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March 14, 2018

Mr. Phil Anderson, Chair
And Members of the Pacific Fishery Management Council
7700 NE Ambassador Place #200
Portland OR 97220-1384

RE: Agenda Item C.4. Process for Review of Reference Points for Monitored Stocks (including Anchovy)

Dear Mr. Anderson and Council members,

As Executive Director of the California Wetfish Producers Association (CWPA), representing the majority of coastal pelagic species 'wetfish' fishermen and processors in California, I appreciate your consideration of our continuing concerns in the ongoing discussion regarding Reference Points for Monitored Stocks, with a focus on anchovy management.

We thank the Council for its stepwise approach so far in seeking a scientific process to review reference points such as Overfishing Limit (OFL) for data-poor monitored stocks, including northern anchovy. We encourage the Council to continue this reasoned path forward, despite extreme pressure from environmental groups who are now attempting to force a decision prematurely through the courts, based on inaccurate and often misrepresented claims. The District Court decision has been questioned, may be appealed, and the legal issue is far from settled. In the meantime, I repeat an agency finding that the District Court judge ignored: the purpose of the monitored stock category is to "monitor" the status of lightly fished stocks, such as anchovy, for which routine stock assessments are not conducted because the fishery harvest level is very low. In the case of anchovy, the OFL (100,000 mt in US waters) was based on a **LONG-TERM AVERAGE MSY** reference point from which 75 percent was subtracted as an added precaution.

Northern anchovy was assigned to Monitored status at the onset of Amendment 8, expressly because landings had shrunk dramatically from the heyday of the fishery, when large volumes of anchovy were landed primarily for reduction. Catches have remained well below their respective ABC/ACL levels since implementation of the CPS FMP in 2000.

In light of the dramatic variability in anchovy abundance, MSY was not intended to be based on a single stock assessment. The current MSY level of 123,336 mt is the lowest MSY estimated by scientists for northern anchovy. California anchovy landings have averaged less than 10,000 mt per year since the mid 1980s, significantly below the 25,000 mt catch limit, but the small anchovy fishery is extremely important to California's wetfish industry, especially in Monterey. Fishermen view our current catch limit as an insurance policy, a fishery that helps to keep the fleet on the water and processing doors open.

Recent studies have found that forage species are affected much more by environmental conditions than by fishing. (*R. Hilborn et al. / Fisheries Research 191 (2017) 211–221*). Richard Parrish also states, in the paper he submitted for the Council's April Briefing Book: "*Protected species are a major source of predation mortality of the northern anchovy, and their take heavily outweighs that taken by the U.S. fishery during the 2000 to 2014 period (Table 2).*" (Agenda Item C.4.b. R. Parrish, Anchovy 2018)

Summarizing points made in our earlier Council testimony and comments [F.3.c.Sep '16, F.4.c. Nov '16, G.2.b. Apr '17]:

- ***"… the biomass of the central stock of northern anchovy is extremely variable and that this variability occurs with and without a significant fishery on the stock."*** [Richard H. Parrish, Agenda Item H.3.b Supp. Public Comment 4, Nov 2015]

- *"… In 2015, the catch-per-tow of northern anchovy YOY … was at record levels over the 2015 sampling period, with the frequency of occurrence near 80% for the entire survey… This would suggest that 2015 summer anchovy spawning was widespread …"* [Juvenile Rockfish Midwater Trawl survey for pelagic juvenile (young-of-the-year, YOY) rockfish - Central California Coast, May-June 2015 [pages 3-4]].

Fishermen continue to observe a great abundance of anchovy of various sizes [small to large] from northern to southern California. Fishermen have presented evidence of this abundance during Council public testimony for the past few years. This recruitment was not included in the MacCall et al egg/larval assessment updated in 2016**.**

Interesting to note, the 2016 and 2017 Acoustic Trawl surveys also observed increasing evidence of anchovy in offshore waters, but ATM biomass estimates do not include the abundance of anchovy that fishermen have been observing in nearshore waters. In fact, the recent ATM Methods Review acknowledged the presence of anchovy (and sardine) inshore of the current ATM survey grid as a problem. The Panel recommendation was that ATM estimates could be used as a "relative" index to assess anchovy abundance but only if nearshore distribution information is included as part of the abundance estimation process. Our EFP proposal includes 2016-17 aerial survey data, our 2017 summer aerial survey flown in the Monterey-Half Moon Bay area in conjunction with the ATM 2017 summer cruise. The spotter pilot observer estimated a total of 107,040 tons over two seasons, more than half of the tonnage identified as anchovy, and all of the biomass inside the ATM survey grid. CWPA's EFP is intended to satisfy SSC recommendations to ground-truth and develop a variance estimator, enabling us to qualify our cooperative aerial surveys for use in future stock assessments.

The SSC November 2016 Supplemental Report identified several important steps and data needs that must be considered to develop a revised OFL for monitored stocks, including anchovy:

- Estimate F_{MSY} or identify a suitable proxy
- Develop methods for estimating total stock biomass, which would at minimum require calibrating survey estimates to account for unsampled areas
- Preferably analyze all the data in an integrated stock assessment.

The joint SSC/CPSMT Report in April 2017 (Agenda Iem G.2.a, April 2017) provided several options and time frames required for scientific analysis. Several options were based on obtaining estimates of absolute abundance, for example from ATM surveys. However, in the recent ATM methods review, the Panel recommended that ATM estimates **cannot** be used as "absolute" biomass estimates for any CPS. *(Please see CWPA comments on the ATM methods review under Agenda Item C.3.b)*

The Council action at this meeting is to provide guidance on a process for review of reference points for monitored stocks, including anchovy. It is important to understand that anchovy biomass variability demonstrates the extremely difficult, and impractical, task of attempting to assess anchovy on an annual basis. Annual stock assessments would be hugely expensive for a fishery that has averaged less than 10,000 mt per year over the past two decades.

Moreover, In a lightly fished, highly dynamic monitored stock like anchovy, OFL should not be based on a single stock assessment. Rather, OFL/MSY is intended to reflect the largest average fishing mortality rate that can be harvested over the long term.

Please recognize that catches have averaged less than half of the precautionary 25,000-mt limit since the 1980s. As Dr. Richard Parrish pointed out in an earlier statement, "*The fact that the stock [biomass] remained in the 0.2 to 0.5 MMT range from 1990 to 2004, surged to over 2.0 MMT in just two years and then fell by more than an order of magnitude in the next couple of years does not appear to have been "monitored" or noticed. The anchovy fishery showed no* *response to the increased population… Fishery management has had essentially no impact as the conservative annual quota was larger than the market.*"

Dr. Parrish also points out in his April 2018 paper," *… the most recent larvae based index of the [Southern California Current] SCC shows a very strong resurgence of the biomass of anchovy (Figure G.3.1);* "Noteworthy observations from 2017 surveys include the increase in relative abundance of anchovy, shortbelly rockfish, and jack mackerel." *(2018 IEA Report). The 2017 index appears to be in the range of that found in the highest years during the peak of the fishery in the 1980s and during the 2005-2006 anchovy population bubble when biomass was in excess of 1 MMT.*"

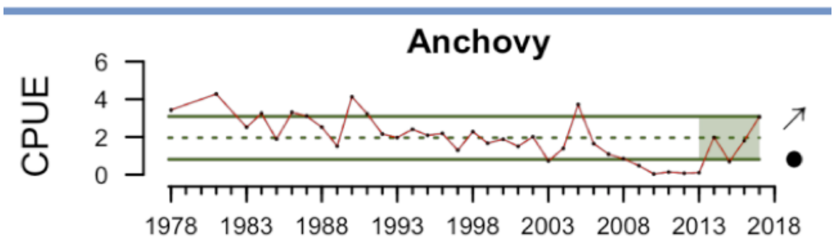


Figure 4. Index of Anchovy Abundance in the Southern California Current Region (Extract from Figure G.3.1 of the 2018 IEA Report: data from larval surveys)

Clearly, there is no biological point of concern regarding anchovy abundance, but there could be a serious socio-economic point of concern if the small harvest limit now allowed in the central stock anchovy fishery is further restricted.

