317.5

HOW DO DIETARY LIPID LEVELS IMPACT THE BODY CONDITION AND HEALTH OF SEALS?

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In Alaska, populations of harbor seals and Steller sea lions have declined significantly. The sea lion is Endangered and the harbor seal is considered for protection. One theory is that the decline results from a change in the type of fish available. The ecosystem had significant levels of herring and now the dominant fish is pollock. Generally, herring is a fattier fish and since seals metabolize mostly fat, the level of lipid in their diet is critical. We have been conducting feeding trials with captive harbor seals at the ASLC. Since Sept of 1998, eight harbor seals have been on a cross-over trial in three seasonal blocks (winter fattening, spring mating and fall molting). A group of seals receives an exclusive pollock diet during one trial, then switches to exclusive herring on the next trial. By the time the experiment end (Sept 2000), each group willhave experienced each seasonal block on a different diet. Results from year one indicate that during molting (fall), both diets allowed the seals to fatten (body morphs, % fat, mass gain). During the winter, some seals on both diets decreased their body condition and some seals gained body condition. During the summer, the herring seals gained significant body condition and the pollock seals lost body condition. In general, the herring are about 12% lipid and the pollock about 6% lipid. In year two, each group will act as their own control and we will be able to compare the same sea. These results indicate that there is a large seasonal control over the impact of diet on these seals and that a diet of pure pollock can sustain the animals over at least 4 month periods.

317.6

RESTING METABOLIC RATE DOES NOT DECLINE WITH AGE IN LONG-LIVED NAKED MOLE-RATS.

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Metabolic rate is widely regarded as an important component and barometer of aging processes. Specifically, conventional mammalian models of aging such as rats and mice tend to show a progressive decline in resting metabolic rate (RMR) with advancing age. The decline in RMR is often associated with increased proportions of body fat and decreased lean mass. In this study, we examined age-related changes in RMR in a remarkable new model of mammalian aging, the naked mole-rat (*Heterocephalus glaber*). Although they are the same size as mice, naked mole-rats are rodents that often live beyond 20 years of age in captivity. We measured RMR as oxygen consumption rate in 1, 10, and 20-year-old naked mole-rats. Body mass increased slightly, but not significantly ($p > 0.06$) with age, and most of this increase took place between the ages of 1 and 10 y. Age did not have a significant effect on either total RMR (in units of ml oxygen consumed per hour) nor mass-specific RMR ($p > 0.7$ in both cases). Preliminary evidence from a body composition study showed that, unlike other mammalian models, naked mole-rats do not show an increased percentage of body fat with advancing age. We have previously reported that the decline in age-related intestinal function is much more modest in mole-rats than in other rodents. Given their extreme longevity and novel physiology, naked mole-rats merit further study as a model of mammalian aging.

317.7

SIMULATED FORAGING EXPERIMENTS ON CAPTIVE DIVING MAMMALS: A FEASIBILITY STUDY WITH STELLER SEA LIONS (Eumetopias jubatus).

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The primary obstacle to understanding the effects of variable prey accessibility on diving mammals is the difficulty of directly observing foraging in free ranging animals. Without direct testing of the relationship between behavior, physiology, and prey accessibility, remotely collected dive profiles have limited use in identifying nutritional stress in declining populations. We conducted a study at the Alaska SeaLife Center (ASLC) in Seward, AK to assess the feasibility of using feeding dives of trained captive animals to simulate different prey density and distribution scenarios. Steller sea lions were trained to target to a lighted pole for a fish reward. After two months of training, sea lions were transitioned to lit targets attached to two fish feeders mounted in their habitat. Each time a sea lion chose the correct lit target, a prey item was released. Sea lions were tasked to swim to and between lit targets for varying durations, with prey released at intervals throughout the dive. Sea lions were solicited to perform extended dives by alternating lit targets and randomizing prey release location and frequency. Sea lions were fitted with time-depth recorders (TDR) and dives were recorded on video. During three months of testing, sea lions chose unlit targets in <20% of dives, and broke off during extended dives in <30% of dives. Breakoff frequency increased with decreasing prey release rates. We conclude that it is feasible to conduct foraging experiments with pinnipeds under controlled conditions, in which prey accessibility can be varied by varying the frequency and amount of prey release. Supported by NOAA, NFWF, ASLC.

