individual vocal patterns in the isolation calls of Amazonian manatees and discussed the possible presence of vocal signatures in this species. One of the assumptions of the vocal signature hypothesis is that there is consistency in the vocal pattern over time. Isolation calls of two captive Amazonian manatees were recorded between 1998 and 2001 in order to verify this assumption. The spectrogram contours of the isolation calls illustrate the maintenance of an individually distinct and stereotyped vocal pattern for both individuals over a period of four years. For bottlenose dolphins, the stereotypy of signature whistles comes from the contour configuration, *i.e.*, the overall shape of the spectrogram rather than from more simple and discrete measurements of acoustic characteristics, such as frequency and duration. Therefore, our results support the applicability of the vocal signature hypothesis to the isolation calls of the Amazonian manatee.

## Noise Constraints on Pinniped Vocal Communication: Integrating Source Level, Ambient Noise, and Audiometric Data

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There is increasing concern about how anthropogenic noise may be contributing to habitat degradation for some marine mammals. Despite recent research efforts, a major limitation in evaluating noise impacts is the lack of knowledge about communicative systems, natural ambient noise conditions, and signal processing characteristics for most species. We will delineate some of the field and laboratory data required to formulate predictions of maximum communicative distances in specific ambient noise conditions. Recent data obtained for northern elephant seals on aerial vocalization source levels, natural ambient noise conditions, and acoustic signal processing will be used to demonstrate the variable constraints placed on pinniped vocal communication by variable noise conditions. For instance, the female-attraction call of a northern elephant seal pup should be detectable to a female over a distance of approximately 14 m during periods of low conspecific vocal activity. However, when many other nearby animals are simultaneously vocalizing, the maximum communicative distance between female and pup may be reduced to as little as 2m. Our recent data on signaling and signal reception in several pinniped species have revealed some apparent adaptations facilitating communication in variable, and frequently high, ambient noise levelsrrHigh vocalization source levels, low critical masking ratios, signal redundancy, and multi-modal signaling have been observed in some of the relatively well-studied pinniped species. The usefulness and limitations of generalizing data from 'representative' pinnipeds to less-accessible species in similar environments will be discussed in the context of anthropogenic noise impacts and conservation management.

## Molecular Analysis of Stress Activated Proteins and Genes in Cetaceans: A New Methodology for Monitoring Environmental Stress Impact

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Recently, there has been documented a worldwide increase in manifestations of environmental stress in the marine ecosystems. Marine mammals have experienced a pandemic of morbilliviral infections, outbreaks of diseases caused by influenza viruses, fungi and algal toxins. Some marine mammal populations are declining due to idiopathic wasting diseases and low reproduction rates. Many of the disease outbreaks appear to have been facilitated by changing environmental conditions triggered by climate variability and human activities. It is imperative to develop novel health-monitoring tools that would provide early warning of increased stress burden in marine mammals, to guide the management of marine ecosystems and facilitate the conservation of key species. We have developed a new methodology for detecting the molecular signature of chronic physiological stress in mammals that can be used as an early indicator of increased environmental stress and compromised health. The methodology is based on molecular analysis of stress-activated proteins and gene transcripts in field micro-specimens of skin or blood. The development of this methodology has involved the analysis of a reference set of specimens from 8 cetacean species. These specimens were obtained from 100 animals with known health status (clinically diseased, highly physiologically stressed, or healthy). Changes in expression levels of 40 stress-activated proteins were detected using computerized quantitative immunohistochemistry. Changes in expression levels of 4000 gene transcripts were detected using the human gene microarray technology. High throughput analysis, such as necessary for ecological-level studies, was supported by the use of multi-specimen slides and novel multi-target stress antibodies developed in our laboratory. The methodology has been applied to evaluate the impact of tuna fishery on the spotted dolphins in the Eastern Tropical Pacific, and the effects of climate change and off shore oil drilling on gray whales.

## Metabolic Rate during Active Diving in Captive Grey Seals (*Halichoerus grypus*)

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The problems associated with recapture means that measurements of energy expenditure of free-living phocid seals diving at sea are extremely difficult to obtain. Yet such information is vital if we are to model the effects of seal populations in the areas where they feed. We measured the oxygen consumption of captive female grey seals voluntarily diving in a large tank. The experimental tank is 42 metres long, 6 metres wide and is sectioned into 4 lanes. It is covered below the water level except for a single instrumented breathing panel, allowing for 'horizontal dives' of up to 170 metres away from the breathing hole. This set-up, combined with TDRs fixed to the animals' fur, allowed us to measure oxygen consumption on a dive by dive basis over a range of behaviour and activity. Using step-wise multiple regression analysis we have developed a model that can be used to predict dive by dive metabolic rate on the basis of body mass, distance covered during the dive, dive duration and surface duration. Swim speeds, dive durations, and surface intervals and thus percent time spent submerged in this study were similar to those measured in wild grey seals. Diving metabolic rate (DMR) was found to be lower than resting metabolic rate, with a decrease in metabolic rate with increased dive duration. DMR was highest where duration was short but distance travelled was high, conversely DMR was lowest when duration was long but activity low. These data indicate that the behavioural options a seal chooses will determine the rate of oxygen utilisation and thus place constraints on dive duration. These data can be used in conjunction with telemetry derived behavioural data from wild seals to estimate the field metabolic rate of grey seals.

## The Epidemiology of Perinatal Mortality in the Florida Manatee (*Trichechus manatus latirostris*)

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Perinatal mortality rates in free-ranging wild animal populations vary, but in many populations they can contribute significantly to overall mortality rates. Numerous factors contributing to perinatal deaths can have especially profound effects on the recovery of endangered species. The population of the endangered Florida manatee is currently estimated at approximately 3300 individuals. The slow growth of this population may be due to the fact that females reach sexual maturity at 6-10 years of age and produce on average only one calf every 3-5 years. Calves nurse for 18 to 24 months. Birth and mortality rates during the first two years are unknown, and cause of death is often undetermined due to rapid carcass decomposition in subtropical conditions. In an effort to better understand perinatal mortality, state manatee mortality records from 1974-2000 (n=4042) were examined to identify any trends. Perinatal deaths accounted for approximately 21% of all mortalities (n=857). Six calves died because of natural predation or human interaction, 57 were stillborn, and 234 died from other natural causes. Cause of death could not be determined in 558 cases. There was no significant difference between the number of male and female calves recovered. Two counties, Brevard and Lee, together accounted for 35.9% of all perinatal deaths, and for 35% of all mortalities during the same period. Although perinatal deaths occurred throughout the year and state, the highest number occurred in spring and early summer months, along the central East and West Coast, and may have been latitude dependent. GIS analyses show consistent overlap between known manatee calving grounds and locations where carcasses were recovered. GIS analyses were used to compare aerial population distribution and abundance data to perinatal mortality patterns within genetically and geographically distinct stocks.