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May 6, 2008

Dr. Samuel Herrick, Chair
Coastal Pelagic Species Management Team
P.O. Box 271
La Jolla, CA 92037-0271

Mr. John Royal, Chair
Coastal Pelagic Species Advisory Subpanel
P.O. Box 1162
San Pedro, CA 90733

RE: Ecosystem Considerations in Coastal Pelagic Species Stock Assessment and Fishery Evaluation (SAFE) Reports and Harvest Guidelines

Dear Chairmen Herrick and Royal:

We are writing to recommend information and analysis that the Pacific Fishery Management Council Coastal Pelagic Species Management Team (CPSMT) should include in the 2008 Coastal Pelagic Species Stock Assessment and Fishery Evaluation (SAFE) reports in order to meet its obligation to incorporate and evaluate ecosystem information. It is imperative that this ecosystem information be used in setting optimum yields for Pacific mackerel and sardines. Given the importance of these and other forage species to the California Current food web, they cannot be managed by single species fisheries management alone but, instead, must be considered in the broader ecosystem context.

Forage species, including those managed under the Coastal Pelagic Species Fishery Management Plan (CPS FMP), play a crucial role in marine ecosystems as they transfer energy from plankton to the larger fishes, seabirds, and marine mammals (Alder & Pauly 2006). The impacts of forage species removals on marine mammals and seabird populations both globally (Tasker et al. 2000, Furness 2003) and on the U.S. West Coast (Baraff & Loughlin 2000; Becker and Beissinger 2006) have been well documented. In fact, fisheries targeting forage species can even reduce the productivity of other commercial fisheries targeting fish that consume forage species as prey (Walters et al. 2006). Maintaining a healthy abundance of forage in our coastal marine systems is critical to the resilience of these systems in the face of the global climate and oceanographic changes we will face in coming decades (IPCC 2006). CPS fisheries management clearly requires a precautionary approach given the multiple sources of uncertainty regarding these species' population sizes and the important role forage species play in the productivity of marine wildlife and commercial and recreational fisheries (i.e. NRC 2006).

The CPS FMP requires that the CPSMT prepare an annual SAFE report and, "in particular, the SAFE report shall include…ecosystem information" (CPS FMP, at 4-6). Currently, SAFE documents lack any meaningful information about the role of CPS in the marine ecosystem or the ecological effects of harvesting CPS. In order to fulfill its obligations under the CPS FMP, we recommend that the CPSMT add an ecosystem chapter to the SAFE document that includes:

- A description of the California Current Large Marine Ecosystem,
- An explanation of the influence of oceanographic conditions on CPS, and

- Food web analyses including information such as
  - The role of CPS in the food web, including analysis of the relative interaction strengths between predators and CPS,
  - Consumption levels of CPS by other species including marine mammals, seabirds, and fish,
  - Shared prey analysis that will help provide an understanding of relative competition for CPS between predators and fisheries,
  - Species sensitivity analysis to determine how impacts to one species might transmit to other species through food web relationships, and
  - Spatial and temporal interactions.

In addition, we request that the CPSMT develop recommendations for setting appropriate levels of allocation of CPS to their predators prior to setting optimum yield in the current harvest guidelines. We recommend that the CPSMT review and utilize the results and methods presented in the ecosystem research currently being conducted by NOAA Fisheries, for example Field & Francis (2006), Field et al. (2006) and Fowler (1999). As such, working with seabird and marine mammal experts can be useful in obtaining initial estimates of quantities of CPS consumed by their predators.

We appreciate the hard work of the National Marine Fisheries Service stock assessment teams, the CPSMT and CPSAS to provide scientific estimates of the abundance of actively managed CPS (Pacific mackerel and sardine) and recommended harvest guidelines. Stock assessments, harvest control rules and management measures are the first step to sustainable fishery management. It is now time to include ecosystem information into the SAFE documents and in the harvest guidelines. The availability of forage species to provide a source of food for salmon, other fish, birds and marine mammals must be a priority consideration. A precautionary approach is necessary, especially for those fisheries targeting species lacking stock assessments and when ensuring abundant populations of forage for ecosystem needs.

Thank you for your time and consideration. We look forward to continuing to work with you.

