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99 Pacific Street, Suite 155C
Monterey, CA 93940
831.643.9266
www.oceana.org

February 28, 2014

Ms. Dorothy Lowman, Chair
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220

Mr. William Stelle, Regional Administrator
NOAA Fisheries, West Coast Region
7600 Sand Point Way NE
Seattle, WA 98115

RE: Agenda Item I.1: Coastal Pelagic Species: Pacific Sardine Temperature Parameter Review

Dear Chair Lowman, Mr. Stelle, and Members of the Council:

Oceana remains deeply concerned about the current collapse of Pacific sardines in the California Current as confirmed in most recent 2013 stock assessment, particularly about the serious ecological consequences of the reduced availability of this critically important forage species to its predators. We commend the Council's necessary triage in response to this information in November 2013 to reduce the 2014 Pacific sardine Annual Catch Target below that specified in the Harvest Guideline. However, the current sardine harvest parameters that provide the default basis for calculating catch levels and other management measures are seriously flawed. These parameters are failing to prevent overfishing, failing to provide sufficient forage to dependent species, and failing to achieve Optimum Yield. To address the current deficiencies and relevant ecological factors, we request that the Council adopt the suite of Harvest Control Rule parameters Oceana proposed in our May 2013 letter, which is analyzed in the CPSMT Report (March 2014 Agenda Item I.1.c, Appendix Table 1, p. 14, Scenario "Request 6". March 2014 Briefing Book (Agenda Item I.1.b). Specifically, we propose a CUTOFF of at least 640,000 metric tons to provide sufficient forage for predators and an alternative for calculating DISTRIBUTION to prevent overfishing. Our full suite of proposed harvest control rule parameters are summarized below in Table 1.

Table 1: Oceana's proposed Pacific sardine harvest control in comparison to the current parameters in the CPS FMP as amended by Amendment 13.

Parameters	Current HG	Oceana Proposed Harvest Control Rule
CUTOFF (B1+, mt)	150,000	640,000
FRACTION	5-15% (based on SIO index)	5-15% (based on CalCOFI index)
MAXCAT (mt)	200,000	300,000
DISTRIBUTION (U.S.)	87% of TOTAL HG	TOTAL HG - Lmexico - Lcanada
MSST (1+, mt)	50,000	640,000
OFL (TOTAL)	18% of Biomass (1+)	Emsy (0-25%) based on CalCOFI
OFL (US)	87% of TOTAL OFL	TOTAL OFL - Lmexico - Lcanada

Sardine management by the PFMC is currently failing meet the goals and objectives of the CPS FMP (in *italics* below) and violating key provisions of the Magnuson-Stevens Act (*e.g.,* 16 U.S.C. §§ 1851(a)(1) and 1853(a)(3)(requiring management measures to prevent overfishing and achieve Optimum Yield, and assessment and specification of OY in FMP); § 1851(a)(3) (requiring a stock to be managed as a unit throughout its range)). Specifically, the fishery fails to:

- *"achieve Optimum Yield"* as required under the MSA, as Optimum Yield is not assessed or specified in the CPS FMP, relevant ecological factors are not identified in the CPS FMP or accounted for in the sardine harvest control rule, and actual exploitation rates exceed the harvest guideline;
- *"provide adequate forage for dependent species"* which is an essential part of achieving OY, as evidenced by the unusual mortality events of California sea lions, nesting failures brown pelicans, in which the lack of sardines and anchovies have been implicated as the primary cause;
- *"prevent overfishing"* as evidenced by the October 2013 stock assessment showing that the exploitation rate on Pacific sardines in 2012 was 25%, exceeding the Maximum Sustainable Yield exploitation rate of 18%; and
- *"encourage cooperative international and interstate management"* as there is no international agreement and U.S. sardine management does not account for actual sardine catch in Mexico or Canada. The MSA requires NMFS, in cooperation with the Secretary of State, to "immediately take appropriate action at the international level to end overfishing." 16 U.S.C. § 1854(i)(*sic*)(1). Yet NMFS has not taken any such action; nor has the Council taken sufficient action to account for U.S. fleet's part in depleting the overall sardine stock, as it must do in order to manage the stock as a unit throughout its range.