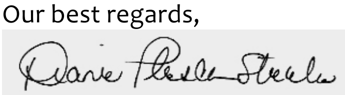
The reduction fishery is history now. However, the anchovy fishery is still very important to California's historic wetfish fleet as a target when no other CPS are available. **A further reduction in current harvest limits, precluding fishing opportunity to fish on anchovy in slack times, could be the proverbial last straw that curtails California's wetfish industry, the historic backbone of California's fishing economy.**

We again recommend that the Council :
[1] retain the status quo management option for the California anchovy fishery, with the current harvest specifications, which represent a reasonable average OFL and precautionary harvest limit, in light of the variability in anchovy abundance and the negligible impact of the fishery on the resource and dependent predators.
[2] acknowledge recent record anchovy recruitment and
[3] recognize the need to expand surveys to completely assess biomass (both anchovy and sardine) in nearshore habitat [inside 50 meters], as well as the upper water column.

Because of its importance to California's historic wetfish industry and negligible impact on the ecosystem, this fishery should be allowed to continue under its current management framework while developing the scientific information needed to review and update reference points.

Thanks very much for your consideration of these recommendations.

Our best regards,



Diane Pleschner-Steele
Executive Director

Dow Jones Factiva

With Data Poor Anchovy Fishery, is the Court the Best Place to Determine the Science? (Opinion)

SEAFOODNEWSW.COM [Santa Cruz Sentinel] By D.B. Pleschner - February 13, 2018

A U.S. District Court judge recently ruled that the federal government's catch limit for California's central stock of anchovy — currently 25,000 metric tons — is far too high.

But instead of weighing all the facts, the judge ignored them, shunned the established precedent of deference to federal agencies' scientific determinations and instead endorsed the flawed arguments of the advocacy group Oceana.

So what happened?

It's a well-accepted fact that the anchovy population on the West Coast has extreme natural variations in abundance, even without fishing. To account for these wild swings, scientists reduced the overfishing limit of 100,000 tons by 75 percent, setting the annual catch limit at 25,000 metric tons. The Pacific Fishery Management Council's Science and Statistical Committee approved the numbers as "best available science" and the National Marine Fisheries Service agreed, recognizing that the anchovy resource ranges from peaks of more than two million tons to orders of magnitude lower and quickly jumps back up again.

In California, the anchovy fishery declined in the 1980s due to adverse market conditions and landings have averaged less than 10,000 tons a year ever since. But this fishery is still important because it keeps the local fleet on the water and processing plant doors open when no other fish are available.

Regardless, environmentalists began lobbying the council in 2015 to curtail California's anchovy catch limit after one advocacy group funded a new research paper that reassessed the basis for anchovy management — a 1991 study based on egg and larval data that represented long-term average biomass abundance, not a single-year stock assessment. Because the reassessment had virtually no adult anchovy biological data from recent years to correlate, the authors had to make assumptions. They concluded that the anchovy population had collapsed, with current biomass estimated at only about 15,000 tons coast-wide.

But other scientists challenged the findings, in part because the new estimate excluded Mexico where a substantial portion of the stock resides, and it also omitted nearshore waters where fishermen were reporting masses of anchovy.

Richard Parrish, retired from NMFS after decades of experience with anchovy, critiqued the paper and stated, "The biomass estimates in the paper cannot be used to estimate the 2016 biomass of the northern stock of anchovy…" He continued, "Clearly, with northern anchovy a five-year-old biomass estimate is not significantly better at estimating current biomass than a 25-year-old biomass estimate." That statement was included in the Administrative Record (AR) for the Oceana lawsuit, but the judge ignored it.

In 2016, the council sponsored a data-poor workshop where internationally recognized scientists reviewed the new egg-larval analysis along with other available data and also rejected the study's findings. As one member said, "The estimate did not pass the straight face test."

Here's why: the new assessment did not consider anchovy fishery landings, which in 2015 totaled about 64,000 tons, only 17,000 tons in California (still under the 25,000 ton catch limit) and the rest from Mexico. As Parrish pointed out, "Clearly, the absolute minimum biomass estimate for 2015, assuming that the fishery caught every last anchovy in the population, would be 64,114 tons. If fishermen took 50 percent of the biomass, based on recorded landings, the estimate would be 128,000 tons and if they took only 20 percent of the biomass, the estimate would be 320,000 tons, massively above the study's assertions."

It remains to be seen what will come next. Will the decision be appealed? Will the council continue to follow its stepwise path to assess the science or be swayed by politics and the court. These are important questions as the fate of California's historic wetfish industry hangs in the balance.

The ultimate question remains, who is best qualified to determine "best available science," the court or knowledgeable fishery scientists.

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STORY TAGS:
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Prey abundance and predator rate of change in the California Current

*The following information is adapted from R. Hilborn et al. / Fisheries Research 191 (2017) 211–221

When does fishing forage species affect their predators? Fisheries Research (Amsterdam).

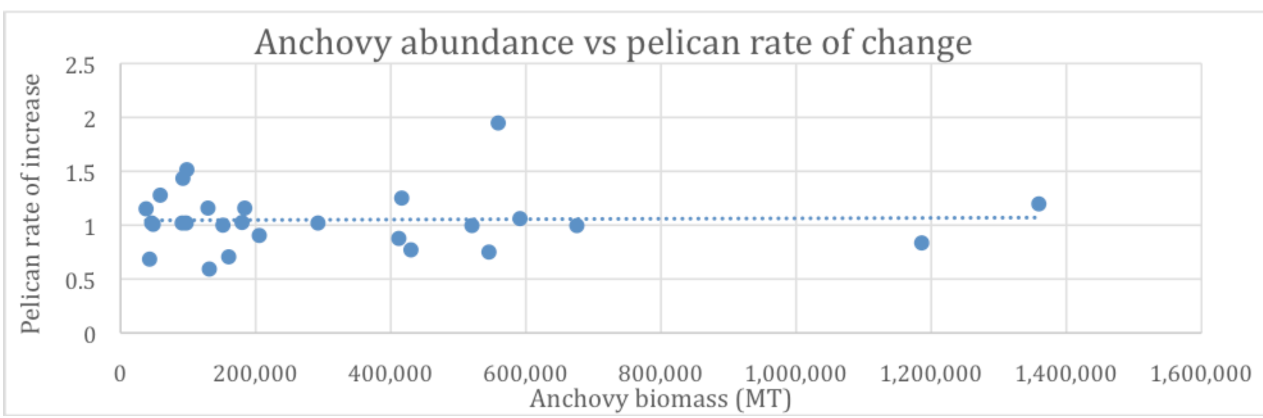
Data compiled by Joel VanNoord, supervising scientist for the California Wetfish Producers Association.

