thank you for this opportunity to comment on the 2012 Pacific sardine specifications. As sardines are an extremely important forage fish in the California Current Large Marine Ecosystem and the West Coast ocean-based economy, we urge the Council to take the utmost precaution in managing this stock. Although the results of the 2012 STAR panel review and Pacific sardine stock assessment are not publically available at this time, we continue to have serious concerns regarding the stock status of Pacific sardines, the harvest control rule used to develop the U.S. harvest guideline, and the lack of international cooperation in managing this transboundary stock. In this letter we detail those concerns and provide recommendations for addressing them.

1. Background explanation of the Pacific Sardine Harvest Control Rule (HCR)

Sardine management currently takes place through an innovative framework that could potentially serve as a model for ecosystem-based fishery management for targeted forage fish stocks.

HARVEST GUIDELINE = (BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION

Pending approval of Amendment 13 to CPS FMP:

OFL = BIOMASS * *F*MSY * DISTRIBUTION

ABC = BIOMASS * BUFFER(P*) * *F*MSY * DISTRIBUTION

ACT= EQUAL TO HG OR ACL (≤ABC), WHICHEVER VALUE IS LESS

In the current framework, a minimum cutoff (CUTOFF) biomass is "set-aside" such that fishing quotas are set on a percentage of the estimated BIOMASS (ages 1+) above the cutoff and the fishery is closed if the total population drops below CUTOFF. The current cutoff for Pacific

sardine is 150,000 metric tons (MT). The percentage (FRACTION) of the remaining biomass that can be fished increases (to 15%) in warmer ocean conditions where the population is thought to be more productive and decreases (to 5%) in cooler, less favorable conditions. DISTRIBUTION (87%) is the percentage of BIOMASS assumed to be in U.S. waters. Finally, there is a maximum catch value (MAXCAT) that cannot be exceeded regardless of how large the population becomes which prevents overcapitalization and provides a level of precaution when stock assessments are uncertain. The Pacific sardine control rule currently employs MAXCAT of 200,000 metric tons. Other targeted forage species do not have this important control in place.

2. The simulation model used to establish the parameters used in the Pacific Sardine HCR was never fully documented, is therefore not transparent, and is outdated

While the framework for sardine management is innovative, we have serious concerns with the parameters going into the framework to determine the harvest guideline. The current harvest rule for Pacific sardines was first established in 1998 through CPS FMP Amendment 8 and reaffirmed in 2011 in the proposed Amendment 13 to the CPS FMP. It is based on results from a simulation model developed by Larry Jacobsen and Richard Parrish, which at the time was presumably determined to represent the best available science. According to Amendment 8, the simulation model used to evaluate MSY control rules was described in a publication that was "in prep"; therefore the Amendment only included "a summary of its essential features" in Appendix B to Amendment 8 of the CPS FMP.[1] While the simulation model itself is available, its formulation, assumptions, functioning, and full suite of model runs have never been adequately explained and the model has not been published.

As a result, there is no public transparency as to the fundamental basis for sardine management decisions. Some additional details of the model simulations not included in Amendment 8 have since been provided by Richard Parrish as Public Comment to the PFMC,[2] but without additional documentation, there can be no legitimate public analysis or peer review. Considering the importance of this stock to the ecosystem, growing public interest in proper management of this important public resource, and the inability of experts to undertake a peer review of a model that has never been made public, we request that the simulation model be fully disclosed and properly documented immediately.

In fact, the PFMC and management bodies have been aware for years that the HCR is outdated and in desperate need of a formal review. As stated in 2008 CPS SAFE document, "…the harvest control rules in the CPS FMP are dated and in need of review and potential revision. Review of the harvest control rules in the CPS FMP has been characterized as a high priority research and data need by the Council and its advisory bodies."[3]

---

[1] PFMC. 1998. CPS FMP Amendment 8, Appendix B, p. B-92.
[2] PFMC. Agenda Item G.1.d. Public Comment. June 2008. and PFMC Agenda Item H.1.c Public Comment, June 2011.
[3] PMFC 2008. SAFE. June 2008, at 46. and see PFMC 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches. Stock Assessment and Fishery Evaluation. June 2011, at 68.

