

**FEDERAL AID
INTERIM PERFORMANCE REPORT**

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

**Alaska Department of Fish and Game
State Wildlife Grant**

Grant Number: T-11 **Segment Number:** 1
Project Number: 1.0
Project Title: Steller sea lion population and health assessment in Alaska
Project Duration: 1 July 2008 – 30 June 2010
Report Period: July 1, 2008 – June 30, 2009
Report Due Date: September 30, 2009
Partner: Alaska Department of Fish and Game

Project Objectives

OBJECTIVE 1: Estimate vital rates of Alaskan Steller sea lions through mark-recapture studies of branded individuals. Age-specific survival and natality rates are needed to model the dynamics of SSL populations in Alaska and to determine processes responsible for observed trends.

JOB/ACTIVITY 1A: Estimate age- and sex-specific survival probabilities. Data for annual survival estimates will be provided by a standard survey of all major rookeries and haulouts in Southeast Alaska and Prince William Sound.

JOB/ACTIVITY 1B: A video monitoring system will be installed at Lowrie Island to document early pup mortality.

JOB/ACTIVITY 1C: Data on reproductive performance of females in Southeast Alaska will be collected during multi-day surveys at all breeding rookeries.

JOB/ACTIVITY 1D: Investigation of remote-sensing and other available data on ocean conditions and prey abundance and distribution to determine underlying mechanisms for geographical and temporal variation in SSL vital rates.

OBJECTIVE 2: Develop indices of weaning and identification of diet composition for juvenile Steller sea lions. Preliminary analyses of stable isotope signatures along the length of vibrissae collected from juvenile sea lions (ages 3 to 24 months) suggest that relative changes in the ratios of carbon and nitrogen isotopes may prove to be a valuable index of shifts in diet such as that expected during the weaning period.

JOB/ACTIVITY 2A: Analysis of stable isotope (^{13}C and ^{15}N) profiles in free-ranging Steller sea lion vibrissae to determine changes in trophic signature of their diet over time.

JOB/ACTIVITY 2B: Analysis of stable isotope (^{13}C and ^{15}N) profiles in vibrissae collected from captive Steller sea lions during a controlled feeding study.

JOB/ACTIVITY 2C: Fatty acid signature analysis of blubber lipids to identify changes in diet source (i.e. biochemical weaning markers).

OBJECTIVE 3: Evaluate nutritional limitation in juvenile Steller sea lions in the western Alaska population. Underwater capture techniques have allowed us to obtain body measurements and

tissue samples to evaluate growth, body condition, health, and weaning status of juvenile SSLs from the western Alaska population in relation to those from Southeast Alaska where the population has been increasing.

JOB/ACTIVITY 3A: Analysis of body condition using body fat content measured by the deuterium dilution technique and using body morphometrics and blubber depth measurements.

JOB/ACTIVITY 3B: Laboratory analysis of blood metabolite chemistry and hematology.

Summary of Project Accomplishments:

JOB/ACTIVITY 1A: Estimate age- and sex-specific survival probabilities. Data for annual survival estimates will be provided by a standard survey of all major rookeries and haulouts in Southeast Alaska and Prince William Sound.

Three research cruises and two field camps were supported during this reporting period for the purpose of collecting brand-resight data for vital rates estimation. Steller sea lion (*Eumetopias jubatus*) rookeries and haulouts throughout Southeast Alaska (SEA) were surveyed from 27 June to 12 July 2008 to observe branded Steller sea lions (SSL), photograph and record entanglements, estimate numbers of animals on shore, and collect scat in conjunction with the University of BC. Resightings of branded individuals will be used to estimate vital rates such as survival, recruitment, and dispersal and to describe seasonal distribution patterns. Haulouts and rookeries were surveyed in Alaska from Graves Rock (Cape Spencer) in the north to Cape Addington in the south. We used two vessels and two crews to conduct surveys in northern SEA and central-southern SEA simultaneously. A count was made of all SSL that could be seen. This count is likely low as some animals were difficult or impossible to see, especially those in low-lying areas. Observers used binoculars (8X to 14X) to conduct counts and read brands. When a branded animal was seen, the boat approached closer to the haulout and digital photographs (Nikon D100 or D1X cameras) were taken. When possible, each branded animal was photographed several times and once out of the field, one to four of the best photographs were saved. When a branded animal was observed the following data were recorded: brand number, brand quality, brand verification check (observer reads and records brand number, reads brand a second time and verifies the brand number written down), status (*e.g.*, female with pup, pup suckling), tag color and number, and comments. When possible, sex and age class (pup, juvenile, adult) were recorded.

