Population Trends, Diet, Genetics, and Observations of Steller Sea Lions in Glacier Bay National Park

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Abstract. We are using demographics, scat analysis, and genetic measurements of Steller sea lions (SSLs)to understand the factors affecting population status throughout Alaska. Steller sea lions are listed as threatened throughout Southeast Alaska including Glacier Bay National Park where they frequent at least five terrestrial sites, including a recently established rookery on Graves Rock. Breeding season counts in GBNP increased at ~6 percent/yr between 1989 and 2002. Brand resighting during 2003 revealed 16 western stock SSLs seen within the park. Survival to two months of age was 90 percent. Fifty pups were branded at Graves Rock in 2002. It is necessary to mark more animals to estimate annual survival rates of juveniles and adults. Sandlance and pollock were top prey items at Graves Rock and South Marble Island. Mitochondrial DNA analysis indicates that the Graves Rock rookery was established in part by females from the western sea lion stock (west of 144° W longitude).

Introduction

The Steller sea lion (*Eumetopias jubatus*, fig. 1) is listed as an endangered species west of 144° W longitude and threatened to the east including Glacier Bay National Park (GBNP; fig. 2). The two populations are genetically distinct (Bickham and others, 1996) and have experienced opposite population trends in recent years with the eastern stock increasing at approximately 3.7 percent (95 percent CI 2.7-4.6 percent/yr) annually between 1990 and 2002, and the western stock decreasing at approximately 4.2 percent (95 percent CI -3.2 to -5.2 percent/yr) annually between 1991 and 2000 (Fritz and Stinchcomb, 2005) . The Alaska Department of Fish and Game and collaborators have been observing and handling Steller sea lions in both regions with research oriented towards understanding differences between the populations. Here we present briefly the recent results of ongoing work involving mark-recapture analysis from marked individuals, prey assessment from scat, and genetic data suggesting that recruitment into the Glacier Bay population includes individuals with western stock lineage.

Figure 1. Branded Steller sea lion on a haul out in Southeast Alaska. Each marked sea lion has a unique letter-number combination that identifies the individual. The preceding "F" on this individual signifies its birth place as the Forrester Island complex near Prince of Wales Island, Alaska.

Methods

An aerial survey of Steller sea lions in Southeast Alaska (SEA) including Glacier Bay has been conducted when possible during the last few years. Sea lions were counted from photographs taken with either a 35 m camera shot from the side, or a belly-mounted medium format camera of haulouts and rookeries. As part of a larger program designed to collect life history data on Steller sea lions in SEA, we have been hot-branding pups with unique letter-number combinations for identification throughout their lives. In late June of each year pups from various rookeries were captured by hand, anesthetized and hot-branded. Measurements and

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tissue samples were collected at the same time. Throughout subsequent years, resightings of these marked individuals are used to track various demographic parameters such as survival, age of first reproduction, reproductive rate, and fidelity to rookeries. During June–July of each year scat was collected from most haulouts and rookeries in SEA including Graves Rock and South Marble Island in GBNP. Prey analysis was generated by identifying the bones of species represented in the scat and calculating the percentage of occurrence for each species appearing in greater than 5 percent of the scats. The mitochondrial DNA haplotype composition and comparison of each rookery in SEA was determined with DNA extracted from tissue samples collected from pups at the time of branding. A permutation chi-square test was used in a pairwise comparison of the rookeries.