The failure to responsibly manage the sardine fishery is causing ecological reverberations in the California current ecosystem. In 2013, over a thousand California sea lion pups were stranded on Southern California beaches because of the lack of forage species, specifically sardines and

anchovies.[1] In addition, California brown pelicans breeding in the Channel Islands have undergone a decline in reproductive success since 2010 culminating in major nesting failures in 2012 and 2013,[i] while unusual adult Brown Pelican stranding events during the non-breeding season on the California and Oregon coasts were observed in 2009-2010. These unusual events were attributed to the lack of prey availability during the breeding season and attributed primarily to starvation[ii]. Sardines are an essential prey item for numerous piscivorous seabirds including Brown Pelicans, Elegant Terns, Heerman's Gulls and the federally threatened Marbled Murrelet[iii]. Sardines comprised 25%-67% of the diets of breeding pelicans in six years of surveys that took place at the Channel Islands between 1991-2005, however have been absent from the diets of breeding pelicans in recent years.[iv] On February 12, 2014, NRDC submitted a petition to the Secretary of the Interior to list the contiguous U.S. distinct population segment of tufted puffins under the endangered species act, citing the current low abundance of Pacific sardines and other prey as a threat to this distinct population segment. These examples illustrate that serious ecological impacts of inadequate forage are occurring at sardine abundances much greater than the current CUTOFF in the Pacific sardine harvest control rule. The fact that the stock biomass from 2007 to 2013 declined by approximately the same amount as was landed by the sardine fishery during this period clearly implicates fishing as a primary driver of the extent of the current collapse. The low current abundance is now causing mortality events and reproductive failure in multiple dependent sardine predators.

While Pacific sardine population dynamics are complex, it has become apparent that while the Pacific sardine population undergoes wide swings in abundance even in the absence of fishing due to prolonged periods of low and high productivity, fishing pressure has a major effect on the population dynamics during periods of low productivity and/or low abundance. In other words, fishing during a natural population decline has three fundamental effects on the sardine stock:

1. Increases the severity or steepness of the decline, causing the population to "bottom out" at a lower level than would have naturally occurred;
2. The population takes longer to recover or rebuild when ocean conditions become more favorable because the population is starting at a lower level than would have naturally occurred;
3. The population peaks at lower levels than would have naturally occurred because the period of higher productivity is finite.

These conclusions are supported not only by the current sardine simulation model, but also by what has been observed over the last century. Specifically, the population in the 1930s and 1940s peaked several times greater than the most recent peak of approximately 1.5 million metric tons, likely because it took so long to recover from the heavy fishing rates in the 1950s and 1960s.

CUTOFF

1 NOAA Office of Protected Resources presented at the December 2013 CalCOFI meeting in La Jolla that the cause of the 2013 California sea lion Unusual Mortality Event was likely a lack of forage

The CUTOFF is the most critical parameter of the harvest control rule for lowering the risk of stock collapse and preventing the fishery from becoming overfished.[2] CUTOFF could – and should – also be used to ensure the provision of adequate forage for dependent predators. At the current level of at 150,000 metric tons, however, the CUTOFF neither prevents the fishery from becoming overfished nor provides forage for dependent predators.

The Lenfest forage fish task force[v] recommended that CUTOFFs for forage species be set at approximately 40% of mean unfished biomass. Based on this recommendation, we propose a CUTOFF of 640,000 metric tons (~40% of mean unfished biomass as estimated in the most recent simulation models). To ensure adequate forage, the CUTOFF should be set higher than the biomass at which predators are impacted by lack of forage (such as nesting failures, starvation, unusual mortality events). This is especially crucial when the predators' alternative preferred prey populations are also suppressed, as they are in the CA Current Large Marine Ecosystem. For example, many of the same predators that rely on sardine also rely on anchovy, which is also at low abundance. As we have indicated, we are now seeing negative effects on sardine predators now that the population is below 640,000 mt. Additionally, if critical biomass thresholds are identified below which the stock becomes at serious risk of collapse (e.g., as identified for Pacific sardines by Zwolinski & Demer 2012)[vi], CUTOFFs should be set to minimize the time at which the population is below these thresholds.