Steller sea lion rookeries and haulouts in Prince William Sound (PWS) and the Northern Gulf of Alaska were surveyed July 16-25, 2008 to observe branded animals, to document birth of pups to branded animals, and to estimate numbers of animals on shore. The principle objectives of this trip were to provide annual resighting data for survival studies and to survey breeding age females (≥ 4 yrs of age) for reproductive studies in PWS. Nine sites were surveyed in PWS and along the outer coast from Point Elrington to Seal Rocks. Sea lions and branded animals were present at all sites except The Pleiades. 129 individual branded Steller sea lions were identifiable in photos. A total of 52 branded males were observed; 45% (13 of 29) of males of known natal rookery were born in the eastern stock (12- from Southeast Alaska, 1-from St. George Reef, California). No branded females from the eastern stock were observed.

Personnel were deployed to the Lowrie Island field camp in southeast Alaska from mid-May to July 2008 to undertake observational research. Age specific survival and reproductive rates of sea lions was assessed on Lowrie Island and 4 nearby offshore pupping areas in the Forrester Island complex . Steller sea lions at Sugarloaf Island, Alaska were surveyed July 19-26 2008 to observe branded animals, document pupping of branded animals and to estimate numbers of animals on shore. A simple camp was deployed for 8-days. A chartered 25' water taxi out of Homer, Alaska (F/V Triton) was used to transport gear and people to and from the island, requiring a 3 hour boat ride. 11 surveys were conducted at the north site and 8 at the west site where 46 individual branded non-pups were identifiable in photos; 34 females and 12 males. The principle objective of this trip was to survey breeding age (≥ 4 yrs of age) females for studies comparing reproductive performance between eastern and western stocks.

JOB/ACTIVITY 1B: A video monitoring system will be installed at Lowrie Island to document early pup mortality.

This project was placed on hold in summer 2008 and is being re-evaluated. Initial costs were estimated and potential equipment/systems researched in 2008. The preliminary work suggested the following system would be appropriate for this project: 4 IQ705 5.0MP video cameras, a Lenel Net DVR, OnGarud Video Database server software, 4 9.0-90.0 mm varifocal lenses, and weatherproof housings. Cost estimates for this system were \$12,000. Lack of personnel time to research the viability of this project was the major deterrent to moving this project forward.

JOB/ACTIVITY 1C: Data on reproductive performance of females in Southeast Alaska will be collected during multi-day surveys at all breeding rookeries.

Of the 53 branded females ≥ 4 yrs old observed in Prince William Sound 42% (22 of 53) were born at Seal Rocks, 40% (21 of 53) were dive-captured animals that were originally captured in PWS (“=” branded females). Fewer were born at Marmot ($n = 5$), Sugarloaf ($n = 3$) or Fish Islands ($n = 2$). No 4 yr olds were observed at rookeries or haulouts with a pup ($n = 6$) and no branded females > 4 yrs of age were observed with or nursing a pup at haul-out sites.

The proportions of females > 4 yrs of age at rookeries ($n = 40$) seen either with or nursing a pup were:

- 54% (7 of 13) for 5 yr olds
- 50% (4 of 8) for 6 yr olds
- 59% (10 of 17) for 7 yr olds
- 50% (1 of 2) for 8 yr olds

Of females aged 5-8 yrs at rookeries or haul-outs without a juvenile ($n = 45$), proportion with pup was:

- 40% (2 of 5) for Marmot or Sugarloaf females (aged 6 and 8 yrs)
- 59% (13 of 22) for Fish Island or Seal Rock females (aged 5 and 7 yrs)
- 44% (8 of 18) for “=” branded females (aged 5-8 yrs)

These results suggest that sample size of breeding age females at Seal Rocks/Fish Island is sufficient for future annual reproductive studies. We expect more females will be available as the 2004-2008 cohorts and younger “=” branded females mature. Multiple

surveys (5-7) per rookery are required to examine reproduction at these sites, due to marginal resighting rates of females per survey and particularly low probability of resighting females and their pups nursing per survey (0.118). Proportions with pup in PWS fell within ranges observed in Southeast Alaska. In PWS, 55% of females at rookeries and 43% of females at rookeries and haulouts were observed with pup.