Sincerely,

Ben Enticknap
Pacific Project Manager
CPS Advisory Subpanel Member

cc: Dr. Donald McIsaac, Executive Director, Pacific Fishery Management Council

References:

Alder, J. and Pauly, D. 2006. On the Multiple Uses of Forage Fish: From Ecosystems to Markets. Fisheries Centre Research Reports 14(3). *The Fisheries Centre, University of British Columbia. 120pp.*

Baraff, L.S. and Loughlin, T.R. 2000. Trends and Potential Interactions Between Pinnipeds and Fisheries of New England and the U.S. West Coast. Marine Fisheries Review 62(4): 1-39.

Becker, B.H., and S.R. Beissinger. 2006. Centennial decline in the trophic level of an endangered seabird after fisheries decline. Conservation Biology. 20(2): 470-479.

Coastal Pelagic Species Fishery Management Plan. December 1998. NMFS and PFMC, at 4-6.

Field, J.C. and Francis, R.C. 2006. Considering ecosystem-based fisheries management in the California Current. Marine Policy 30:552-569.

Field, J.C., Francis, R.C., Aydin, K. 2006. Top-down modeling and bottom-up dynamics: Linking a fisheries-based ecosystem model with climate hypotheses in the Northern California Current. Progress in Oceanography 68:238-270.

Fowler, C.W. 1999. Nature's Monte Carlo Experiments in Sustainability. Proceedings, 5th NMFS NSAW. 1999. NOAA Tech. Memo. NMFS-F/SPO-40.

Furness, R. 2003. Impacts of fisheries on seabird communities. Sci. Mar. 67(2): 33-45.

Intergovernmental Panel on Climate Change (IPCC). 2007. Fourth Assessment Report: Climate Change 2007: Synthesis Report. United Nations Environment Programme.

National Research Council, Committee on Ecosystem Effects of Fishing, Phase II. Dynamic Changes in Marine Ecosystems: Fishing, Food Webs, and Future Options. National Academies Press, Washington, D.C. (2006). 160 pp.

Tasker, M. L., Camphuysen, C. J., Cooper, J., Garthe, S., Montevecchi, W. A., and Blaber, S. J. M. 2000. The impacts of fishing on marine birds. ICES Journal of Marine Science, 57: 531–547.

Walters, C. J., Christensen, V., Martell, S. J., and Kitchell, J. F. 2005. Possible ecosystem impacts of applying MSY policies from single-species assessment. ICES Journal of Marine Science, 62: 558-568.

Dr. Samuel Herrick, Chair May 11, 2008
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Mr. John Royal, Chair
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San Pedro, CA 90733

RE: Oceana's letter of May 6, 2008 "Ecosystem Considerations in Coastal Pelagic Species Stock Assessment and Fishery Evaluation (SAFE) Reports and Harvest Guidelines"

Dear Chairmen Herrick and Royal.

I am writing this letter in response to Oceana's concerns about the importance of the sardine stock as forage for other species. The existing sardine control rule was developed using a model designed by Larry Jacobson, and I did the evaluations of model output that resulted in the original CPS Management Team's recommended harvest rule that was accepted by the Pacific Council. I believe Sam Herrick is the only original member of the CPSMT who is a member of the current CPSMT.

Unfortunately, Larry Jacobson transferred to the Northeast Fisheries Research Center shortly after the sardine harvest rule was enacted and I was unable to secure the travel budget needed for me to travel to the east coast to organize a paper, with Larry, describing the modeling work. Therefore the basis and results for the sardine harvest rule were never published.

I will briefly describe the concepts used in the development of the present sardine harvest rule later, but at the outset it needs to be recognized that the sardine harvest rule is clearly ecosystem-based management. The figures shown below are the same figures I presented to the Pacific Council. The rationale for the CPSMTs recommended harvest rule was dominated by a concern for maintaining the sardine stock at population levels well above that which would occur with a single-species, MSY-based management strategy. In fact, the principal basis for the present sardine rule was to maintain a large population of sardine due to their importance as forage. I personally testified to the Pacific Council concerning the ecosystem value of sardine. During my presentation I noted that many of the fish stocks that were then in trouble (bocaccio, cowcod, lingcod and salmon) were fish eaters and I suggested that maintaining high sardine population levels could be a major factor in the recovery of these depressed stocks. In addition, the modeling included a published relationship between sea surface temperature and recruitment success in sardine as it was realized that bottom up ecosystem forcing needed to be included in any fishery management plan. The present sardine harvest rule therefore is clearly ecosystem-based management and it includes both physical environmental factors and trophic level concerns.