Lastly, the proposed CUTOFF may address practical, economic interests of the fishing industry. Once Pacific sardine biomass drops below 640,000 metric tons, for example, it may take more time and effort to locate sardines (as was seen in Southern California in early 2013), and thus it may not be as profitable to fish sardines at these low relative levels. In summary, our proposed CUTOFF is based on sound science and economic reason, and should be fully considered and analyzed.

TEMPERATURE-BASED FRACTION

We understand that the SSC has previously identified the CalCOFI 3-year average temperature index as the best available predictor of Pacific sardine productivity, and that the revised analyses have reconfirmed that conclusion. Therefore, we support the proposed HCR change to the CalCOFI index for use in the Harvest Guideline and ABC control rule.

We strongly oppose the CPSMT's proposed change in FRACTION range of 10-20 (Scenario K). This is a significantly more aggressive harvest policy than the current harvest control rule, in which FRACTION ranges from 5-15%, which we have previously argued is already insufficient to protect the stock. Table 3 of the CPSMT March 2014 report demonstrates that increase the FRACTION range from 5-15% to 10-20% would result in lower mean sardine biomass (hence less forage production) and higher catch levels. Absent any other changes in harvest parameters,

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2 If the CUTOFF is sufficiently high, it may be possible to increase FRACTION and/or MAXCAT parameters while still minimizing risk to the sardine stock and its ability to provide forage. The CUTOFF only applies to the Harvest Guideline, not the OFL or ABC control rule; therefore it only operates when the HG is below the ABC control rule.

increasing the FRACTION would allow higher catches – moving sardine management in the opposite direction of where it must go given the current dire situation of the sardine stock, the identified failures of the current harvest control rule, and the best available science. The CPSMT's rationale that new median CalCOFI temperatures and a new understanding of sardine productivity justify a FRACTION increase directly conflicts with the reality of severely depleted sardine numbers and steep declines in predator health that are now playing out in the water.

In addition, the proposed increase in the lower bound of the FRACTION range conflicts with one of the primary objectives of the current harvest control, which is to add additional precaution during periods of low sardine productivity. In the current structure of the HG formula, the CUTOFF reduces harvest rates when the stock is low, while the FRACTION range reduces harvest rates when productivity is predicted by temperature to be low. Setting the lower bound at 10% rather than 5% diminishes this effect.

Moreover, the ABC control rule does not account for these concerns, as it only creates a scientific uncertainty buffer from the OFL. As indicated in Fig. 1 of the CPSMT report, the Emsy for sardines drops below 10% with CalCOFI temperatures below 15.2 degrees C. Raising the lower bound of the range up to 10% would essentially eliminate the role of CUTOFF when the temperature-based Emsy is less than 10% and sardine productivity is low, as the ABC becomes lower than the HG at low temperatures. This is a more risk-prone approach than the current Harvest control rule. . Allowing the FRACTION range to reach zero would ensure sufficient precaution when sardine productivity is low, so that the HG is always below the ABC control rule regardless of temperature.

We do not think there is a need or rationale to change the FRACTION range. However, if the Council substantially increased the CUTOFF as we have proposed, we could potentially support a change in the FRACTION range to 0-20% to allow for increased fishing opportunities during periods of high abundance and productivity, while adding more precaution during periods of low abundance and/or productivity.