Key findings:

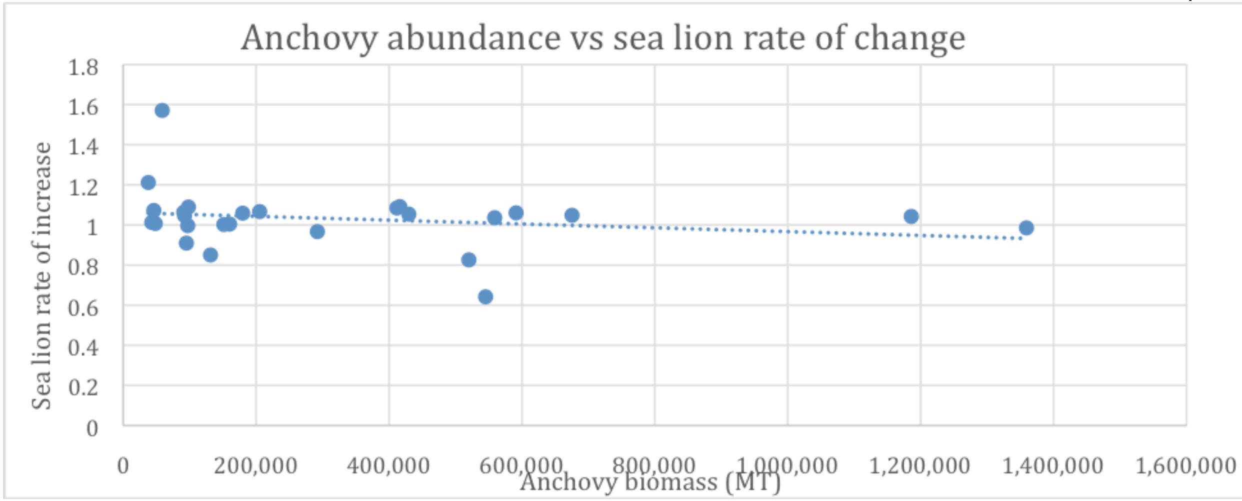
- · Predator rate of increase is uncorrelated with forage fish abundance.
- · Forage species are affected much more by environmental conditions than by fishing.
- · Previous analysis of forage fish impacts on predators ignored natural variability.
- · Spatial distribution of forage species may be more important than their abundance.
- · Predators often take small forage fish that are unaffected by fishing.

Neither anchovy nor sardine abundance influences the rate of change in either Sea Lion or Brown Pelican populations.

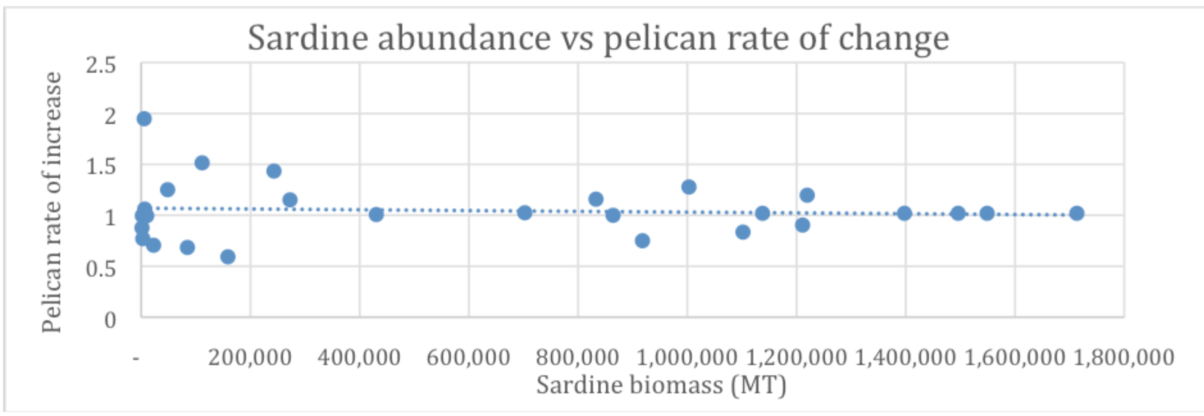
If anchovy or sardine populations controlled the growth rate of predators, we would expect an increasing population growth rate for predators with an increasing sardine or anchovy population. For example, the predator population would increase as more prey became available. Abundance data do not support this, however. We see a constant predator growth rate regardless of the population size of either anchovy or sardine.



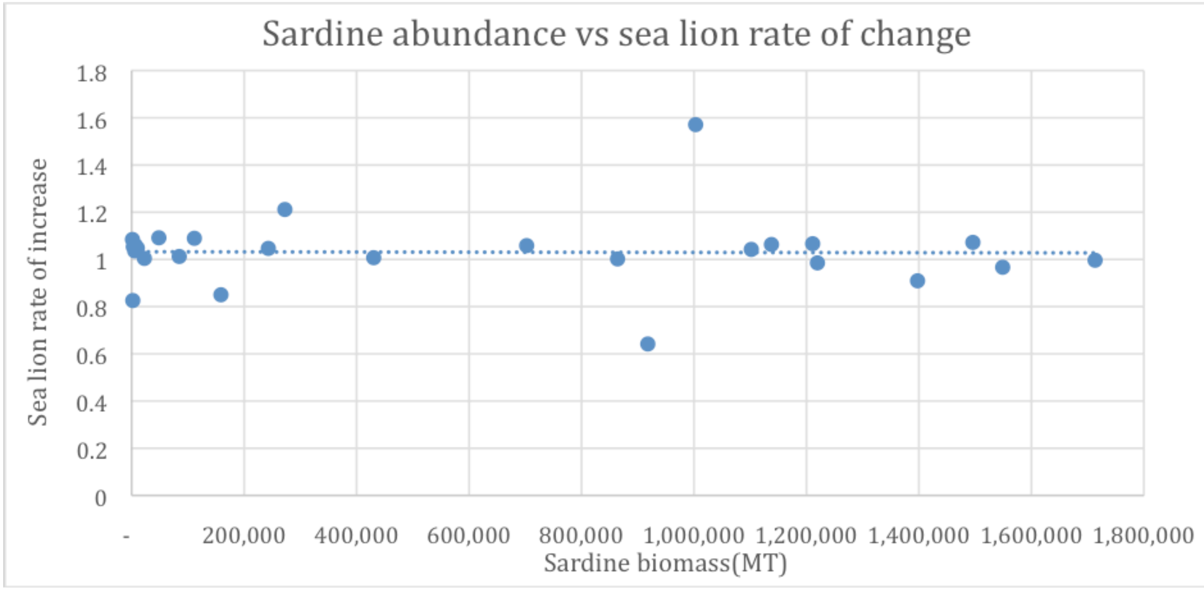
The estimated yearly biomass of the central subpopulation of northern anchovy ranged widely, from ~40,000 to nearly 1.4 million metric tons during the period from 1981-2009. Despite a wide range of anchovy prey available, the rate of increase of pelican nests remained unchanged during the same time period. A rate of change value of 1 indicates no change in the population. This pattern is similar for both predator and prey relationships, shown in the three graphs below.