317.8

Physiological constraint and diving ability: a test in hooded seals, *Cystophora cristata*

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Hooded seals are one of the most precocial mammals. They have the shorted nursing period of all pinnipeds (4 days) and one of the earliest onsets of independent foraging (4 weeks). In addition, adult hooded seals make foraging dives that are remarkably deep and long for their size. In combination, these findings suggest that the physiological processes related to diving would both mature more rapidly in hooded seals than in species with longer dependent periods, and mature to a higher capacity than in shallower diving species. To test these hypotheses, we compared the blood and muscle oxygen stores of 6 hooded seal pups to those of 6 adults. Hematocrit and hemoglobin values were similar, but pups had a smaller blood volume than adults (14.9 vs. 18.0 ml/kg). In addition, pup muscle mass was smaller (18.5 vs. 29.8%) and myoglobin load lower (2.8 vs. 7.5 g%). While blood oxygen stores were similar to those of other deep diving species, adult swimming muscle Mb values were the highest yet measured (9.4±0.3 g%). This study revealed 1) that pups have lower mass specific body oxygen stores than adults, 2) that pups store a larger fraction of their oxygen in blood than adults, and 3) that adult hooded seals have maximized both blood and muscle oxygen storage capacity. Interspecific comparisons suggest that there is a maximal rate at which physiological processes can mature, and that physiological limitations have the potential to significantly impact the foraging ecology of juvenile hooded seals. Funded in part by the Institute of Marine Science, University of California Santa Cruz.

317.9

Male short-tailed field voles (*M* icrotus agrestis) construct better insulated nests than females.

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The construction of nests is an extremely widespread behaviour, which in small endotherms serves primarily to provide insulation and therefore retard heat loss of the constructor, or of its offspring. We measured the physical properties of nests built by captive short-tailed field voles, *M* icrotus agrestis, maintained under cold conditions (8±3°C). Nest wall thickness was the most important factor influencing nest insulation; however nests with thick walls also contain more nesting material. An asymptote in nest insulative capacity was not reached until nests contained over 20g of material. No correlation was seen between nest insulation and either resting metabolic rate, body mass or body composition (lean and fat mass) of the vole that built the nest. However, nests constructed by males had greater insulation than those of females. Males with nests also had significantly lower food intake rates when compared to females with nests. No significant difference was observed between the sexes in either fat mass or whole animal thermal conductance. Thermal conductance increased significantly with increasing body mass, but not with resting metabolic rate. Voles with nests for prolonged periods had lower food intake rates than voles without nests. This absolute saving averaged 1.9g and was independant of body mass, meaning a 28% saving on food intake for a 22g vole, but only a saving of 18% for a 40g individual. Voles which had access to nests for short periods of time used the energy saved to reduce food intake and increase body mass.

317.10

Natural hyperthermia and expression of Hsp70 affect larval mortality and the incidence of fitness-reducing developmental abnormalities in Drosophila melanogaster

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Natural heat stress on larval Drosophila melanogaster results in high rates of larval mortality and severe developmental defects in eclosing adults, while increased copy number of the gene encoding the major inducible heat-shock protein (Hsp) of D. melanogaster, Hsp70, is sufficient to mitigate these effects. Specifically, D. melanogaster larvae inhabiting necrotic fruit experienced severe, often lethal heat stress in natural settings. Approximately 10% of adult flies eclosing from wild larvae that had survived natural heat stress exhibited severe developmental anomalies of wing and abdominal morphology. Heat-induced wing deformities dramatically reduced mating ability in male flies. In natural populations, the frequency of developmental abnormalities varied along a natural thermal gradient, exceeding 12% in adults eclosing from larvae developing in warm, sunlit fruit. When exposed to natural heat stress, D. melanogaster larvae with the wild-type number of *hsp70* genes (10) had higher rates of mortality and developed abnormal wings significantly more frequently than a transgenic sister strain with 22 copies of the *hsp70* gene.