

provided the taking will have only a negligible impact on the affected species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and that the permissible methods of taking and requirements for monitoring and reporting any takings are provided in the authorization. Although not implemented until late in 1981, when the MMPA was amended by Public Law 97-58, the National Marine Fisheries Service since that time has authorized the incidental taking of marine mammals for such widely diverse activities as seismic exploration by both the U.S. oil industry and scientific research institutes; highway bridge construction in California; military and oil industry undersea explosives detonations; and Navy sonar operations. This presentation provides a brief historical overview of these authorizations, reviews improvements in the program, including new mitigation and monitoring protocols for reducing impacts on marine mammals to the lowest level practicable, and how new acoustic information is being addressed when making the legally required impact determinations for marine mammals under the MMPA.

Investigating the Assumption of Signal Homogeneity in Marine Mammal Stable Isotope Studies: Within and Across Tissue Comparisons in Otariids

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In marine mammal ecological studies, stable isotope analysis (SIA) may be used to examine issues of trophic dynamics and diet choice. However, the technique makes a number of assumptions that are largely untested to date. One assumption is within-tissue signal homogeneity; that is, marine mammal SIA studies typically sample a small section of tissue that is assumed to be representative of the whole animal, since sampling an entire carcass would require the sacrifice of that animal, and is also logistically impractical. To specifically test this assumption of signal homogeneity we repeat-sampled biopsies of muscle and skin taken from Steller sea lions ($n = 5$) and Californian sea lions ($n = 6$) at six standardized locations across the animal's body. Multivariate analyses demonstrated that both skin and muscle isotope signatures could be used to determine species. For $\delta^{15}\text{N}$ values, skin values were significantly higher than muscle values in both Steller sea lions (mean difference [MD] = 0.46‰) and Californian sea lions (MD = 0.93‰). Similarly, skin values for ^{13}C values were significantly higher than muscle values in Steller sea lions (MD = 1.21‰), and in Californian sea lions (MD = 0.82‰). Importantly, a lack of significant differences between tissue sampling locations indicated signal homogeneity within skin tissues for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. Similarly, muscle tissues demonstrated signal homogeneity for both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ variables. These results indicate that sufficient homogeneity exists within skin and muscle tissues for point sampling to be a representative technique in marine mammal stable isotope studies. However, as a note of caution, preliminary data also suggested that isotopic signal may become more variable in poorer condition carcasses.

Evidence of Continuing Declines in Fecundity of Steller Sea Lions in the Central Gulf of Alaska

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From 2000 to 2004, index counts of western stock Steller sea lions (*Eumetopias jubatus*) in the Gulf of Alaska and Aleutian Islands increased by ~10%, reversing a 30-year, 80% decline. A demographic model based on counts of pups and non-pups and the proportion of juvenile sea lions on haul-out sites in the central Gulf of Alaska indicated that the steep decline experienced by the population in the 1980s was caused primarily by a large drop in the survival rate of juvenile sea lions, but smaller decreases in the rates of adult survival

and female fecundity occurred as well. As the rate of population decline slowed through 1998, juvenile and adult survival rates increased, but the decline in fecundity persisted. Here we report that these trends continued through 2004. These findings support the hypothesis that factors affecting the condition and reproductive potential of adult females (e.g., disease, nutritional stress), rather than direct mortality sources affecting some or all of the population (e.g., illegal shooting, predation), are the primary threats to recovery of the western Steller sea lion population.

Occurrence of Cetaceans During Shipboard Surveys in the Eastern Tropical Pacific Ocean off Central America, November–December 2004