3. The HCR Uses a Temperature-Recruitment Relationship that is not based on the Best Available Science

A peer review of the model as well as a detailed analysis of sardine management is of utmost importance as information that has become readily available after 1998 clearly demonstrates that both the model formulation (as summarized in CPS FMP Amendment 8) and the parameters used in the current HCR are not accurate. For example, in the description of the simulation model, Amendment 8 stated that

> *The simulation model used a Ricker (1975) recruitment model based on sardine spawning biomass and mean sea surface temperatures at Scripps Pier, California (Jacobsen and MacCall 1995).... Temperature data and reproductive success in the simulations were related functionally and autocorrelated so that years of good and bad recruitment success occurred in regimes of approximately a decade.*[4]

Most recently, McClatchie et al.[5] published a re-analysis of the temperature-recruitment relationship for Pacific sardine that found "the temperature–recruit relationship no longer holds for the SIO [Scripps Institute of Oceanography] pier when time series are updated with data from more recent years", meaning that the relationship between temperature and reproductive success used in the simulation models are not valid. In addition, this also invalidates the temperature-based F_{MSY} calculation and thus the calculation of Overfishing Limit (OFL). The fact that temperature no longer predicts the recruitment of sardines represents a fundamental invalidation of the entire harvest guideline, which was built around the temperature-recruit relationship. This relationship was also used to justify the FRACTION in the HCR allowing higher exploitation rates in "favorable" regimes. Since the McClatchie et al. paper found that temperature does not predict favorable regimes, it is inappropriate and not in accordance with the best available science to continue using temperature as the basis for the FRACTION parameter in the control rule. While we encourage the development of a new, robust environmental indicator, it would be irresponsible to continue to use one that is known not to hold.

4. The DISTRIBUTION factor does not reflect current catch or stock distribution and international overfishing is occurring

A further flaw with the harvest guidelines is that the DISTRIBUTION parameter was intended to reflect the proportion of the available Pacific sardine stock that occurred in the U.S. versus other nations (Mexico and Canada), with the assumption that each nation is entitled to catch that proportion out of the overall coastwide catch. This was based on Summer-Fall fish spotter surveys conducted two decades ago during a period of low sardine abundance and has been used to justify the assumption that 87% of the stock is in U.S. waters while 13% of the stock is in Mexico waters.[6] This results in a much greater estimate of the proportion of Pacific sardine in

[4] CPS FMP Amendment 8, Appendix B, p. B-92.
[5] McClatchie, S., R. Goericke, G. Auad, K. Hill. 2010. Re-assessment of the stock-recruit and temperature-recruit relationships for Pacific sardine (*Sardinops sagax*). Can. J. Fish. Aquat. Sci. 67(11): 1782-1790.
[6] CPS FMP Amendment 8, Appendix B, p. B-87-88.

U.S. waters than the State of California was using to set quotas in 1998 (59%, based on both CalCOFI data and fish spotter data).[7]

Species	United States	Mexico
Pacific (Chub) Mackerel	84%	16%
Jack Mackerel	75%	25%
Pacific Sardine	87%	13%
Northern Anchovy	98%	2%

Table. Fish Spotter (Summer-Fall) Distribution.
From Amendment 8 to the CPS FMP, Appendix B. p. B-88

According to the current distribution, we would expect that the U.S. would land approximately 87%, Mexico would land 13%, and Canada would land 0% of the total coastwide sardine landings. In fact, according to this estimate there should be no portion of the overall Pacific sardine stock in Canada at all.

Recent catch levels, however, indicate the use of an 87% estimate for U.S. waters is seriously flawed. For example in 2010, U.S. catch levels were only 46% of total catch (66,922 MT) as Mexico and Canada caught 39% and 15% respectively. The fact that Canada has any catch is evidence alone that the current DISTRIBUTION parameter does not accurately reflect the proportion of the stock in the respective waters of all three countries.