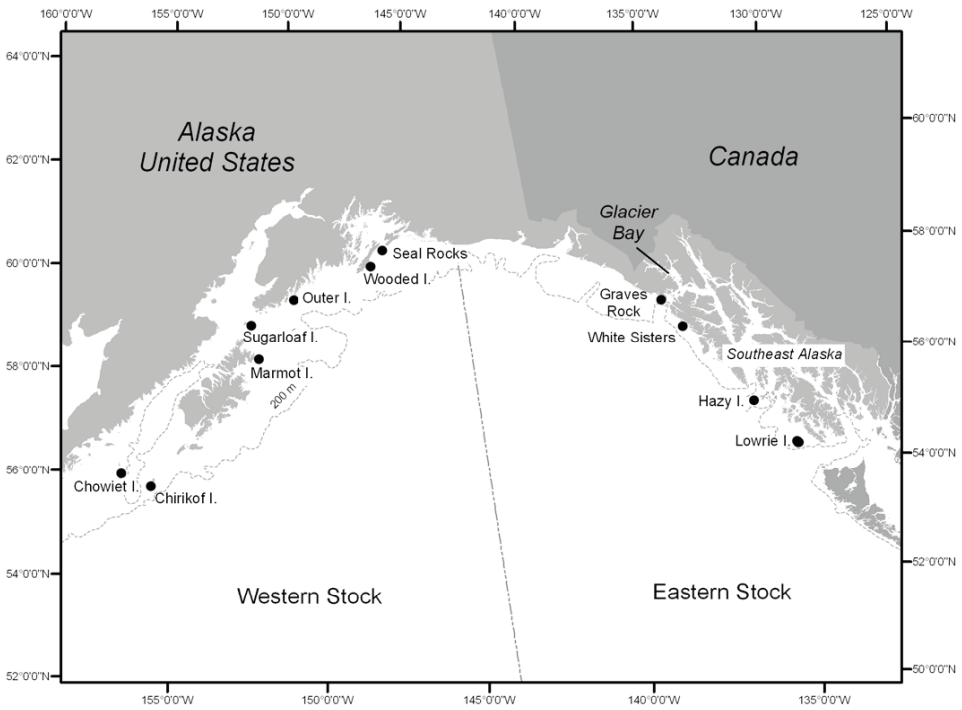

Figure 2. Location of Steller sea lion rookeries in the Eastern Gulf of Alaska and Southeast Alaska. The geographic boundary between the endangered western stock and threatened eastern stock is identified by a line at 144° W longitude.

Results

Demographics

Aerial surveys of non-pups at South Marble Island in Glacier Bay recorded no sea lions in 1992 and 42 in 1993. Since that time the count has increased at a rate of approximately 38 percent/yr including all age classes. In 1998, pups were first seen at Graves Rock, the only rookery in the park; 94 pups were counted four years later. In June of 2002, 50 pups were branded with the letter "V" followed by a number. Preliminary mark-recapture analyses of resightings demonstrate a minimum survival rate of 90 percent for the first two months post-branding. Preliminary minimum estimate of first year survival was similar to that of pups from other rookeries in SEA at ~50 percent. Interestingly, the sex ratio of branded pups was skewed with over twice as many males handled (34) compared to females (16). Since ADF&G re-initiated branding and brand-resighting programs in SEA in 2001, 42 sea lions branded in the western stock have been observed east of the stock boundary. Approximately 79 percent of these were seen in GBNP.

Prey Analysis

Species identification from scat collected in 2001 indicated that sandlance, pollock, and capelin were the most frequently consumed prey by animals at South Marble Island whereas sandlance, pollock, and arrowtooth flounder dominated at Graves Rock (fig. 3). A sample collected in 1994 at Graves Rock highlighted a possible change in prey usage in the interim with pollock and salmon dominating and sandlance occurring at a reduced frequency in 1994.

Genetics

The haplotypic diversity of mitochondrial DNA extracted from pups born in 2002 at Graves Rock differed significantly from Lowrie Island and the White Sisters Islands (P=0.0001 between Graves and Lowrie, and P=0.014 between Graves and White Sisters)), the two largest rookeries in SEA (fig. 4). The differences were due to the presence of "western stock" haplotypes at Graves Rock. The White Sisters rookery to the south of Graves Rocks is the only other rookery tested in SEA and found to have animals present with some of these same haplotypes. The presence of these haplotypes in newborn animals and the age of the rookeries suggest that these new rookeries were founded by females from both the eastern and western stocks after the designation of the original population subdivisions which created the stock boundary.