The sardine model management assessment model is briefly described in the 1998 CPS Management Plan which is available on the Council's website. The table below describing the then proposed management options is taken from that management document.

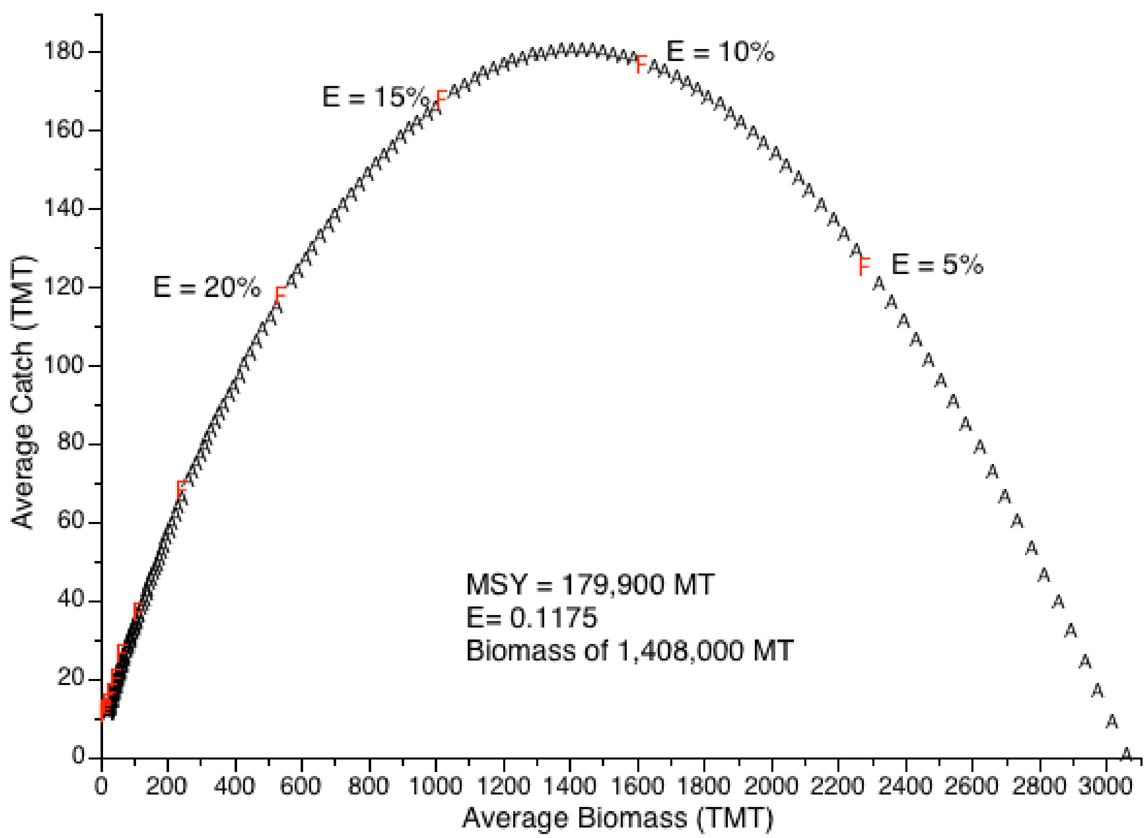
TABLE 4.2.5-1. MSY control rule options for Pacific Sardine. All options evaluated in a stochastic model.