Of the 32 branded females ≥ 4 yrs old observed at Sugarloaf Island the proportions of females either seen with or nursing a pup were:

50% (3 of 6) for 4 yr olds* (or 17% see below)

80% (4 of 5) for 6 yr olds

85% (17 of 20) for 8 yr olds

0% (0 of 1) for 20 yr olds

The sample size of breeding age females at Sugarloaf Island is sufficient for future annual reproductive studies. We expect more females will be available as the 2004-2008 cohorts and younger “=” branded females mature. The supplemental camp added 60% more breeding-aged females to the resight cruise sightings at Sugarloaf (32 vs. 20); one 4-yr-old seen at Sugarloaf during the resight cruise, T244, was not seen by the Sugarloaf camp. Multiple surveys at the rookery assisted with pup sightings and will provide multiple occasions for resighting rates and pup detection rates to be accounted for with mark-recapture models. Resight rates of females and females and their pups were similar to those seen in Southeast Alaska in 2007. Proportions with pup at Sugarloaf were high compared to Southeast Alaska rookery data 2005-2007, and Seal Rocks (PWS) data 2007-2008.

JOB/ACTIVITY 1D: Investigation of remote-sensing and other available data on ocean conditions and prey abundance and distribution to determine underlying mechanisms for geographical and temporal variation in SSL vital rates.

No research activity on this job/activity during the reporting period.

JOB/ACTIVITY 2A: Analysis of stable isotope (^{13}C and ^{15}N) profiles in free-ranging Steller sea lion vibrissae to determine changes in trophic signature of their diet over time.

Progress was made in several aspects of the analysis of diet composition and weaning status using stable isotopes and fatty acid composition analysis. Laboratory preparations and data analysis time were supported by this funding. During this reporting period, carbon and nitrogen isotope values for over 2500 whisker samples have been returned to our lab for data analysis and inclusion in the Access database. To date over 10,000 vibrissae (whisker) sections have been analyzed by collaborators at the Crustal Imaging Laboratory, USGS in Denver, CO or by the UAF Stable Isotope Facility to reconstruct timelines of isotopic change in the whiskers of approximately 216 individual young of the year and juvenile Steller sea lions in the Aleutian Islands (n=47), southeast Alaska (n=105), and Prince William Sound (PWS; n=64). Nineteen young of the year sea lions recaptured in PWS have had two whiskers analyzed to document changes in diet between 5 and 10 months of age and to determine the growth rate of whiskers. Key findings from this study include new knowledge that the stable isotope signatures from whiskers of young sea lions prove to be a valuable index of shifts in diet, such as that expected during weaning and that seasonal changes in the stable isotope composition of ingested milk samples are reflected in the whiskers of dependent pups, suggesting that pup whiskers can provide a history of changes

in their mothers' diets both during the nursing period and possibly *in utero* (Rea and Eischens 2008, Rea *et al.* 2008). One publication has resulted from early analysis comparing the stable isotope composition of Steller sea lion milk, serum, and vibrissae in order to understand fractionation rates in tissues (Stegall *et al.*, 2008). This data analysis will continue into the next funding period to determine the weaning age of animals studied since 2000 with emphasis on juveniles and specifically animals for which foraging data is available.

JOB/ACTIVITY 2B: Analysis of stable isotope (¹³C and ¹⁵N) profiles in vibrissae collected from captive Steller sea lions during a controlled feeding study.

Significant progress has been made during this reporting period in our laboratory preparation of sea lion whisker samples for stable isotope analysis at the UAF Stable Isotope Facility. Pairs of whiskers collected from ten juvenile Steller sea lions held temporarily captive at the Alaska SeaLife Center have been sectioned and delivered to the analysis laboratory to determine changes in diet signature during the 2 to 3 month period of captivity. By comparing isotopic profiles of the vibrissa collected when the animal was brought into the research facility with the isotopic profiles prior to release back to the wild, we can also determine growth rates of the vibrissae in this species. The remaining 8 sets of vibrissae collected from these transiently captive animals will be processed for stable isotope analysis during the next reporting period.

JOB/ACTIVITY 2C: Fatty acid signature analysis of blubber lipids to identify changes in diet source (i.e. biochemical weaning markers).

Data on the fatty acid composition of blubber samples collected from free-ranging juvenile SSL (n=53) were delivered to our laboratory by the UAA ASET laboratory during this reporting period. Initial data analysis on these samples has begun to determine if the fatty acid composition of the blubber changes between 5 and 10 months of age in pups recaptured in Prince William Sound. The preliminary analysis indicates that there are slight changes in the fatty acid signature that could be attributed to seasonal changes in the diet of adult females in this area, but there are no indications of significant changes in signature that would indicate early weaning in any of these study animals by 10 months of age.