The amount of anchovy prey available in the water also had little effect on the rate of change on the abundance of sea lion pup counts from 1981-2006.



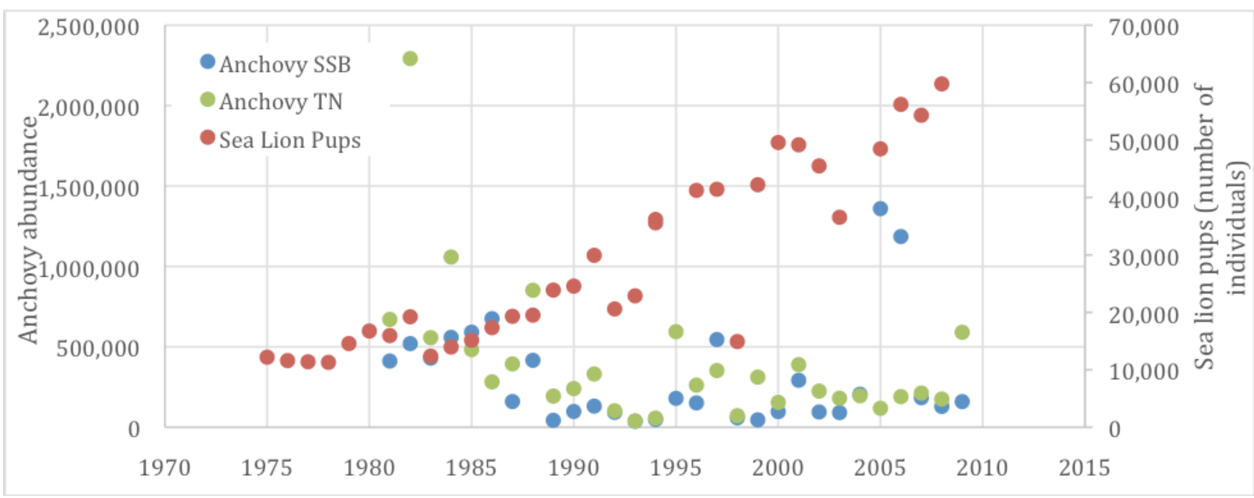
Sardine abundance ranged from < 7,000 to ~1,700,000 MT during the period from 1981-2007. Despite this wide range of estimated prey available in the water from year to year, the rate of change of pelican nests was not affected by this, meaning the growth rate was the same whether there were 7,000 MT of sardine, or 1,700,000 MT.



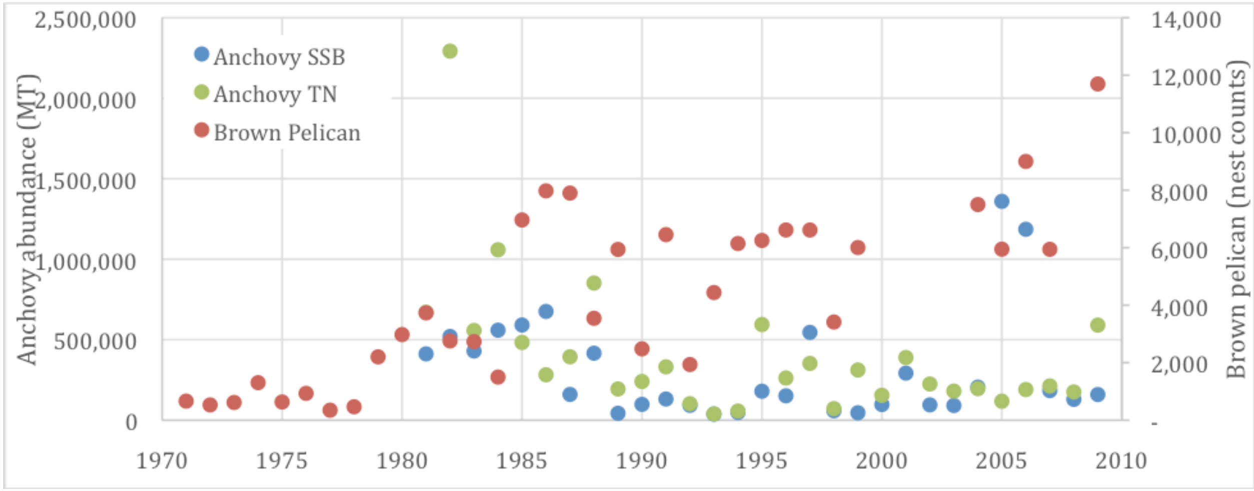
The amount of sardine prey available in the water also had little effect on the rate of change on the abundance of sea lion pup counts during the period from 1981-2006.

Predator populations increased while prey declined

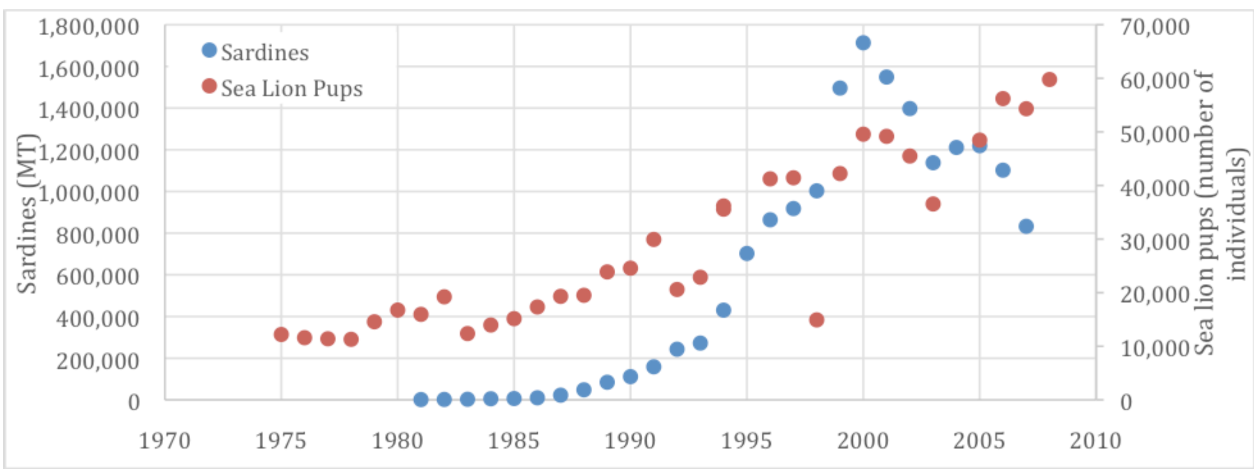
Sea Lion and Brown Pelican abundances have increased steadily from 1971 to 2009 despite declines and variability in anchovy and sardine populations. This is especially evident for anchovy populations, which seem to show an inverse relationship with sea lion pup counts. This shows a thriving predator population increasing over time, despite variability in prey populations and declines in anchovy abundance.