DISTRIBUTION

Most of the analyses by Hurtado-Ferro and Punt and the CPSMT are predicated on the assumption that Mexico and Canada always catch 13% of the coastwide harvest, as the analyses use a DISTRIBUTION of 1.0 as was done originally in Amendment 8 (CPSMT report, March 2014 Agenda Item I.1.c, p. 5). Based on their sensitivity analysis of this assumption, Hurtado-Ferro and Punt (p. 5) acknowledge: "The results are sensitive to Mexico and Canada not following the US control rule". In their model scenario where Mexico and Canada do not follow the US control rule, mean B1+ biomass is 42% lower than under the current option J, and this scenario is the only one that results in full stock collapse (see Table 6, Scenarios "HG J" and "MF"). The fact that the actual 2012 coastwide exploitation rate on the Pacific sardine population was 25% (greater than the coastwide Emsy of 18% used by the SSC to set the OFL) is definitive evidence that Mexico and Canada are not following the U.S. control rule, resulting in overfishing (October 2013 Pacific Sardine Stock Assessment). This existence of this problem also supports a higher CUTOFF. Specifically, the CPS FMP currently states "If the portion of the stock in U.S. waters cannot be estimated or is highly variable, then other approaches may be

used. It may be more practical, for example, to use a high CUTOFF in the harvest control rule to compensate for stock biomass off Mexico or Canada."

Correcting the U.S. DISTRIBUTION value so that the annual total tri-national landings more consistently match the target fishing fraction is essential for managing this stock. Therefore, we propose the PFMC adopt the landings-based formula for calculating U.S. distribution where the US harvest guideline and US OFL are calculated by reducing the coastwide HG and OFL by the most recent year's actual landings (L) in Mexico and Canada (as proposed and analyzed in Demer & Zwolinski 2013)[vii]:

HG (US) = HG (TOTAL) – L (MEXICO) – L(CANADA)
OFL(US) = OFL(TOTAL) – L(MEXICO) – L(CANADA)

Alternatively, as is suggested in the CPS FMP (4.6.1), if the stock assessment provides estimates of only the portion of the Pacific sardine stock biomass currently within U.S. waters, this value can be used as BIOMASS without any need to pro-rate harvest with a DISTRIBUTION parameter. Therefore, the Council may also consider requesting changes to the terms of reference for future sardine stock assessments to provide estimates of only the biomass within US waters to help simply and resolve the current problems with the DISTRIBUTION parameter.

Minimum Stock Size Threshold

The minimum stock size threshold (MSST) is intended to indicate when a stock is considered "overfished", prompting rebuilding. 16 U.S.C. § 1853(a)(10); 50 C.F.R. § 600.310(e)(2). While we recognize the difficulty in applying this concept for a stock that may vary widely even in the absence of fishing, the practical application is generally that fishing effort be reduced or ceased when the stock is below MSST. *See, e.g.,* 50 C.F.R. § 600.310(e)(2)(ii)(B)-iii. However, current MSST of 50,000 metric tons violates both the letter of the NS1 guidance and the overall purpose of the guidance and statute. Therefore, we propose the Council and NMFS set MSST equal to Oceana's proposed CUTOFF, as fishing for sardine would close whenever the biomass drops below this threshold value anyway.

Summary and Discussion of CPSMT Analysis of Oceana's Proposed Harvest Control Rule

Given the new analysis and information on stock dynamics and the ecosystem impacts of the current harvest control rule now available since the adoption of Amendment 8, we believe a management change is warranted. To achieve Optimum Yield and provide adequate forage for dependent predators, it is necessary to further reduce catches at times of low stock abundance and/or productivity when the stock is most at risk.

According to the analyses in the CPSMT analysis, Oceana's proposed HCR outperforms the current status quo HCR (Option J) in terms of biomass (hence provision of harvest) and risk to the stock regardless of what is assumed about foreign catch. In terms of mean sardine catch and number of years with low catch (<50,000mt), it initially appears that Option J is preferable to Oceana's proposed HCR. However, given that available evidence clearly documents that Mexico and Canada are not following the US control rule, it is likely that the full adoption of Oceana's HCR would outperform the status quo HCR on catch, stability, biomass, forage provision, and precaution (Table 2).

Table 2: Summary of key performance measures of three HCR scenarios from CPSMT March 2014 Report and Hurtado-Ferro and Punt (2014).