Pacific sardines are a particularly vulnerable international fish stock because unlike Pacific halibut, Pacific hake, and the highly migratory tunas, there is no international agreement governing the proportion of the stock to which each country is entitled. The fundamental problem is that neither Mexico nor Canada ever agreed that the U.S. is entitled to 87% of the coastwide catch. Therefore, each of the three countries is fishing the perceived portion of the stock to which each country believes they are entitled, and these proportions add up to far greater than 100%.

This lack of international coordination severely undermines any HCR that the U.S. establishes and jeopardizes the health of the stock. For example, under the current HCR, the CUTOFF parameter should prevent the total exploitation rate from exceeding 12% and should decrease the exploitation rate as the stock declines. In every year since the HCR was established, however, the total exploitation rate has exceeded 13% (including the current rate of approximately 20%), and the exploitation rate has increased as the stock has declined. Therefore, even if the U.S. follows its own HCR, the actual coastwide catch undermines any precaution or ecological consideration present in the HCR.

As per the Magnuson-Stevens Act and the NS1 guidelines, immediate action must be taken if

> *…a fishery is overfished or approaching a condition of being overfished due to excessive international fishing pressure, and for which there are no management*

[7] PFMC. CPS FMP, Amendment 8, Appendix B, p. B-88. December 1998.

> *measures (or no effective measures) to end overfishing under an international agreement to which the United States is a party…* [8]

Within one year of making this determination, the Council must then develop recommendations for addressing the relative impact of U.S. fishing vessels on the stock and submit recommendations to the Secretary of State for international actions to end overfishing.

Therefore, the critical determination is whether overfishing is occurring. The NS1 guidelines define F_{MSY} as "the fishing mortality rate that, if applied over the long term, would result in MSY".[9] For the case where fishing mortality is applied at a constant rate over the long term, the analysis in Amendment 8 to the CPS FMP determined the F_{MSY} (stochastic) to be 12%.[10] The NS1 guidelines define MSY stock size (B_{MSY}) as "the long-term average size of the stock or stock complex, measured in terms of spawning biomass or other appropriate measure of the stock's reproductive potential that would be achieved by fishing at F_{MSY}".[11] The analysis in CPS FMP Amendment 8 determined the average biomass of Pacific sardine to be 1,408,000 metric tons when fished at the F_{MSY} of 12%.[12] According to the current coastwide exploitation rate on Pacific sardines of 20% (in serious excess of the 12%), it is clear that $F > F_{MSY}$. Therefore overfishing is occurring on sardines at the international level.

In addition, based on the NS1 guidelines, the stock of Pacific sardines should be considered overfished. According to the NS1 guidelines:

> *To the extent possible, the MSST [Minimum Stock Size Threshold] should equal whichever of the following is greater: One-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years, if the stock or stock complex were exploited at the MFMT [Maximum Fishing Mortality Threshold] specified under paragraph (e)(2)(ii)(A)(1) of this section. Should the estimated size of the stock or stock complex in a given year fall below this threshold, the stock or stock complex is considered overfished.*[13]

Therefore, it is possible using the sardine simulations from the CPS Amendment 8, Appendix B to derive an MSST (overfished threshold) for Pacific sardines based on one half the MSY stock size (704,000 MT) as required in the NS1 final rule.[14] This is in stark contrast to the MSST value of 50,000 MT established in the CPS FMP. While the 2011 STAR panel assessment is not yet available, last year's assessment indicated that the stock was below 704,000 MT since

[8] 50 C.F.R. § 600.310 (k)
[9] 50 C.F.R. § 600.310 (e)(1)(i)(B).
[10] PFMC. CPS FMP, Amendment 8, Appendix B, p. B-94. December 1998.
[11] 50 C.F.R. § 600.310 (e)(1)(i)(C).
[12] PFMC. CPS FMP, Amendment 8, Appendix B, p. B-94. December 1998.
[13] 50 C.F.R. § 600.310(e)(2)(ii)(B).
[14] 50 C.F.R. § 600.310(e)(2)(ii)(B).