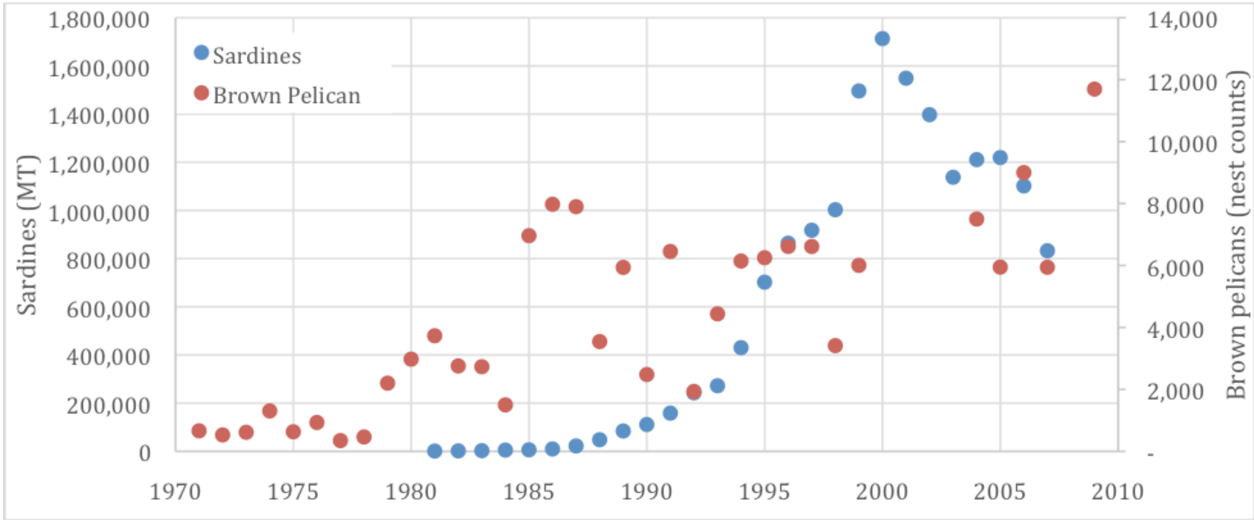
Sea lion pup counts increased dramatically from the 1970's to the present, despite an overall decrease in anchovy biomass available. The sea lion abundance increase is largely associated with the success of increased protections enacted with the 1972 Marine Mammal Protection Act. The major drop in sea lion pup counts seen in 1998 was largely attributed to warm ocean waters caused by the historically strong El Niño of 1997-98.SSB refers to spawning stock biomass, TN refers to total numbers.



Brown pelican nest counts were as low as 663 nests in the early 1970's. These low population levels are largely due to the widespread use of pesticides, such as DDT and dieldrin, which caused high hatching mortality due to a thinning of the egg shells. After the elimination of these pesticides, brown pelican nest counts rose dramatically during the 1980's to a high of ~12,000 nests in 2009, this is despite decreasing and variable anchovy population estimates, indicating that the population recovery was largely due to the removal of poisons from the environment, and not the availability of additional prey resources.



Sardine and sea lion pup counts were in sync from the 1980's through 2000, when the sardine population began to decline, largely due to a changing oceanographic regime. Despite this drop in sardine prey availability, sea lion pup counts continued to increase.

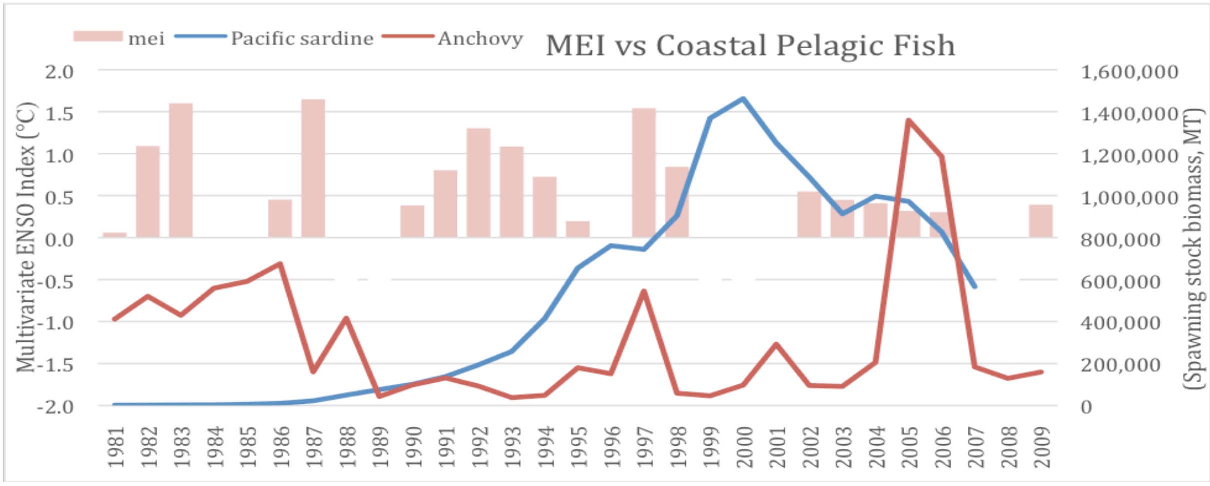


Brown pelican nest counts were very low in the 1970's, in large part to the widespread use of pesticides and such as DDT and dieldrin, which caused a thinning of pelican egg shells. After the elimination of these pesticides, brown pelican nest counts rose dramatically during the 1980's, a period when the sardine population was low. The brown pelican population then leveled off as the sardine population hit an estimated high in 2000 before dropping off again. Brown pelican nest counts were largely uninfluenced by sardine abundance.

Small coastal pelagic fish variability controlled by the environment

Anchovy and sardine are short-lived species that undergo periodic, asynchronous and large-scale population fluctuations that are driven by warm and cool phases of the El Niño Southern Oscillation and the Pacific Decadal Oscillation. We can see that in the time series below, where the anchovy population is initially high, drops, and begins to rebound. The sardine population is initially low, peaks in 2001, and begins to decline. This pattern has been ongoing long before the presence of commercial fishing. Lindegren et al. (2013) modeled the population fluctuation from the 1660's onward and found the same large-scale and asynchronous patterns of population expansion and contraction.

These patterns were concluded to be driven by both density-dependent and density-independent dynamics (Lindegren et al. 2013). Management of these stocks is precautionary, conservative, and successful. Fishing pressure is generally negligible compared to the large-scale effects of environmental forcing.



Notes and sources of data:

Data prepared by:
Hilborn, R., Amoroso, R, Bogazzi, E., Jensen, O.P.,Parma, A, Szuwalsky, C., Walters, C.J. submitted. When does fishing forage species affect their predators? Fisheries Research (Amsterdam).