Performance Measure	Oceana proposed ("Request 6")	Option J assuming Mex/Can follow US (Option J)	Option J with only US following US control rule (MF)
Mean B1+	1346	1220	716
% of unfished B1+	0.86	0.78	0.46
%B1+>400	97.75	92.4	58.9
Mean catch (all years)	89.4	105.8	57.2
% catch<50	49.2	31.2	58.8

Due to the natural fluctuations in productivity, sardine catch is inherently unstable. While efforts can be made to make catch more stable, it is inevitable that the fleet will undergo prolonged periods of low or zero harvest of certain individual species. However, because catch stability requires continued harvest during periods of low abundance and productivity, more stable catch results in lower long-term catch, greater risk of stock collapse, lower stock biomass, and diminished provision of forage to dependent predators. The ability to cope with these events by targeting other species in the CPS assemblage (e.g., market squid, Northern anchovy, and Pacific mackerel) while setting up markets and infrastructure that can respond to such changes is critical to the socioeconomic success of CPS fisheries, regardless of the HCRs used for each species. We urge the Council to further explore how to address these inherent socioeconomic challenges through a more holistic approach to the CPS assemblage whereby the harvest of each individual species depends not only on its biomass, but also the biomass and catch rates of other species in the assemblage, as well as the status of dependent predators.

In conclusion, the current sardine crisis and its ramifications for key California current predators is clear evidence that the existing harvest parameters are not working. We support updating the temperature index to CalCOFI based on the best available science. However, it would be irresponsible to maintain the other aspects of the status quo harvest parameters given this information, much less make it more aggressive as suggested by the CPSMT. We ask that the Council adopt Oceana's full proposed suite of harvest parameters as presented in this letter as soon as feasible, for the sake of U.S. west coast communities, fisheries, wildlife, and ecosystem.

Sincerely,

Geoffrey Shester, Ph.D.
California Program Director

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References:

Harvey, L. 2013. California Institute of Environmental Studies. California Brown Pelican reproductive decline on the Channel Islands colonies. Unpublished data. March.

ii
Nevins, H. et al. 2011. Summary of unusual stranding events affecting Brown Pelican along the US Pacific Coast during two winters, 2008-2009 and 2009-2010. California Department of Fish and Wildlife.

iii
See September 17, 2013 Letter from Audubon California and Center For Biological Diversity to US Fish and Wildlife Service regarding Post-ESA Delisting Monitoring of the Brown Pelican

iv
Harvey, L. 2013. California Institute of Environmental Studies. California Brown Pelican reproductive decline on the Channel Islands colonies. Unpublished data. March.

v
Pikitch, E., Boersma, P.D., Boyd, I.L., Conover, D.O., Cury, P., Essington, T., Heppell, S.S., Houde, E.D., Mangel, M., Pauly, D., Plagányi, É., Sainsbury, K., and Steneck, R.S. 2012. Little Fish, Big Impact: Managing a Crucial Link in Ocean Food Webs. Lenfest Ocean Program. Washington, DC. 108 pp.

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Demer, D.A. and Zwolinski, J.P. 2012. A cold oceanographic regime with high exploitation rates in the Northeast Pacific forecasts a collapse of the sardine stock. Proceedings of the National Academy of Sciences. www.pnas.org/cgi/doi/10.1073/pnas.1113806109

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Demer, D.A. and Zwolinski, J.P. 2013. Optimizing U.S.-harvest quotas to meet the target total exploitation of an internationally exploited stock of Pacific sardine (*Sardinops sagax*). Manuscript presented at the 2013 Sardine Parameters Workshop, SWFSC.