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Visual and acoustic surveys were done as part of the monitoring and mitigation program during Lamont-Doherty Earth Observatory's seismic survey in the Eastern Tropical Pacific. Few if any systematic surveys for cetaceans have taken place in the study area at that time of year. One or two observers watched for cetaceans from the flying bridge of the source vessel, *R/V Maurice Ewing*. A total of 4965 km of visual observations were made. Most (69%) effort occurred during the day with 31% at night. Eighty-four percent of the effort occurred during seismic operations with a small source consisting of three Generator-Injector (GI) guns; the maximum discharge volume was 315 m³. A total of 2091 individual cetaceans were seen in 81 groups; 23 of these groups were also detected acoustically, as were an additional 194 groups. The pantropical spotted dolphin, *Stenella attenuata* ($n = 13$ sightings) and humpback whale, *Megaptera novaeangliae* ($n = 11$) were the most commonly identified species, followed by the bottlenose dolphin, *Tursiops truncatus* ($n = 8$). *S. attenuata* was also the species most frequently detected acoustically. On an individual basis, more spinner dolphins, *S. longirostris* ($n = 1350$ individuals) were seen than any other species. In addition, single sightings of the following species were made: short-beaked common dolphin, *Delphinus delphis*; *Delphinus* spp.; Risso's dolphin, *Grampus griseus*; false killer whale, *Pseudorca crassidens*; short-finned pilot whale, *Globicephala macrorhynchus*; and minke whale, *Balaenoptera acutorostrata*. A small concentration of humpbacks was seen (and heard) in the Gulf of Fonseca on 9 December. To our knowledge, concentrations of humpbacks, particularly singing humpbacks, have not been reported in this specific area. A humpback mother-calf pair was also seen off northern Costa Rica on 25 November. Northern and southern hemisphere humpbacks may overlap geographically off southern Costa Rica during November.

Behavioral and Playback Investigations of Call Directionality in Male Northern Elephant Seals

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Most animal vocalizations are directional, that is, the signals are focused in a particular direction that is dependent on caller orientation. However, few attempts have been made to address the behavioral significance of vocal directionality in animal communication systems. Such signal design may serve to maximize propagation, direct calls to intended receivers, reduce the likelihood of eavesdropping, and mediate appropriate listener responses. During the breeding season, male northern elephant seals (*Mirounga angustirostris*) form dominance

hierarchies through multiple dyadic interactions involving acoustic, visual, and seismic signals. Male vocalizations are both highly stereotyped and directional. The objective of this study was to test whether males in sexual competition attend to the directional cues of the calls of conspecifics (*i.e.*, variation in call spectra and source level) using *in situ* behavioral observations and vocal playbacks. Individual males at Año Nuevo State Reserve, California were identified within a breeding season by unique dye markings. Playback calls were multiple exemplars of a dominant male from an isolated area that were edited into a prescribed natural sequence. Control playbacks were recordings of ambient rookery sounds with male calls removed. Playbacks were conducted on 20 males (10 adults and 10 subadults). Calibrated playback presentations were broadcast 7m from each subject. Responses to playbacks were easily classified into the following categories: visual orientation, postural change, calling, positive or negative phonotaxis, and re-directed aggression. Hierarchical and developmental variables were also considered. Calling in response to playbacks was only observed in older, more dominant males and rarely occurred during control sequences. Phonotaxis was correlated with the directionality of recorded calls and consistent with behavioral observations. These results suggest that call directionality is an important cue used in male-male competition and, thus, elephant seal reproductive behavior.

Resting Metabolic Rate in Free-ranging Juvenile Steller Sea Lions (*Eumetopias jubatus*)

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Nutritional stress, resulting in reduced juvenile survival, is the leading hypothesis for the dramatic decline in the western stock of the Steller sea lion (SSL) population. This hypothesis suggests that energy intake is insufficient to meet daily energetic demands. Some animals are able to compensate for limited food intake by limiting their energy expenditures, with the most common physiological response being a lowering of resting metabolic rate (RMR) known as metabolic depression. To assess the potential significance of metabolic depression in juvenile SSLs, RMR was determined by measuring in-air oxygen consumption rates of free-ranging animals captured from western stocks in Prince William Sound (PWS, n=30) and the Central Aleutian Islands (AL, n=16), and from the eastern stock in Southeast Alaska (SE, n=43). RMR was measured in post-anesthetized animals aged 2, 5, 8, 11, 14, 20 and 26 months at ambient air temperatures (-6 to 18 °C). SSLs were anesthetized for the purposes of deuterium administration and blood sampling (part of a larger study) and no significant differences in RMR were detected in the subset of animals that were measured both pre- and post-anesthesia. Mean RMR ranged from 11.0 to 32.3 MJ d⁻¹ across all aged animals, and as expected, increased with increasing body mass. Similarly, mean mass-specific RMR ranged from 0.13 to 0.28 MJ d⁻¹ kg⁻¹ and decreased with increasing body mass. These values represent a mean (± SE) of 2.2 ± 0.6 times the expected mammalian value. Although ambient air temperatures and animal ages varied between locations, similar air temperatures existed between PWS and SE locations. RMR was not significantly different for similarly aged pups and yearlings from PWS and SE. From this study there was no evidence of metabolic depression in western stock animals.