Brown Pelican: data were extracted from a graph reported at
http://www.esasuccess.org/birds.shtml

California Sea Lion:
Carreta, J. V, Forney, K. A, Oleson, E., Martien, K., Muto, M. M., Lowry, M. S., Barlow, J., Baker, J., Hanson, B., Lynch, D., Carswell, L., Brownell Jr., R., Robbins, J., Mattila, D. K., Ralls, K. and Hill, M. C. 2011. US. Pacific Marine Mammal Stock Assessments: 2011. NOAA-TM-NMFS-SWFSC-448. 356 pp.

Pacific Sardine:
Hill, K.T., Dorval, E., Lo, N. C. H., Macewicz, B. J., Show, C. and Felix-Uraga, R.. 2007. Assessment of the Pacific Sardine Resource in 2007 for U.S Management in 2008 .NOAA-TM-NMFS-SWFSC-41. 157 pp.

Northern Anchovy:
Fissel, B. E., N. C. H. Lo, and S.E. Herrick. 2011. Daily egg production, spawning biomass and recruitment for the central subpopulation of northern anchovy 1981–2009. CalCOFI Rep. 52:116-129.

Lindegren, M., Checkley, D.M. Jr., Rouyer, T., MacCall, A.D., Stenseth, N.C. 2013. Climate, fishing, and fluctuations of sardine and anchovy in the California Current. PNAS. 100:33, 13672-13677.

Abundance of anchovy and sardine correspond to the best estimates of the spawning biomass expressed in metric tons. In the case of the California Sea Lion, the preferred time series of abundance correspond to pups counts. For Brown Pelican, we used the number of nests as a proxy for abundance.

Rate of change for predators was calculated by subtracting the log of next year's abundance from the log of the current year's abundance estimate, divided by the number of years between counts, and then taking the exponentiation of that. So that,

$$h \quad = \quad \log(\quad .\ 2) - \log(\quad .\ 1) \quad 2 - \ 1,$$

Where e is the exponential, abund.y2 is predator abundance in the subsequent year, abund.y1 is predator abundance in the current year, y2 is the subsequent year, and y1 is the current year.

Mr. Phil Anderson, Chair, and
Members of the Pacific Fishery Management Council
7700 NE Ambassador Place #200
Portland OR 97220-1384

Management of the Northern Anchovy in US Waters

By
Richard H. Parrish
March 7, 2018

Summary:

- Fishery management should include both bottom up and top down ecosystem dynamics in establishing the future management of fisheries.

- It is apparent that during the present environmental regime, competition between protected species is far more important than competition between protected species and the U.S. fishery for forage fishes.

- Protected species are a major source of predation mortality of the northern anchovy, and their take heavily outweighs that taken by the U.S. fishery during the 2000 to 2014 period (Table 2).

- The present management regulations have resulted in minimal 2016 landings for sardine (502 mt) and northern anchovy (8,583 mt). These landings are only 0.7% of the total annual take of the key forage fishes by fishes, mammals and birds.

- Assessment of the population size of anchovy in the CCC requires egg and larval surveys during both the spring and summer/fall spawning seasons of northern anchovy, and the population size would be the sum of the two surveys, not the mean.

- Both the MacCall et al (2016) and Fissel et al (2011) estimates of biomass have a negative bias because they do not include young, non-spawning anchovies, anchovies that spawned south of the US-Mexican Border and anchovies spawning inshore of the egg and larvae surveys. They also do not include fall spawning anchovies in the CCC. Age 0 and age 1 anchovies are concentrated in shallow coastal water (Parrish et al. 1985). This negative bias can be readily seen in the landings data (Figure 2), where it is obvious that a very significant biomass of anchovies was present in Northern Baja California.

- It is clear that the ATM and egg and larvae-based assessments of biomass of the central stock of northern anchovy share the inability to assess the recruiting year-class, and they do not include the total area inhabited by the stock.

- The natural mortality rate of anchovy is not well established, if the higher natural mortality rates recently observed in sardine also occur in anchovy, the present anchovy population will be heavily dominated by ages 0 and 1 which largely reside inshore and/or south of the ATM and egg and larval survey grids.

- Further, in the recent methods review of the acoustic trawl surveys now proposed to assess biomass, CIE reviewers recommended that acoustic trawl estimates could be used as a relative index of abundance only if accompanied by surveys of nearshore waters, where the young anchovy are concentrated.

- The most recent CalCOFI larvae based index of the SCC shows a very strong resurgence of the biomass of anchovy (2028 IEA Rep. Figure G.3.1). The 2017 larval index appears to be in the range of that found in the highest years during the peak of the fishery in the 1980s and during the 2005-2006 anchovy population bubble when the anchovy biomass was in excess of 1 MMT.

Comments:

Discussion of the management of the northern anchovy in the California Current System should include an analysis of the role that other species play in the population dynamics of the anchovy as well as the role anchovy plays in the ecosystem.

The northern anchovy is one of the few species that has documented population sizes that have varied by two orders of magnitude over the last century. Sardine is the other forage fish with this magnitude of change, and one predator, the California sea lion, can also be included in this group. The anchovy population size may be affected by the sardine population size due to competition and by the California sea lion due to predation. Population estimates of the sardine and California sea lion are available back to the late 1920s and early 1930s; however, anchovy population indices only go back to 1950.

<u>Anchovy Biomass:</u>

With the exception of the 2005-6 anchovy bubble, the central anchovy stock has not exceeded 0.4 MMT for nearly three decades (MacCall et al. 2016). The lowest population levels appear to be closely associated with the survival rate of anchovy eggs and early larvae. Fissel et al (2011) found "*that egg densities were highly variable while larval densities have been persistently low since 1989. Recruitment estimation suggests that poor environmental conditions have potentially contributed to the low productivity. Mortality estimation reveals through an increasing egg mortality rate that low larval densities were primarily the result of high mortality during the pre-yolk-sac period*."

The decrease in the early life history survival rate is clearly seen in the Fissel et al (2011) analysis (Figure 3). It is clear that environmental conditions affecting the survival rate of eggs and early larval stages are a primary reason for the low population of anchovy in the Southern California Current Region. Oddly, the 2005-6 anchovy bubble does not appear to have been associated with an increase in the survival of larvae as measured by the surveys.

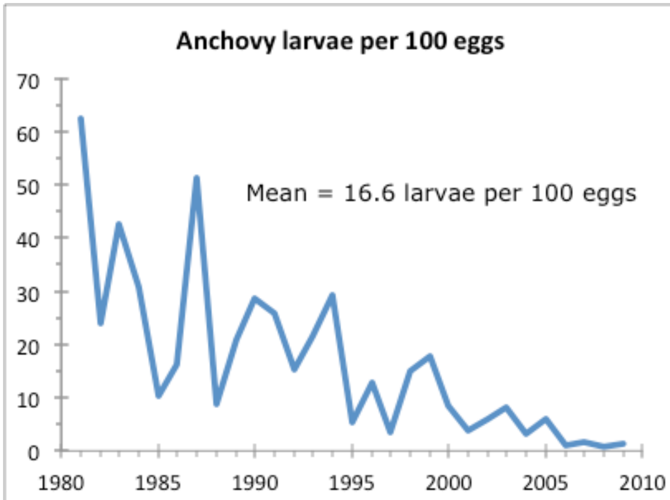


Figure 3. Mean number of anchovy larvae per 100 eggs (from Table 1 Fissel et al 2011)

The 2005-6 anchovy outbreak could be considered an interesting fishery management experiment. The spawning biomass of the central stock of anchovy had been in the 0.1-0.45 MMT range since the decline of the previous anchovy regime, when it suddenly increased to a 2005 peak of 2.0 MMT (MacCall et al 2016) or 1.36 MMT (Fissel et al 2011). The outbreak appears to have been a single year-class, probably 2003, which must have been the result of extremely high reproductive success. This enormous year-class produced the highest spawning biomass recorded (Fissel et al 2011) or one of the highest (MacCall et al 2016). There was no management response to the huge increase in the biomass of anchovy, and this was undoubtedly due to the fact that there was little fishery response to the increase.