	Option A (Status Quo)	Option B	Option C	Option D	Option E	Option F	Option G	Option H	Option I	Option J	Option K	Option L (Stochastic F_{MSY})	Option M (Determ. Equil. F_{MSY} in a Stochastic Model)
Overfishing Definitions													
Overfishing Rate	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC	Catch> ABC
Overfished Threshold (mt)	50	50	50	50	50	50	50	50	50	50	50	50	50
Control Rule Parameters													
FRACTION	20%	F_{MSY} (10-30%)	20%	F_{MSY} (10-30%)	F_{MSY} (10-30%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (5-15%)	F_{MSY} (5-25%)	F_{MSY} (5-15%)	F_{MSY} (10-30%)	12%	8.8%
CUTOFF	50	50	100	100	100	100	100	100	100	150	50	0	0
MAXCAT	400	400	400	400	300	400	400	300	300	200	200	Infinite	Infinite
Performance Measure													
Average Catch	151	159	165	171	165	177	179	169	169	145	141	180	170
Std. Dev. Catch	137	140	140	143	113	143	133	105	112	67	72	180	153
Mean Biomass	936	964	1,073	1,091	1,280	1,216	1,543	1,665	1,400	1,952	1,516	1,408	1,784
StdDev Biomass	27	27	29	28	34	32	39	42	37	49	43	39	43
Mean Log Catch	4.33	4.46	4.44	4.54	4.64	4.62	4.77	4.80	4.70	4.76	4.65	4.72	4.77
Mean Log Biom	6.24	6.37	6.50	6.59	6.75	6.74	7.06	7.15	6.89	7.34	6.87	6.89	7.24
Percent Years Biomass>400	61%	64%	70%	73%	79%	81%	90%	92%	84%	96%	79%	84%	93%
Percent Years No Catch	5%	2%	7%	4%	3%	2%	1%	0%	1%	0.5%	1%	0%	0%
Median Catch	103	104	119	121	148	131	140	156	158	182	188	128	127
Median Biomass	598	600	700	748	898	850	1,248	1,349	1,048	1,648	1,099	1,500	1,049

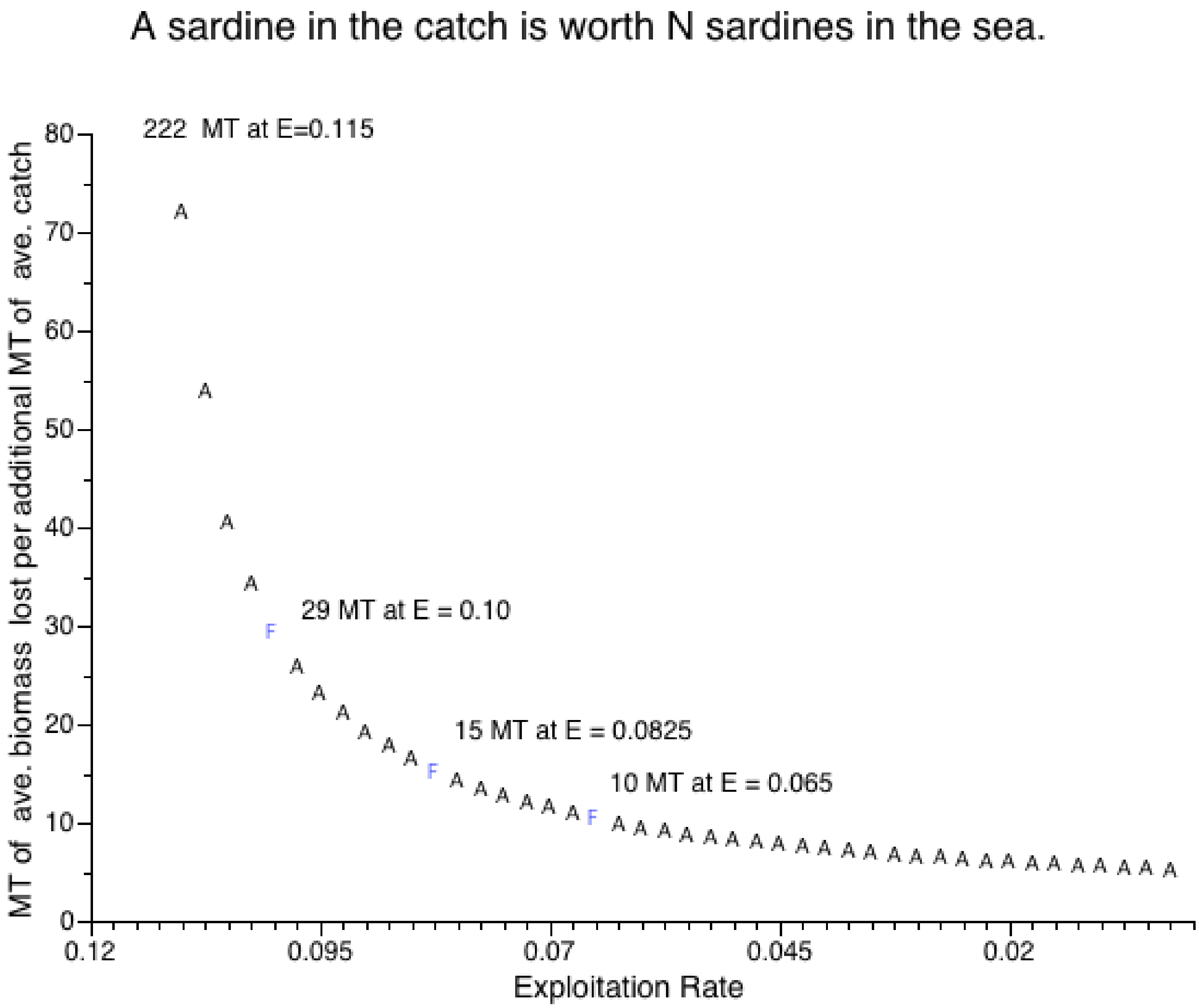
The following figures were used to demonstrate to the Pacific Council the relationship between increasing exploitation and average catch in the stochastic sardine simulations and the effect of increasing catch on the value of sardine as forage for other species. The first shows the average catch and average biomass with increasing exploitation rates. The bell shaped curve shows that at low exploitation rates catch rises rapidly in relation to the decline in biomass, at about E=0.10 the curve has flattened markedly and as the exploitation rate continues to increase the catch increases only slightly while biomass continues to decline. The catch reaches a maximum at E=0.1175 and at higher exploitation rates both catch and biomass decline.