JOB/ACTIVITY 3A: Analysis of body condition using body fat content measured by the deuterium dilution technique and using body morphometrics and blubber depth measurements.

Progress was made in the evaluation of nutritional limitation in Steller sea lions through studies on body composition, haptoglobin concentrations and metabolic chemistry. This funding supported both personnel time and laboratory costs to accomplish these laboratory and data analysis tasks and travel expenses for presentation of research at the 2009 Alaska Marine Science Symposium. Laboratory analysis was completed for over 150 blood samples to determine the concentration of deuterium oxide for calculation of percent body water for percent body fat estimation. These data provided estimates of changes in percent body fat for free-ranging pups captured at 5 months of age and then recaptured at 10 months of age. These data also completed a dataset of over 500 animals studied in Alaska for which percent body fat content has been measured using this method. Initial data analysis was undertaken on the portion of this data set representing young of the year pups for scientific presentation (Rea *et al.* 2009a). Preliminary data

analysis was also undertaken to determine if phase angle calculated from resistance and reactance data measured using bioelectrical impedance analysis was consistently represented in multiple measurements per animals and if this data is closely correlated with the percent body fat content of the animal. These analyses are ongoing through the next reporting period.

JOB/ACTIVITY 3B: Laboratory analysis of blood metabolite chemistry and hematology.

Laboratory analysis of blood metabolite concentrations were completed for over 300 animals during this reporting period and included assessment of blood urea nitrogen, non-esterified fatty acid and ketone body levels in serum or plasma collected from free-ranging pups and juveniles captured in Alaska and Russia. These data supplemented a data set on over 700 pups captured on breeding rookeries in Alaska and Russia and these data were analyzed for scientific presentation (Rivera et al. 2009). We have also made significant progress in validating the use of a spectrophotometric assay kit for analysis of haptoglobin (acute phase protein used as a physiological stress indicator) in Steller sea lions. Over 150 animals have been assessed for blood haptoglobin levels and these preliminary data will be presented at an upcoming scientific conference during the next reporting period (Rea et al. 2009b). These laboratory and data analyses are ongoing through the next reporting period.

Significant Deviations: Funding originally planned for the deployment of remote video monitoring of maternal attendance at Lowrie Island was redirected to initiating vital rates research at new western stock locations (Sugarloaf Island and PWS).

Literature and conference presentations cited:

- Rea, Lorrie D, Sean D. Farley, Craig A. Stricker, Vicki K. Stegall, Carrie A. Eischens. 2008. A novel approach to monitoring changes in the diet of lactating mothers through isotopic analysis of young Steller sea lion vibrissae. Oral presentation at the 7th Comparative Nutrition Society Symposium, Liscomb Mills, Nova Scotia, Canada. August 8-13, 2008.
- Rea, L. D., K.W. Pitcher, S.D. Farley, J.P. Richmond and W.S. Dunlap-Harding. 2009. Percent total body lipid content increases in Steller sea lion (*Eumetopias jubatus*) pups during the first year of life in a similar pattern to other otariid species. Oral presentation at the Alaska Marine Science Symposium, Anchorage, Alaska, 19-23 January, 2009.
- Rea, Lorrie D, Judith M. Castellini and Alison Banks. 2009. Plasma haptoglobin concentrations vary by region of capture in free-ranging Steller sea lions, but not by age. Oral presentation at the 18th Biennial Conference on the Biology of Marine Mammals, Quebec City, Quebec, 12-16 October, 2009.
- Rivera, P.M., L.D. Rea, B.S. Fadely and V. Burkanov. 2009. Investigating stock differences in nutritional metabolites of young Steller sea lion pups in Southeast Alaska, western Alaska and Russia. Poster presentation at the Alaska Marine Science Symposium, Anchorage, Alaska, 19-23 January, 2009.

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Stegall, V.K., S.D. Farley, L.D. Rea, K.W. Pitcher, R.O. Rye, C.L. Kester, C.A. Stricker, and C.R. Bern. 2008. Discrimination of carbon and nitrogen isotopes from milk to serum and vibrissae in Alaska Steller sea lions (*Eumetopias jubatus*). Canadian Journal of Zoology 86:17-23.

Prepared By: Lorrie Rea