



United States Department of Commerce  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Alaska Fisheries Science Center  
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Memorandum For: Douglas Mecum, Acting Regional Administrator  
NMFS Alaska Region  
Kaja Brix, Director  
Protected Resources, NMFS Alaska Region  
From: Douglas DeMaster, Director  
NMFS Alaska Fisheries Science Center  
John Bengtson, Director  
NMFS AFSC National Marine Mammal Laboratory  
Subject: Review of Maniscalco et al. (2009), ASLC-0901

The Alaska Fisheries Science Center was asked by the Protected Resources Division, Alaska Region, to review Alaska SeaLife Center Technical Report ASLC-0901 entitled, "Evidence for high natality rates among Steller sea lions in the Gulf of Alaska". ASLC-0901 contains an analysis of data that describe the birth rate of primarily naturally-marked female Steller sea lions observed on Chiswell Island, a relatively small rookery in the eastern Gulf of Alaska (GOA). ASLC's Chiswell study results are significant because there are only two longitudinal natality studies of the endangered western stock of Steller sea lion currently underway, ASLC's and NMML's. A thorough analysis of ASLC's data would make an important contribution to our understanding of spatial variation in Steller sea lion vital rates. We recognize that ASLC is continuing to analyze the data contained in ASLC-0901 and we offer our comments and suggestions to the authors in an effort to improve their analysis.

The AFSC reviewed ASLC-0901 and re-analyzed the data in Appendix 1 using mark-recapture and full probability models to estimate natality and survival rates of the Chiswell females (see attached review of ASLC-0901 and report by D. Johnson). We used models specifically designed to analyze mark-recapture data instead of the *ad hoc* method used by ASLC. Mark-recapture models account for some, but not all, of the sampling biases inherent in the ASLC study design, and incorporate these biases and uncertainties into the natality rate estimate and its variance. As a result, AFSC's estimate (in the Johnson report) of the mean natality rate (probability of giving birth to a live or stillborn pup each year, as defined by ASLC) of the Chiswell females (0.54: 0.46 – 0.63) is ~10% lower and has wider 95% confidence bounds than ASLC's estimate (0.60: 0.54 – 0.64). A separate cohort analysis was also done (see report by E. Holmes), and resulted in a natality rate estimate (point estimate of 0.52 assuming a non-declining population) that was similar to that of the mark-resight analysis. These independent natality rate estimates are only slightly higher than the mean of 0.49 predicted by Holmes et al.(2007) for the central GOA Steller sea lion population during the same period.

There are two sampling biases in the Chiswell study design that are improperly accounted for in the analysis presented in ASLC-0901. First, in order to become part of the study group, a female must be observed at a rookery (Chiswell I.), where the vast majority of sea lion births occur. Thus, females with lower natality appear in the data set less frequently than females with high natality. Second, almost all of the observations of these females occurred at a rookery. Both of these factors would yield natality rates which were biased high compared to the true natality rate of all females in the Chiswell study group since the proportion of females producing a pup is known to be higher on rookeries than on haulouts. Mark-recapture and cohort models do a better job of estimating the effect that these biases have on the natality (and survival) rate estimates for the Chiswell study group than the *ad hoc* method used by ASLC.

However, there is a third sampling bias that cannot be estimated because the data in ASLC-0901 Appendix 1 contain no information on female sea lions that never appear at the Chiswell rookery yet are 'mature' (old enough) and reside in the eastern Gulf of Alaska. These females are likely to have a lower reproductive rate than those in the Chiswell study group because they have never been observed at the rookery, where the vast majority of breeding and births occur. As a consequence, the true natality of the eastern Gulf of Alaska population likely to use the Chiswell rookery is likely lower than both the AFSC and ASLC estimates. If a female is mature and breeds exclusively at another eastern Gulf of Alaska rookery (Seal Rocks or Fish Island), then they are not part of the Chiswell group at all and there is no information within the Chiswell data to estimate their natality. This third sampling bias precludes extrapolation of ASLC's or AFSC's Chiswell natality rate to the larger Gulf of Alaska Steller sea lion population; as such, it was inappropriate for the authors of ASLC-0901 to do so.

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