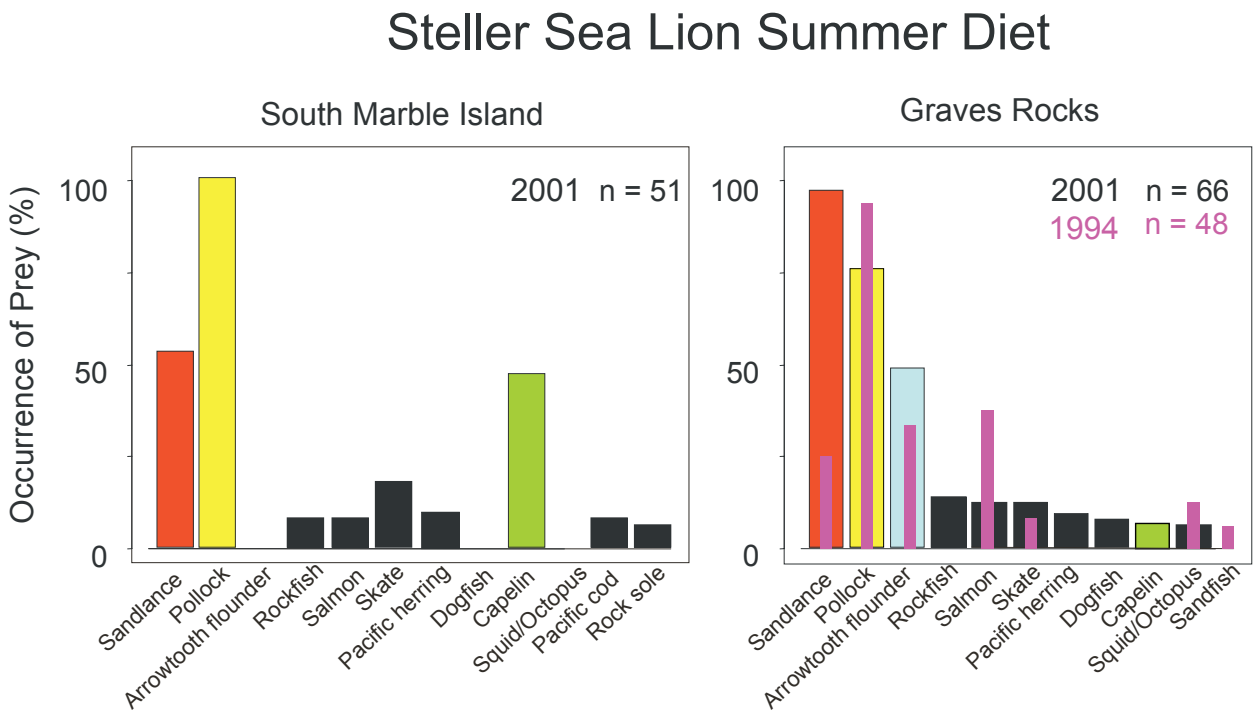

Figure 3. The frequency of occurrence of predominant prey items found in scat from Steller sea lions at Graves Rock (1994 and 2001) and South Marble Island (2001 only) in Glacier Bay National Park. Figures show species occurring in greater than 5 percent of scats.