2009.[15] Based on the metric described by the NS1 final rule, the Pacific sardine stock is at an overfished level.

However, regardless of whether overfishing is occurring at the international level, Mexico and Canada are together catching far more than the 13% of the total harvest guideline as specified in current sardine management. This alone is grounds for a revision of the DISTRIBUTION parameter and/or international engagement with Mexico and Canada to address the discrepancy. Such international engagement could build on or be modeled off existing international fishing agreements the U.S. currently has with those countries.

5. The Current Management Structure Fails to Achieve Optimum Yield

Even if the Parrish and Jacobsen Pacific sardine simulation model used in CPS Amendment 8 continues to be used as the basis for the formulation of the harvest control rule, substantial changes to the harvest control rule are necessary to ensure the HCR meets the Magnuson-Stevens Act mandate of achieving Optimum Yield on an ongoing basis.

A recent study published in the journal Science concluded that fishing at MSY levels on low trophic level species (i.e. forage species) has widespread ecological consequences in all ecosystems assessed to date.[16] To maintain high catch levels while greatly reducing these ecological impacts, the study recommended setting exploitation rates for low trophic level species to below one half of MSY levels and establish B75% as a target. Based on the current stochastic MSY exploitation rate for Pacific sardines (12%), applying this approach to Pacific sardines would require reducing the coastwide exploitation rate to below 6%.

Regardless of the CUTOFF, FRACTION, and MAXCAT parameters of the harvest rule, recent coastwide exploitation rates have been on the order of 20%. Interestingly, based on the simulation model used in the current harvest rule and the current coastwide exploitation rate of 20%, an exploitation rate of 6% would actually yield greater average harvest levels than the status quo (approx 130,000 MT) (see figure below). At the same time, average sardine biomass would increase approximately 4 fold (from 500,000 MT up to over 2,200,000 MT) to levels approaching B75%. Such an increase in sardine biomass would result in a much greater amount of forage available to sardine predators throughout the California Current ecosystem, as well as greatly increased catch per unit effort of sardines in the fishery (hence lower fishing costs and increased profits associated with any given level of catch). This is shown in the graph below, which was derived from the same Pacific sardine simulation model used as the basis for the current HCR. While the figure does not include variability, and other tools such as MAXCAT and CUTOFF, it does provide a general indication of long-term averages, which are the basis of Optimum Yield. Notably, an exploitation rate of 6% would lead to similar average catches and higher average biomass that the current harvest control rule (Option J estimated to have an average biomass of 1,952 in Amendment 8). Furthermore, one of the performance indicators in

[15] Hill et al. Assessment of the Pacific Sardine Resource in 2010 for U.S. Management in 2011. NOAA Tech Memo NMFS SWFSC 469.
[16] Smith et al. 2011. Impacts of Fishing Low-Trophic Level Species on Marine Ecosystems. *Science*. www.sciencemag.org July 21, 2011.

Amendment 8 was the percentage of years with a biomass above 400,000 MT, however there was no justification for how this threshold was selected, particularly in relation to providing adequate forage.

