TO WHOM IT MAY CONCERN:

In the last few weeks, I reviewed the peer-reviewed Becker et al. "Evidence for long-term spatial displacement of breeding and pupping harbour seals by shellfish aquaculture over three decades", *Aquatic Conserv: Mar. Freshw. Ecosyst*. (2011)

As a result, I have concluded that:

- **Becker 2011 uses well-established and appropriate statistical methodology that addresses and goes beyond suggestions from the National Research Council**

- **Becker 2011 provides statistically accurate results that confirm a strong inverse correlation between oyster harvest (as well as the related special extent of the operation in Drakes Estero) and harbor seal use of key sandbars preferred by females with pups.**

- **Because of its thorough response to NRC concerns and because of its methodological integrity Becker 2011 conclusion must be given due recognition in evaluating the DBOC controversy. In effect Becker 2011 supersedes rather than complements Becker 2009.**

Details:

Having reviewed the calculations supporting Becker 2011, I concur with the overall architecture of their arguments. In a scientifically appropriate manner, the paper confirms and expands Becker 2009 conclusions by modifying and refining the analysis to reach more reliable and accurate understanding of the situations being considered at several level of geographic granularity (i.e., sub-sites, colony and region).

The National Research Council (NRC) having also reviewed the harbor seal issue in its publication "Shellfish Mariculture in Drakes Estero" suggested (pg 42-44) that *"abundance trends in Drakes Estero should…be considered in relation to wider-scale population trends."* Becker 2011 responds by using population ratios instead of counts and expands the analysis from the sub-site level addressed in the 2009 paper to the colony level (i.e., Drake's Estero, defined in two zone, upper and lower Estero) and the regional level (i.e., all seal hauls out around Point Reyes Peninsula).

The NRC suggested that the 11 years of Drakes Estero data in Becker 2009 (1997-2007, specifically excluding 2008) *is "not sufficient to make a robust comparison of trends at other sites in the Point Reyes region with even fewer years of standardized count data."* Becker 2011 responds by including 10 more years of data in Drakes Estero, specifically including 2008 and also newly includes 15 years of regional data.

The NRC noted that Becker 2009 relied on both harvest data and disturbance data to reach its conclusions, but noted that "[disturbance] *data have more limited utility in estimating changes in the level of disturbance with the Estero or in the relative importance of different disturbance sources*. Becker 2011 responds by not relying on disturbance data in its analysis.

The NRC also noted that *"use of the annual oyster harvest as a proxy for disturbance rate at the haulout subsites relies on the assumption that mariculture methods and daily activities have not changed over the 11 years that were analyzed. Some potential confounding factors include changes in the fraction of harvest from oysters cultivated using the rack system (mostly more distant from the haul out sites) and the fraction cultivated in bags placed on sand bars also used by seals as haul out sites."* Becker 2011 responds by adding data based on photographs of the size of areas actually used each year for bag mariculture activities which occur on the sandbars used by the seals.

In addition to the NRC suggestions, Becker 2011 also models ENSO with a non-linear characteristic which dampens the effect of past El Niňo events in a non-linear (e.g., logarithmic) way.

Furthermore Becker 2011, like Becker 2009 uses a methodology grounded in the Generalized Linear Model (GLM) framework which has been used extensively in a variety of applications and has been theoretically further developed to address the specific requirements of ecological modeling.

So, to address the colony level questions, NPS used the R procedure `glmmML` to account for random effect beyond the standard error. To confirm the result of this analysis it also considered the effect of autocorrelation between surveys with the procedure `Geeglm`, and, finally, used a bootstrapping procedure to confirm the unbiased nature of these results. The concurrent use of these procedures - which are all part of the GLM framework -served to confirm the coherence of their results, not unlike looking at the same object from different perspectives.

To address the regional level questions NPS used the standard procedure `glm` to establish an information criterion adjusted for dispersion and small sample size (QAICc), which help to select models used to construct a weighted multi model to explain regional seal population dynamics. As a follow up, the authors conducted a Baysian analysis which, despite a stricter information criterion (BIC), yielded results commensurable with the results from the *glm* analysis .

These methodologies are considered standard in the field of ecology (e.g., biological diversity, forestry , population estimate in capture-recapture models) so they seem an appropriate choice for the analysis of seals population dynamics. In fact the authors of the main reference quoted in Becker et al. (*David Anderson and Kenneth Burnham (2002))* are both involved in ecological population studies and were close collaborators with Jean-Dominique Lebreton (CNRS, center for evolutionary and functional ecology) and Jean Clobert (CNRS/ENS Experimental ecology), who were pioneers in the development of these statistical techniques.

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