The MacCall et al (2016) study shows the spawning biomass in 2003 was about 0.13 MMT, this increased to about 0.6 MMT in 2004 and to a peak of about 2.0 MMT in 2005. The drop in spawning biomass from 2005 to 2006 was about 0.75 MMT and the drop from 2006 to 2007 was about 1.0 MMT. The spawning biomass declined by more than two orders of magnitude from 2005 to 2009. Average U.S. landings from 2005 to 2009 were 0.01 MMT. This small fishery would have had no measureable effect on a population of 1-2 MMT.

It should be noted that both the MacCall et al (2016) and Fissel et al (2011) estimates of biomass have a negative bias because they do not include young, non-spawning anchovies, anchovies that spawned south of the US-Mexican Border and anchovies spawning inshore of the egg and larvae surveys. They also do not include fall spawning anchovies in the CCC. This negative bias can be readily seen in the landings data (Figure 2), where it is obvious that a very significant biomass of anchovies was present in Northern Baja California.

Moreover, the Thayer et al. (2017) update of the MacCall et al (2016) analysis gives a 2015 central stock biomass estimate of 5,300 mt. The California and Northern Baja California landings for that year were 64,114 mt. If fishermen took 50% of the total biomass, an extremely high exploitation rate, the biomass would have been 128,228 mt or 24 times as high as the Thayer et al. (2017) biomass estimate.

In contrast, the most recent larvae based index of the SCC shows a very strong resurgence of the biomass of anchovy (Figure G.3.1); *"Noteworthy observations from 2017 surveys include the increase in relative abundance of anchovy, shortbelly rockfish, and jack mackerel."* (2018 IEA Report). The 2017 index appears to be in the range of that found in the highest years during the peak of the fishery in the 1980s and during the 2005-2006 anchovy population bubble when biomass was in excess of 1 MMT.

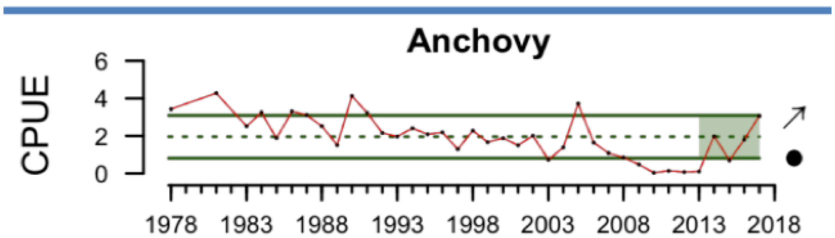


Figure 4. Index of Anchovy Abundance in the Southern California Current Region (Extract from Figure G.3.1 of the 2018 IEA Report: data from larval surveys)

This follows observations in the Rockfish Recruitment and Ecosystem Assessment Cruise Report (October 14, 2015): *"Adult Pacific sardine and northern anchovy catches remained low in all areas as in prior years, but catches of larvae and pelagic juveniles were the highest ever in the core and north and still relatively high in the south (Appendix III)."* (It should be noted that the juvenile rockfish survey was not designed to catch adult sardine and anchovy.)

<u>Natural Mortality Rate</u>.

What caused the 1.75 MMT, 2005 to 2007 decline in the biomass of the central anchovy stock?

The obvious answer is, something ate them!

According to MacCall et al (2016) *"It is reasonable to expect that abundance could recover quickly again if and when favorable conditions return. However, other factors such as predation may be currently limiting population growth. Major anchovy predators, such as California sea lions and humpback whales, have recovered from their very low abundances during the 1950s (Carretta et al., 2014; Calambokidis and Barlow, 2004), and may now be consuming a larger fraction of the anchovy population, especially under the presently low abundances and nearshore concentrations."*

The original estimate of natural mortality (M=0.4) for sardine was made from the extensive information on the age structure in the early fishery (Murphy 1966). This value was used until very recently, when information showed that the recent natural mortality rate has increased substantially. Based on the size structure of sardines sampled in 2003-13, Zwolinski and Demer (2013) estimated the natural mortality rate to be M=0.52, with larger values for both young sardines and old sardines. The most recent sardine biomass assessment uses a natural mortality rate (M=0.6) that is 50% higher than that observed in the 1930s and 1940s (Hill et al. 2017).

If anchovy age composition information from the recent NMFS ATM surveys is available, it could easily be compared to that from the California Sea Surveys carried out during the 1960s and 1970s to assess any increase in natural mortality of anchovy. One can only wonder why this simple analysis has not been carried out.

Table 1. California Sea Lion Population Trends. Pup counts multiplied by 4.317, CDF&G survey counts multiplied by 1.935 (Carretta et al 2013) and forage based on 4.563 mt per sea lion. (Survey and pup counts from Bonnot 1928, Cass 1946, Carretta et al. 2013. Baja estimates from Lowry and Maravilla-Chavez 2005. US carrying capacity from press releases)

	Pup counts	Survey counts	Population estimates	Forage Consumption mt	Annual Growth
USA					
1928	-	1,429	2,800	13,000	9.3%
1938	-	3,882	7,500	34,000	8.6%
1946	-	7,338	14,000	64,000	6.8%
1975	12,000	-	52,000	237,000	5.8%
2000	49,000	-	212,000	967,000	4.3%
2008	68,740	-	297,000	1,355,000	2.3%
Carrying Capacity			275,000	1,255,000	
Baja California (Pacific Coast)					
2000			81,000	369,000	
2018 Projection					
US Carrying Capacity			275,000	1,255,000	
Baja California [1]			105,000	479,000	
TOTAL in 2018			**380,000**	**1,734,000**	

[1] 2018 Baja Estimate = 2000 Baja estimate * US carrying capacity / US 2000 population estimate.

Much of the increase in the natural mortality rate of sardine can be attributed to the difference in the size of the California sea lion population from that present at the start of the original sardine fishery in the late 1920s to the present. Based on the Demer et al. (2015) method of calculating consumption of forage fishes in 1928, during the build-up of the original California sardine fishery, the California sea lion population consumed 0.013 MMT of forage fishes, this rose to 0.237 MMT in 1975 during the peak of the California anchovy fishery, and the projected 2018 consumption estimate for the combined California and Pacific Baja populations of California sea lions is 1.734 MMT (Table 1). According to Carretta et al. (2013) "*Males from western Baja California rookeries may spend most of the year in the United States.*"

It is possible that there has been a larger increase in the natural mortality rate of the central stock of anchovy than that observed in the northern stock of sardine. This is partially due to the fact that the central anchovy stock's distribution closely overlaps that of the California sea lion. In addition, anchovy has the highest frequency of occurrence in the sea lion diet and sardine has the 8th most frequent (Table 3 from Lowry and Carretta 1999). The central stock of anchovy largely remains in the Southern California area and is preyed upon all year. In contrast, older sardine migrate northwards in the late spring and return in the early winter. The abundance of sardine in Southern California is at a minimum in the spring to late fall, when marine mammals and birds that breed and raise their young in Southern California are the most in need of forage.