Sardine 1000 year simulations with exploitation rates from 0.0025 to 0.6

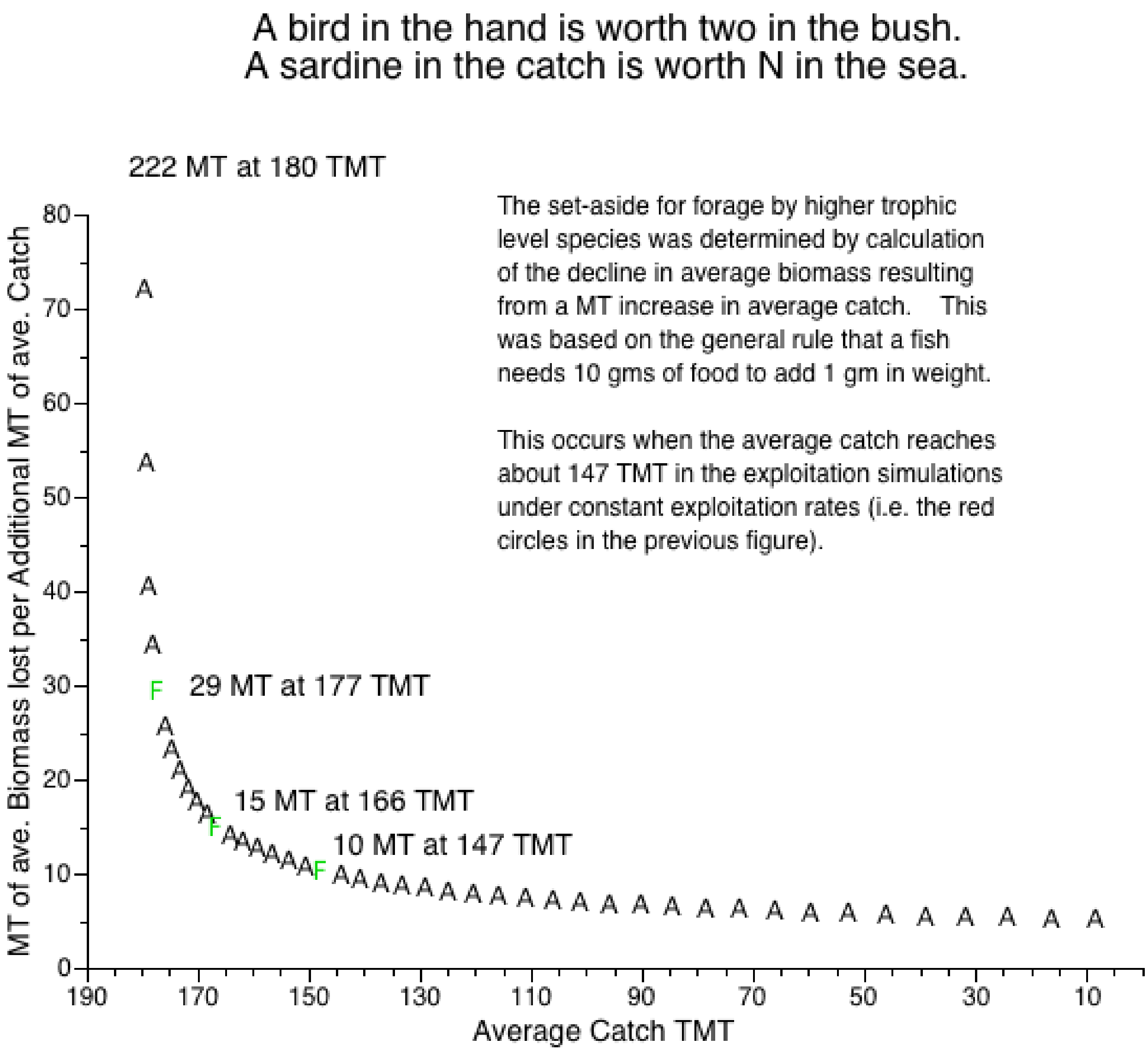
(no cutoff or maxcat)