Use of Pupping Phenology to Assess Reproductive Success of Harbor Seal Populations

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During the past three decades, numbers of harbor seals (*Phoca vitulina*

richardii) in regions of the Gulf of Alaska have diminished 60-90%. Although the decline occurred concurrently with large-scale ecosystem shifts, causal mechanisms for the decline harbor seal populations remain elusive. Nutritional stress associated with ecosystem change could affect seal populations by decreasing survival or reproduction. Otariids and phocids have shown prolonged embryonic diapause associated with nutritional stress. Mean parturition dates of harbor seals occurred 6-10 days earlier during periods of stable or increasing pup production than during periods of decline. Our objective was to retrospectively assess pupping phenology and productivity of harbor seals in Aialik Bay, a tidewater glacial fjord in southcentral Alaska, during periods of regional population decline (1979-1981) and increased pup productivity (2002-2005). During the decline, field observations documented maximum numbers of pups on 6/18/1979 (256 pups), 6/13/80 (358 pups) and 6/11/81 (235 pups). Parturition rates, identified by sightings of bloody natal icebergs from 1979 through 1981, showed a bimodal tendency, with peaks clustered around 25 May and 6 June. By 1994 only 40 pups were counted (6/13/94). Since 2002 harbor seals have been monitored using remotely controlled video cameras. From 2002-2005, numbers of pups have increased. Maximum numbers of pups were counted on 3 June 2002 (42 pups), 7 June 2003 (45 pups), 1 June 2004 (59 pups), and 1 June 2005 (70 pups). Coincident with increased pup production was a shift to earlier parturition dates, as indicated by the earlier maximum pup counts. Both phenology and production of pups reflect improved reproductive success of the harbor seal populations in Aialik Bay. The shift toward earlier parturition as the number of pups increased may be suggestive of the duration of embryonic diapause and the condition of pregnant females during the previous summer and fall.

Using a Combination of Swim Speed and Stomach Temperature Sensors to Determine Feeding Events and Prey Encounter Rates in Southern Elephant Seals (*Mirounga leonina*)

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Simultaneous recordings of dive depth, light levels, swim speed and stomach temperature were collected for a post-breeding female southern elephant seal from Macquarie Island. Feeding events were clearly detectable from marked declines in stomach temperature, and occurred at a mean rate of 8.4 events per day (or 1.6% of all dives) for the first 5 days of the foraging trip (after which the temperature sensor was lost). Feeding occurred in both day and night, but was more common at night. The period of acceleration was often in an upward direction indicating that the seals attacked their prey from beneath, and this behaviour was most prevalent during the day. There were other behavioural correlates with feeding events, most notably a marked period of acceleration immediately prior to 85% of all ingestion events. Using the characteristic burst of acceleration as an prey encounter index (PEI), we determined that prey encounters were more common at night, and increased in the days after the seal left the island to be most common while the seal was in the vicinity of the Antarctic Polar Front. Extending this analysis across the entire 58 day foraging trip indicated that the PEI varied considerably, ranging from a PEI of less than 50 per day during the outward and inward phases of the trip, to 150 per day during the middle phase. During this middle phase, prey encounters also varied considerably, ranging from 100 to 150 encounters per day (or 1.5 - 2.6 encounters per dive, per day), suggesting that the prey were patchily distributed in both space and time. This study demonstrates that combining stomach temperature and swimming speed provides a powerful tool for study the foraging ecology of this species.

Differentiation of Adipocyte Collected from Steller Sea Lion *Eumetopias jubatus*

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