Nutritional Limitation? An Alternative Hypothesis

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Steller sea lions of the western stock in Alaska have declined substantially over the past 25 years or so. Although there is considerable variation in the spatial and temporal patterns of decline we are now at the point where nearly all regions within the western Alaska stock have declined by over 80%. Although not as well documented, we have seen similar declines of harbor seals (*Phoca vitulina*) within this region (Pitcher 1990, Frost et al. 1999).

After reviewing all data available to me I am convinced that the information now available justifies serious consideration of an alternative hypothesis to the current working hypothesis of nutritional limitation. I think that one of the things that has made this whole issue difficult to understand is that the North Pacific Ocean is a dynamic environment and we often try to understand what we are currently observing with data collected in past years under different environmental conditions.

There is substantial evidence that during the 1970s declines of Steller sea lions and harbor seals occurred in conjunction with nutritional stress (Jemison 1997, Calkins et al. 1998, Pitcher et al. 1998). It is probable that changes in prey availability brought on by climate change in the North Pacific Ocean played a significant role in these declines (Springer 1998, Anderson and Piatt 1999) although several aspects of timing of the decline do not fit well, namely that the decline in the eastern Aleutian Islands began before the 1976-1977 shift and that the decline in the northeast Gulf of Alaska may not have started until the late 1980s.

Something appeared to occur around 1989-1990 both in regard to Steller sea lion and harbor seal population dynamics and in regard to the ocean environment. In some areas the decline of Steller sea lions, particularly the eastern Aleutian Islands and the western Gulf of Alaska, and of harbor seals (Tugidak Island) appeared to moderate. It is also my under-

standing that changes in the ocean environment probably also occurred at about this time (Springer 1998). A number of studies evaluating the nutritional status of adult female and neonatal pup sea lions took place during the 1990s. Surprisingly, nearly all results appeared to indicate that the nutritional status of western stock animals was similar or even superior to those in southeast Alaska where the population was increasing. Following is a brief summary of those findings.

- While pup masses at birth were similar between populations, pup growth rates were higher in the west (Brandon 2000).
- Pup masses at one month of age were greater in the west (Merrick et al. 1995, Rea et al. 1998).
- Foraging effort, as defined by foraging trip length and time spent ashore, for females with pups on rookeries was less in the west (Brandon 2000).
- No evidence that pups <1 month of age from the west were nutritionally compromised based on blood chemistry and hematology (Rea et al. 1998).
- Masses of adult females greater in west (Adams 2000) and perhaps fatter in west (M.A. Castellini, Institute of Marine Science, University of Alaska Fairbanks, pers. comm.).
- Behavioral observations of maternal attendance patterns and activity budgets were not consistent with the hypothesis that animals from the western stock were having greater difficulty obtaining prey compared to those from the eastern stock (Milette 1999).

More recent work has focused on growth and body condition of juvenile Steller sea lions. While we are in the early stages of this work and our sample size is small, particularly in the west, we have found nothing to suggest that either growth or body condition is less for western stock animals than it is for juveniles from southeast Alaska. Mass at birth appears similar between pups in southeast Alaska and the west but growth rates appear higher in the west supporting the findings of Brandon (2000). Body composition estimates, if anything, suggest better condition in western stock animals. Data from harbor seals on Tugidak Island in the Gulf of Alaska also suggested improved nutritional status during the 1990s. For example, pupping dates were earlier in the 1990s than in the 1980s. In addition, haulout patterns indicated that animals from the 1990s were able to capture prey more easily than in the 1980s (Jemison 1997).

Comparisons of indices of Steller sea lion abundance and prey abundance suggest that on a per capita basis, prey availability is substantially higher than it was during the late 1970s or is currently in southeast Alaska where the population is increasing.

The question remains: why are Steller sea lion numbers in the western stock continuing to decline if adequate quantities of prey are available and the animals are not nutritionally limited? One possibility is that the combined sources of non-nutritionally linked mortality are high enough, in relation to current population size, to prevent recovery and cause additional declines in some areas. I loosely refer to this as the predator pit hypothesis. Mortality factors may include predation by killer whales and sharks, subsistence harvests, illegal shooting, incidental take in fisheries, rookery trauma, and entanglement in marine debris.

While I suspect that the original decline was largely due to nutritional factors and that the current population may be regulated by non-nutritionally linked mortality factors, there are several research findings that I find bothersome. These issues should not be ignored. These include findings of elevated haptoglobin levels in the west (Zenteno-Savin et al. 1997), elevated PCB and DDT metabolites in Steller sea lions from a portion of western stock range (unpubl. data), elevated mercury in the western stock (L.K. Duffy, Dept. of Chemistry, University of Alaska Fairbanks, unpubl. data), abnormal porphyrin ratios (L.K. Duffy, unpubl. data), and abnormal hemograms (K.B. Beckman, College of Veterinary Medicine, University of Illinois at Urbana Champaign, unpubl. data). These findings are suggestive of stressors such as toxins and diseases but I have no idea of their importance or if they are significantly affecting population dynamics.

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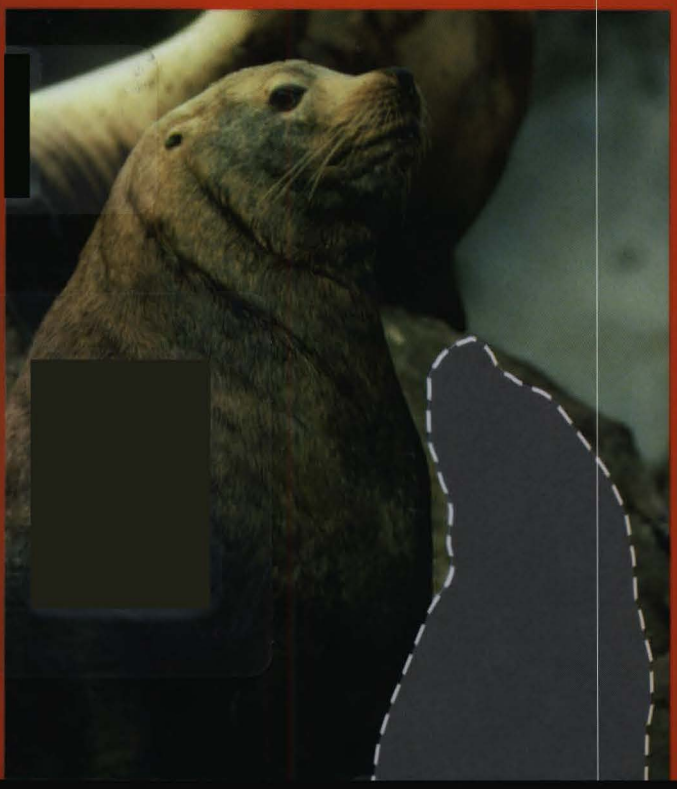
STELLER SEA LION DECLINE: IS IT FOOD II



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