The second figure, below, shows the rate of decline in average biomass versus the exploitation rate at levels below that producing the maximum sustainable yield. This relationship shows the drop in average biomass that occurs with each additional average metric ton of annual catch over the range of exploitation rates below the MSY rate. For example at E=0.10 each additional metric ton of annual catch results in a loss of 29 metric tons of average biomass; at E=0.065 the result is 10 metric tons.



The third figure shows a similar relationship to that in the second figure except that the exploitation rate is replaced with the average catch that occurs at the given exploitation rate. Note that the non-linear relationships in the three figures offer little information on where the optimum exploitation rate (or average catch) and average biomass occurs. The 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. Note that this is a quite conservative estimate because 10 metric tons of average biomass would produce less than half of this weight in natural mortality or forage for other species in any given year.

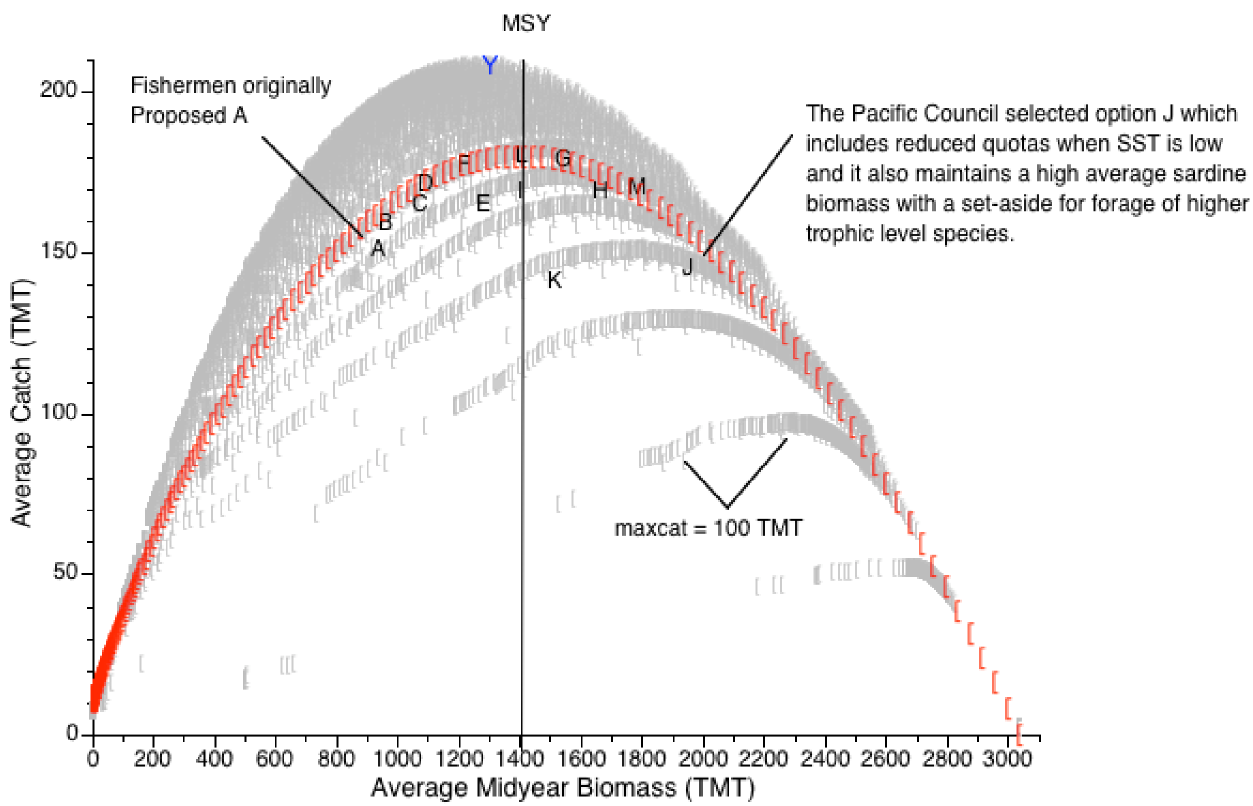


Given the above assumptions for a forage allocation, analyses of the sardine model output were made to establish a harvest rule that achieved a mix of the following characteristics.

1. High average biomass.
2. High median biomass
3. High standard deviation in biomass (it was found that low standard deviation in biomass was associated with low biomass)
4. Low percentage of years with biomass below 400 thousand mt. (this is the population level where the sardine population became restricted to the area south of Point Conception in the historical fishery).
5. Average catch near 147 thousand tons
6. High median catch
7. Low standard deviation of catch (to achieve a stable fishery)
8. Low percentage of years with no fishery.

An extremely wide range of harvest rules was used in the population simulations. The following figure shows the resulting average catch and average biomass from the harvest rule policies examined. The maximum average catch was from a policy with a cutoff of 1 million mt, a high fraction, and maximum catch of 1 million mt (Y in the figure). This harvest rule produced a pulse fishery with no fishery in nearly half of the years. The simulation with stochastic MSY (L) had an average catch of 180 thousand mt and an average biomass of 1408 mt. The council selected the CPSMT's preferred option (option J) that had an average catch of 145 thousand mt and an average biomass of 1,952 mt. The MSY option would result in an average depletion of 46% and option J would have 64%. Option J would have an average biomass 544 thousand mt greater than the stochastic MSY option.