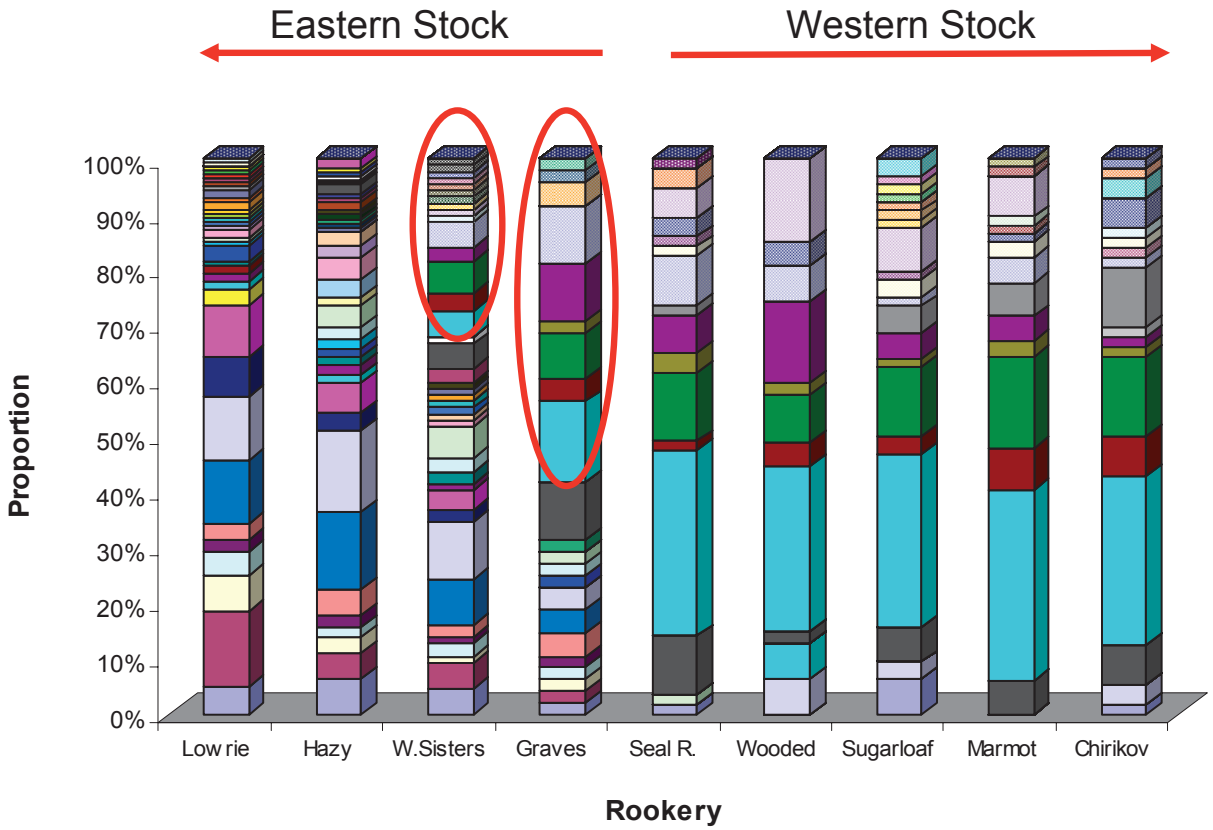

Figure 4. Distribution of mtDNA haplotypes in Steller sea lion pups sampled at rookeries in Southeast Alaska (Eastern stock) and Gulf of Alaska (Western stock). Each shaded color represents a unique mtDNA haplotype. The circles at White Sisters and Graves Rock rookeries delineate haplotypes commonly found in Western stock rookeries but not seen in any other Eastern stock rookeries.

Discussion and Conclusions

The eastern stock of Steller sea lions, primarily those in SEA, have increased on both a regional and local scale during the last 10 years. Notably, within GBNP the number of sea lions using South Marble Island as a haulout continues to increase as does the new rookery at Graves Rock. More western stock-branded sea lions were seen within the park than any other area in the eastern stock. Collectively, when considering these sightings in the context of genetic data that indicates western stock females have given birth at Graves Rock, it seems apparent that the dynamics of the northern portion of the eastern stock are different than that seen elsewhere in the species range. Post-branding pup survival was similar to that seen at other rookeries in SEA, and future work should focus on branding pups and resightings to estimate long-term survival for comparisons.

The skewed sex ratio of captured pups may reflect a bias in the sampling although similar capture methods used on other rookeries has usually produced approximately equal numbers of males and females. Alternatively, a continuing topic in science is the hypothesis that if female condition influences the ultimate success of male offspring, then females in better than average condition should produce more males (Trivers and Willard, 1973; Kruuk and others, 1999). Graves Rock is a recently established and growing rookery founded by immigrants, and could be argued to be facing less density dependent factors than older rookeries in the region. Under this hypothesis we would expect to see the pup sex ratio move towards equilibrium as the rookery reaches carrying capacity. Therefore, additional sampling of pups in the future could provide an index of the population trajectory at the Graves Rock rookery.

The diet of Steller sea lions as indicated by scat was found to be similar to other regions in SEA in terms of the types of species consumed. Differences in frequency of occurrence likely reflect regional differences in availability (Arimitsu and others, 2003). We do not know if the change in dominant prey types between 1994 and 2001 at Graves Rocks is indicative of a local change in prey availability, animal selection, or seasonal difference.

Management Implications

Steller sea lion use of GBNP has increased in recent years. Greater haulout use and relatively high numbers of branded animals distinguish South Marble Island as an important area for resightings used in life history analyses. Genetic data on newborn pups suggest that female dispersal from the western stock may be greater than that noted at the time of the original population subdivision (Bickham and others, 1996; Loughlin, 1997). As the eastern stock of Steller sea lions has increased, the greatest growth in numbers has appeared at this northern edge as evidenced by Graves Rock. The most efficient way to monitor the growth and success of this rookery is through the continuation of marking, resighting, and prey and genetic studies. By applying similar survival rates seen at other rookeries where branding has been conducted for years, we know that the small sample of 50 pups branded in 2002 will not provide a large enough cohort to estimate annual survival to breeding age. Continued data collection, including marking, is imperative in order for the NPS to manage Steller sea lion use areas in the future. Managing this resource without investigating the reasons for differences from other rookeries in SEA would be an oversight for such a unique location.

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Suggested Citation

Gelatt, T.S., Trites, A.W., Hastings, K., Jemison, L., Pitcher, K., and O'Corry-Crow, G., 2007, Population trends, diet, genetics, and observations of Steller sea lions in Glacier Bay National Park, *in* Piatt, J.F., and Gende, S.M., eds., Proceedings of the Fourth Glacier Bay Science Symposium, October 26–28, 2004: U.S. Geological Survey Scientific Investigations Report 2007-5047, p. 145-149.

A group of sea lions in lower Adams Inlet, looking west. (Photograph by Bill Eichenlaub, National Park Service.)