THE PEW CHARITABLE TRUSTS

4189 SE Division St.
Portland, OR 97202

March 2, 2014

Dorothy Lowman, Chair
Pacific Fishery Management Council
1100 NE Ambassador Place, #101
Portland, OR 97220

RE: Agenda Item I.1 – Sardine Temperature Parameter Review

Dear Chair Lowman and Council Members,

We write in regards to the Pacific Fishery Management Council's (Council) consideration of changes to the harvest control rule for the Pacific sardine fishery. We support the proposed Council action to adopt the California Cooperative Fisheries Investigation (CalCOFI) temperature index for use in management of the Pacific sardine fishery. This change is consistent with the best available science on sardine population dynamics.

Specifically, we request that the Council take the following action at this meeting:

- Adopt the CalCOFI temperature index for use in the calculation of the annual harvest guideline (HG). Taking this action will help ensure that catch limits correspond accurately to sardine productivity and the overall status of the stock.
- Establish a range of FRACTION (fishing mortality rate) of 5 - 20 percent. Taking this action will help ensure that fishing pressure is sufficiently reduced in times of low sardine productivity.
- Continue to pursue development of ecosystem-based improvements to the management of coastal pelagic species in order to maintain adequate forage for dependent predators and the long-term health of the sardine stock.

Below we discuss each of these requests in greater detail.

Adopt CalCOFI Temperature Index

The current harvest control rule for sardine includes a parameter that is dependent upon sea-surface temperature (SST), which has been measured at the Scripps Institution of Oceanography pier. In the control rule, SST is considered a proxy for sardine productivity and is used to determine the allowable fishing mortality rate, referred to in the rule as FRACTION. In 2010, scientists at the National Oceanic and Atmospheric Administration's Fisheries Service (NOAA Fisheries) found that the SST at Scripps pier no longer accurately reflected ocean SST off the southern California coast and therefore was no longer a reliable proxy for productivity.[1] During a sardine workshop held in February of 2013, scientists determined that the CalCOFI mean

[1] McClatchie, S., R. Goericke, G. Auad, and K. Hill. 2010. Re-assessment of the stock–recruit and temperature–recruit relationships for Pacific sardine (*Sardinops sagax*). Can. J. Fish. Aquat. Sci. 67: 1782–1790.

temperature index more accurately reflected the SST off of California and better explained sardine recruitment variability.[2]

Based on this new information, the Coastal Pelagic Species Management Team (CPSMT) recommended that the CalCOFI temperature index should be used in the harvest control rule for sardine. We support the Council taking action to make this change to the control rule so that fishing mortality rates are better linked to sardine productivity. This change will help ensure the long-term sustainability of the sardine fishery by reducing fishing mortality rates when sardine productivity is low or declining, and raising rates when productivity is increasing.

Establish a Precautionary Range for FRACTION

An updated sardine population model was developed to perform the current analysis of the harvest control rule.[3] This updated model is age-structured, whereas the previous model used to develop the original suite of control rules was production-structured. Additionally, the newer model incorporates more recent data from a number of years when the sardine population was expanding rapidly. This results in a higher estimate of stochastic Emsy[4] than the previous model; 18 percent of the biomass available to the fishery as opposed to 12 percent.

In the original control rule, when stochastic Emsy was set at 12 percent, fishing rates (FRACTION) were allowed to rise as high as 15 percent, or drop to as low as 5 percent depending on SST at Scripps pier. Now that stochastic Emsy has been updated to 18 percent, we understand that the Council will also be considering a corresponding increase in the range of potential fishing rates to 10 – 20 or perhaps 15 – 25 percent. Regarding this issue, we request that the Council adopt a range of fishing rates that is at least as precautionary as the current range. Capping rates at 20 percent appears to maintain the Council's previous level of precaution by only exceeding stochastic Emsy by 2 percent. (In the original control rule, rates were capped at 15 percent, which exceeded stochastic Emsy by 3 percent) Considering the current state of the sardine stock, it is essential that fishing rates decrease sufficiently in times of low SST and low productivity. Correspondingly, we recommend a lower bound for FRACTION at 5 percent rather than the 10 percent suggested by the CPSMT. In summary, we urge the Council to adopt a range of FRACTION from 5 – 20 percent.