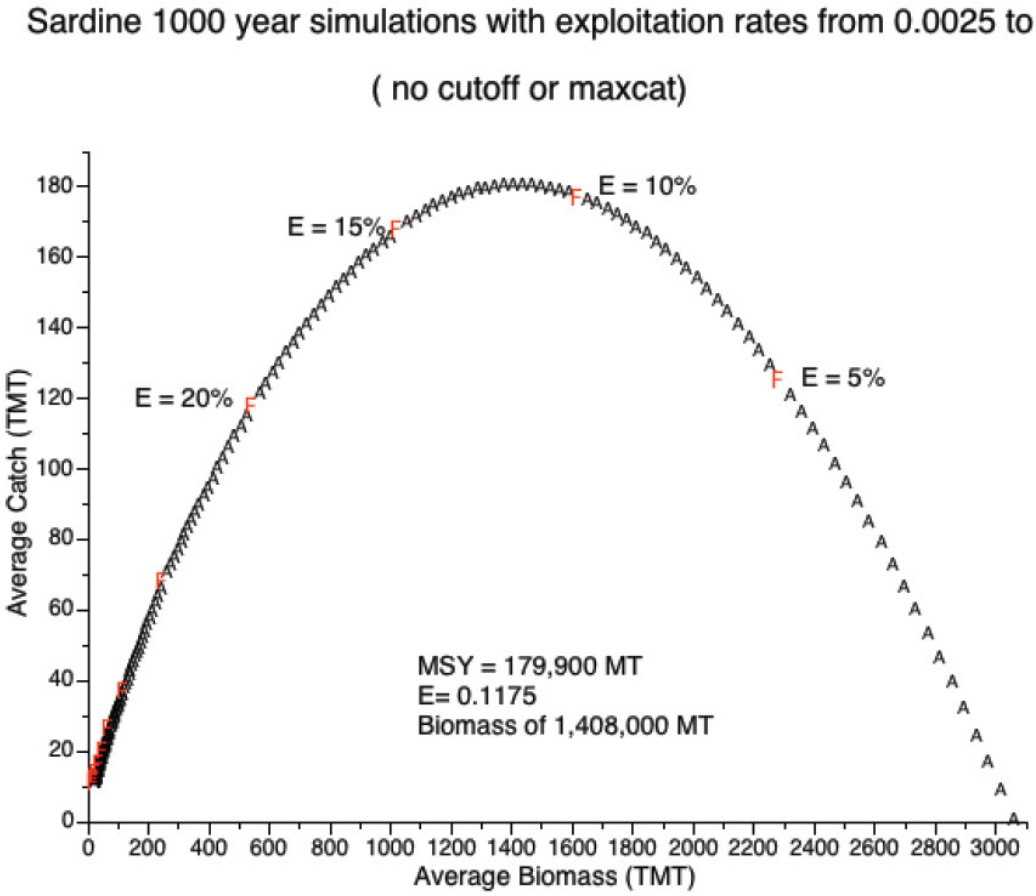


Figure from Parrish' May 11, 2008 letter.
PFMC Agenda Item G1d. Public Comment. June 2008 Briefing Book.

6. The Current Management Structure Fails to consider Adverse Impacts to Essential Fish Habitat for other Council-managed species.

Pacific sardines comprise a significant component of the diets of several Council-managed species in the Groundfish, Salmon, and Highly Migratory Species FMPs, and they are a major prey item which makes Pacific sardines essential fish habitat for those species.[17] As such, the Council and NMFS must consider the extent to which Council-authorized specifications for Pacific sardines reduce their availability as major prey for those species, which could constitute adverse impacts on EFH. The Council and NMFS must consider whether the overly aggressive Pacific sardine harvest rates constitute adverse impacts to EFH and, if adverse impacts exist, minimize them.

[17] As defined in EFH Final Rule. 16 U.S.C. 1853 §303(a)(7)

7. CUTOFF Does Not Adequately Include Forage Considerations

The original documentation for the harvest control rule in CPS FMP Amendment 8, Appendix B did not contain a justification for the use of a 150,000 MT CUTOFF. Later documents explain that "The purpose of CUTOFF is to protect the stock when biomass is low" and "CUTOFF provides a buffer of spawning stock that is protected from fishing and available for use in rebuilding if a stock becomes overfished."[18] In 2008, however, Richard Parrish submitted a letter to the PFMC describing that the approach was used to determine the forage set aside. The letter explains that

> *[t]he approach taken by the CPSMT was to use the general ecological rule that it takes ten gms. of food to produce one gm. of weight. This point occurs at an annual average catch of 147 thousand tons or an exploitation rate of 0.065. Using this approach the exploitation rate should not exceed the rate where an increase in catch results in a tenfold decrease in average biomass. In other words the set aside for forage by other species was determined by setting the exploitation rate at the level where the weight of the last mt of catch equaled the increase in biomass that would occur if the resulting ten mt. average biomass were left in the ocean.*[19]

We do not agree with the logic behind this approach and have great concern that it was neither published nor adequately peer-reviewed. First, rather than identify the predator populations that consume sardines and use information on actual consumption levels or conversion ratios, the approach simply relied on a general estimate of a 10:1 conversion. Second, this assumes that the value of the predators by weight is equal to the value of sardines by weight. This is clearly incorrect—for example, a pound of Chinook salmon is far more valuable than a pound of sardines.