The major cause of natural mortality in forage fishes is predation. Based on information presented in the recent Koehn et al (2016) California Current ecosystem model and its supplemental information, 52% (684,232 mt) of the annual predation of anchovy is from protected mammals and birds and 48% (633,862 mt) is from fishes. These values are averages of the base 2000 to 2014 period used in the Koehn et al (2016) analysis. Protected species are a major source of predation mortality of the northern anchovy, and their take heavily outweighs the annual take by the U.S. Fishery (8,095 mt) during the 2000 to 2014 period (Table 2).

Table 2. Average (2000-14) annual take (mt) of northern anchovy by protected species and species groups vs. that taken by the U.S. fishery. (Calculated from Koehn et al. 2016: Table 1 and supplemental data).

Common murre	103,082	California gull	23,671
Humpback whale	94,725	Fin whale	22,822
Dolphins	89,179	Western/Glaucous gull	22,027
Porpoises	87,135	Brown Pelican	21,013
Shearwater	52,885	Brandt's cormorant	10,741
Harbor seals	50,677	Rhinoceros auklet	8,724
Sea lions	41,741	**U.S. Fishery**	**8,095**
Fur seals	35,768	Minke whale	6,018

The natural mortality rate of anchovy is not well established, and different authors have used different values. MacCall (1974) found that natural mortality increased with age and suggested that M=1.06 (an annual rate of 65% per year) was the best single estimate. Jacobson et al (1994) 'assumed' a rate of M=0.8 based on the longevity of the species.
If the anchovy natural mortality rate increased by 50%, as observed in sardine, the present natural mortality would be M=1.2 with the Jacobson et al (1994) estimate or M=1.59 with the MacCall estimate. This would give an annual mortality, in the absence of a fishery, of either 69.9% per year or 79.6% per year, and age 1 anchovy would account for 70% or 80% of the age 1+ population.

When age zeros are added, it is clear that, if the higher mortality rates are valid, the present anchovy population is heavily dominated by ages 0 and 1. Much of this biomass is not measured currently because it is inshore of the current survey grids.

Concluding Remarks:

There are now 100 times as many California sea lions as there were in 1928 when the original sardine fishery was developing, and there are 18 times as many as there were in 1975 during the peak of the California anchovy fishery. Populations of other protected species such as the humpback whale are also greatly larger than they were in 1928.

The consumption of forage by sea lions in the California Current was 1.49 MMT based on the information in Koehn et al. (2016). Based on the Demer et al. (2015) methodology the 2008 consumption of forage by the U.S. population of California sea lions was 1.36 MMT and the projected 2018 consumption of the California Current population of California sea lions would be 1.73 MMT (Table 1).

The calculated take of anchovy by the common murre was 12 times larger, humpback whale 11 times larger and the brown pelican 2.5 times than the take of the U.S. fishery in 2000-2014 (Table 2: calculated from information in Koehn et al. 2016).

The natural mortality rate of the northern anchovy is very poorly known, and there is no reason for it to be the same in different regions of the California Current or different time periods. Effort should be made to establish the present rates.

Fishery management should include both bottom up and top down ecosystem dynamics in establishing the future management of fisheries.

In conclusion, it is apparent that during the present environmental regime, competition between protected species is far more important than competition between protected species and the U.S. fishery for forage fishes. The present management regulations have resulted in minimal U.S. 2016 landings for northern anchovy (8,583 mt). These landings are only 0.7% of the total annual take of anchovies in the California Current by fishes, mammals and birds.

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March 16, 2018
Chair Phil Anderson and Council Members
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384
pfmc.comments@noaa.gov

RE: Agenda Item C.4 Process for Review of Reference Points for Monitored Stocks

Dear Chair Anderson and Council Members:

On behalf of Border Grill, I am writing to ask the Council to adopt an ecosystem-based approach to managing northern anchovy given their essential role in the Pacific Ocean food web. This action should include regularly assessing the stock, adopting science-based catch limits, protecting spawning regions at important times of the year, and a precautionary cutoff that suspends fishing when populations are low. Northern anchovies are among the most important forage fish in the California Current ecosystem. These fish are a critical food source for salmon, tuna, brown pelicans, sea lions, humpback whales, and dozens of other marine species.

Like other forage fish, anchovy are known to experience natural fluctuations in abundance, and scientific studies indicate that the stock's central subpopulation, found off California, was in a collapsed condition as recently as 2015. Yet catch limits for the West Coast's anchovy fishery have remained the same since the 1990s, when numbers were much higher.

Anchovy are simply too important to be managed passively. Catch limits and other regulations should correspond and be updated using the best available science, not an outdated number from more than two decades ago.

The Council can ensure adequate prey for everything from whales to salmon, prevent overfishing, and maintain both a healthy ocean and productive and sustainable fisheries by bringing anchovy management into the 21st century.

Sincerely,

Mary Sue Milliken

March 16, 2018

Chair Phil Anderson and Council Members
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, Oregon 97220-1384

RE: Agenda Item C.4 Process for Review of Reference Points for Monitored Stocks

Dear Chair Anderson and Council Members:

On behalf of Crown Prince, Inc., I am writing to ask the Council to adopt an ecosystem-based approach to managing northern anchovy given their essential role in the Pacific Ocean food web. This action should include regularly assessing the stock, adopting science-based catch limits, protecting spawning regions at important times of the year, and a precautionary cutoff that suspends fishing when populations are low. Northern anchovies are among the most important forage fish in the California Current ecosystem. These fish are a critical food source for salmon, tuna, brown pelicans, sea lions, humpback whales, and dozens of other marine species.

Like other forage fish, anchovy are known to experience natural fluctuations in abundance, and scientific studies indicate that the stock's central subpopulation, found off California, was in a collapsed condition as recently as 2015. Yet catch limits for the West Coast's anchovy fishery have remained the same since the 1990s, when anchovy stock numbers were much higher.

Anchovy are simply too important to be managed passively. Catch limits and other regulations should correspond and be updated using the best available science, not an outdated number from more than two decades ago.

As an importer of Moroccan sardines, which are rightly viewed by the government as a vital part of the country's economy and balance of trade, Crown Prince is deeply conscious of the necessity of governmental support in protecting and encouraging sustainable fisheries. The Council can ensure adequate prey for everything from whales to salmon, prevent overfishing, and maintain both a healthy ocean and productive and sustainable fisheries by bringing anchovy management into the 21st century.

Sincerely,

Anddrea Linton
Manager, Natural Products Division
Crown Prince, Inc.

Crown Prince Inc.
18581 Railroad Street, City of Industry, CA 91748