Pursue Ecosystem-Based Improvements

As part of the analysis of the FRACTION parameter and SST indices, the CPSMT was also provided with simulated long-term results from potential changes to other parameters in the harvest control rule, including CUTOFF (The biomass level below which fishing is not allowed) and MAXCAT (The maximum catch allowed for any year). The results of this analysis help to

[2] PFMC. March 2014. Coastal Pelagic Species Management Team Report on Sardine Harvest Parameter Changes. Agenda Item I.1.c.

[3] Hurtado-Ferro, F., and A. E. Punt. 2013. Revised analyses related to Pacific sardine harvest parameters. School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195-5020

[4] Emsy is an annual exploitation rate used as a proxy for Fmsy, and is the established fishing mortality rate for a given year, dependent upon sea-surface temperature.

illustrate the economic, social and ecological tradeoffs resulting from different fishery management strategies. This type of evaluation can and should be a key tool in determining how best to achieve optimum yield from our nation's fisheries. For example, increasing CUTOFF along with MAXCAT creates more of a pulse fishery where revenue is maximized, yet the number of years with low or no fishing is increased.[5] This management strategy (higher CUTOFF) provides more forage for the ecosystem relative to other strategies, but results in a short-lived fishery. Ostensibly such an approach would not be attractive to the CPS fleet unless there were science and management in place and ready to respond to changes in the relative abundance of CPS species. This is exactly why a forward thinking, ecosystem-based assemblage approach is need for the management of the Coastal Pelagic Species Fishery Management Plan (CPS FMP). Rather than fighting over the last sardine, we should be looking ahead to make sure that we are prepared to correctly manage the next iteration of the CPS fishery. For instance, ecosystem-based control rules for anchovy and mackerel, with CUTOFF, MAXCAT, and other precautionary reference points, as well as environmental parameters, will be needed to support responsible shifts in fleet effort.

Moving forward as the Council considers such an approach to the CPS FMP we would like to see this management strategy evaluation tool utilized within a multi-species context to ensure that catches are set at ecologically sustainable levels and that fishing opportunity is adaptive to species abundance. We fully understand and acknowledge that there are data gaps that will need to be filled and multi-species population models to be developed to truly usher in an ecosystem-based approach to CPS management. However, such an approach is needed if management is to be responsive to the highly variable, dynamic, and environmentally-dependent species that comprise the CPS FMP.

In addition to the multi-species evaluation described above the Council should continue to explore new methodologies and sources of data to better inform the DISTRIBUTION parameter that sets the percentage of the sardine stock in U.S. waters and therefore available to the U.S. fishery. We know that this percentage changes with the status of the sardine stock, yet it currently is set at a fixed value. This issue was discussed at length during the February 2013 workshop and should be a research priority for the CPS FMP moving forward.

Conclusion

In many regards, the management of the Pacific sardine fishery can serve as a model for ecosystem-based management of forage fisheries. The control rule used to establish the annual catch limit includes a biomass reserve below which fishing is not allowed (CUTOFF), sets the fishing rate according to ocean temperatures (used as a proxy for sardine productivity) and buffers against international catch. The changes under consideration today will bring management up-to-date with the best available science regarding sardine population dynamics.

However, more can and should be done to ensure that management of sardine and other CPS provides adequate forage for the ecosystem and avoids negative impacts to marine wildlife. As

[5] Hurtado-Ferro, F., and A. E. Punt. 2013. Revised analyses related to Pacific sardine harvest parameters. School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195-5020

our knowledge of ecosystem dynamics expand, fishery managers should establish CUTOFF at a level that is informed by predator dependencies, and set fishing rates that respond quickly and accurately to stock productivity. Ultimately, we look forward to a management regime that is adaptive to the relative abundance of CPS so that as the ocean changes, management responds accordingly and appropriately.

We appreciate the Council undertaking this endeavor and look forward to working with all stakeholders to maintain healthy oceans and sustainable fisheries.

Thank you in advance for your time and consideration.

Sincerely,

Steve Marx
The Pew Charitable Trusts
smarx@pewtrusts.org