Furthermore, even if one accepts these assumptions, the goal of the approach was to derive a harvest rate that should not be exceeded, which according to Dr. Parrish's letter was 0.065. However, rather than setting a maximum harvest rate, the corresponding catch at an exploitation rate of 0.065 (i.e., 147,000 MT) became the CUTOFF, not the maximum harvest rate. There is therefore a serious disconnect as the analysis was used to determine a harvest rate, but was instead then used to create the CUTOFF. Since the combination of the CUTOFF and the FRACTION together determine the actual harvest rate (which generally exceeds 0.065 in the current harvest control rule), the harvest control rule actually exceeds the rate where an increase in catch results in a tenfold decrease in biomass, violating the objective of the forage set aside as described in Dr. Parrish's letter.

This is of great concern as the coastwide exploitation rate has exceeded the harvest control rule every year since the HCR was implemented. Therefore, not only do the exploitation rates

[18] PFMC 2011. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches. Stock Assessment and Fishery Evaluation. June 2011, at 21.
[19] PFMC Agenda Item G1d. Public Comment. June 2008.

produced by the current HCR exceed the levels necessary to provide adequate forage, but the HCR itself is being exceeded.

8. Summary and Conclusions:

As detailed above, there are several fundamental flaws in the current harvest control rule used to develop harvest specifications for Pacific sardine.

These include:

- Use of a simulation model to derive the harvest control rule that has yet to be fully documented, is not transparent, and is clearly out of date;
- Use of flawed logic to justify a "forage set aside", thereby failing to meet optimum yield requirements;
- Use of a temperature-F_{MSY} relationship now known to be inaccurate;
- Failure to analyze the extent to which Pacific sardine harvest may adversely impact prey availability as a component of EFH for other Council-managed species;
- Failure to account for or coordinate management of Pacific sardine in Mexico and Canada.

The result is excessive fishing pressure on Pacific sardines that threatens the stock itself, the fishing communities that rely on long-term consistent sardine harvest, and populations of natural predators of sardines and their associated economic sectors. The PFMC and CPSMT have been aware for years that the harvest control rule needs to be revised. In fact, a formal review of the harvest control rule has been repeatedly identified as one of the highest priority research needs by the CPSMT and the Council. Given the gravity of these flaws, we realize that remedying the current situation is beyond the scope of what the Council can accomplish at the November 2011 meeting.

Therefore, we suggest the following:

1. The Council immediately task the CPSMT and SSC to re-evaluate and revise the harvest rule based on best available information, including providing adequate forage (for example, as per the recommendations in the Smith et al. *Science* study[20]) and fully documenting the simulation approach used, and to conduct a full management strategy evaluation;

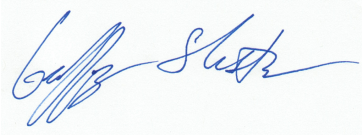
[20] Smith et al. 2011. Impacts of Fishing Low-Trophic Level Species on Marine Ecosystems. *Science*. www.sciencemag.org July 21, 2011.

2. Request that NMFS and the US State Department engage in international discussions with Mexico and Canada to prevent overfishing;

3. Consider management measures that would expeditiously rebuild the Pacific sardine stock to levels exceeding $B_{MSY.}$

Once the results of the STAR panel review and stock assessment are available, we will provide more specific recommendations regarding the 2012 Annual Catch Limit. Thank you for your time and consideration of these comments.

Sincerely,



Geoffrey Shester, PhD
California Program Director, Oceana

cc: Rodney McGinnis; NMFS Regional Administrator, Southwest Region