Sardine Fishery Simulation Results: Average biomass vs average catch for 13 proposed management policies, 240 exploitation rates (0.0025-0.6) and 9260 policies with a wide range of cutoffs (0-1000 TMT), constant fractions (0.05-1.0) and maxcats.(50-1000 TMT).



The Oceana letter includes the following statement "In addition, we request that the CPSMT develop recommendations for setting appropriate levels of allocation of CPS to their predators prior to setting optimum yield in the current harvest guidelines". Oceana apparently failed to realize that the current harvest guidelines include a large "allocation" for forage. However, having been closely involved in the development of the current harvest guidelines, I note that the term "allocation" is difficult to define. One way to define an "allocation" would be to use the CUTOFF portion of a harvest guideline as the definition of "allocation". Under this definition the harvest policy with the maximum average catch (CUTOFF = 1 million mt) would have a much higher "allocation" than the current harvest policy (CUTOFF = 150 thousand mt) but it would have an average depletion of 42% (option J has 64%). Using the current harvest rule, the forage allocation could be considered to be the difference (i.e 544 thousand mt) between the average biomass with the current rule and the MSY option.

To do what Oceana suggests (i.e. have the Council determine the forage allocation resulting in optimum yield) the present harvest rule would have to be abandoned and the harvest policy would probably revert to an ABC established by the MSY exploitation rate (E=0.12) with the addition of the 25% overfishing definition and 40% point of concern. The Council would then develop some criteria for establishing OY based on the ABC. If this sort of approach is followed it will be necessary to evaluate the performance of the resulting policy in comparison to the current policy.

Obviously the sophisticated analyses suggested by Oceana would need to be carried out before altering the present harvest rule, which already has a large allocation for forage. This allocation was assessed in a model that uses stochastic environmental variability that was based on the variance, auto correlation and 60 year cycle observed in the California Current System. I note that ecosystem analyses such as the Field et al model are not presently capable of incorporating the complex temporal patterns observed in the California Current System.

If the analyses suggested by Oceana are carried out the discussion between the relative accuracy of the present harvest policy (which includes realistic temporal resolution but no trophic level interaction) versus a model with poor temporal resolution and extensive trophic level interaction should be very interesting.

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