It is becoming apparent that man-made noise can impact the hearing and behavior of marine mammals. Not only are hearing and behavior concerns, but noise can potentially affect immune function and impact health as has been shown in other mammals. To this end we have begun studies to investigate the effects of intense underwater sounds such as sonar pings, simulated explosions, and seismic impulses on autonomic nervous system activation and immune function in marine mammals. The current studies are being carried out in conjunction with the US Navy Marine Mammal Program to investigate underwater hearing thresholds before and after exposure to single underwater impulsive sounds produced from a seismic watergun. Blood samples are being obtained from a white whale, *Delphinapterus leucas*, and a bottlenose dolphin, *Tursiops truncatus*, before, approximately 1 hour after, and 24 hours after sound exposures. Blood samples are also collected before and after control sessions in which the test subjects are not exposed to intense sounds. Measurements of the autonomic nervous system and immune system that are being carried out include: catecholamines by High Performance Liquid Chromatography, neuroendocrine hormones by radioimmunoassay, serum chemistries and CBC's, quantification of lymphoid cell subsets by flow cytometery, and immune function. Preliminary results indicate little or no change in nervous system activation or immune function after exposure to peak sound pressures up to 200 kPa (30 psi); these sound pressures were sufficient to cause temporary elevations in hearing thresholds in the white whale. We will continue monitoring of the marine mammal nervous and immune systems before and after exposure to different sound levels, intensities, and sources. These studies will be important in determining and evaluating the effects of sound on marine mammal health.

Past and Present Utilization of Marine Mammals in Grenada, W.I.

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Marine mammals have been exploited in Grenada, W.I., since pre-Columbian times in the form of manatee hunting. In the nineteenth century foreign whalers visited Grenadian waters and in the 1920's a short-lived attempt for the development of a local whaling industry took place. Since then there seems that no interactions have teken place between Grenadians and marine mammals until the 1990's when two whalewatching operations were established. Recent developments in Grenada and neighboring islands raise concerns about the resumption of some sort of whaling in those waters. Non-intrusive whalewatching operations, including land-based alternatives, are proposed.

The Marine Mammals of Grenada, W.I.: Biogeographical Implications for the Eastern Caribbean

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To document the Grenadian marine mammal fauna and its distribution in the eastern Caribbean, we conducted field studies in that country that included, but were not limited to, research cruises and interviews with fishers. Also, all historical records of sirenians and cetaceans for Grenada were assembled and analyzed. We confirmed the presence of 11 species of marine mammals for that part of the world. Humpback whales (*Megaptera novaeangliae*) was the most commonly reported species of mysticete while a variety of odontocetes seem to be equally frequent in those waters, including a resident population of sperm whales (*Physeter macrocephalus*). The manatee (*Trichechus manatus manatus*) has been extinct from those waters for at least 300 years. Comparisons with the marine mammal fauna of adjacent regions (Venezuela, Trinidad and Tobago, and St. Vincent and the Grenadines), lead us to believe that at least seven additional species of cetaceans may be present in Grenadian waters. Our results from those waters and adjacent areas indicate a high level of homogeneity in the marine mammal fauna for the South Eastern Caribbean.

Regional Heterothermy in Seals, Dolphins, and Manatees

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In healthy terrestrial mammals, colonic probes usually show relatively uniform core temperatures. In contrast to this terrestrial mammal homeothermic paradigm, some marine mammals display regional heterothermy in colonic temperatures. These marine mammals have stable, regionally specific temperatures at different locations along their colons; observed temperature differences are related to vascular adaptations that inhibit elevated temperatures at their reproductive tissues. We have shown that seals, dolphins, and manatees possess vascular structures which permit shunting of cooled superficial blood to positions deep within their bodies to avoid reproductive hyperthermic insult. These marine mammals divert cooled venous blood to tissues surrounding their reproductive organs before it is mixed with the core circulation -- coopting extrinsic venous circulation that is separate from the intrinsic circulation of their reproductive tissues. To quantify thermal effects of these vascular structures, we have measured temperatures simultaneously at several locations along the colon in the harbor seal, bottlenose dolphin, and Florida manatee. In seals, the distal colon follows the midline and thus, passes between cooled venous plexuses that line the abdominal and pelvic cavities; the venous plexuses are juxtaposed to the testes or uterus, thus providing direct cooling for these thermally sensitive tissues. We have observed colonic temperature differences greater than 2°C deep within the pelvic and abdominal cavities in the harbor seal. In dolphins, the distal colon follows the midline and passes between paired arteriovenous countercurrent heat exchangers that are found between the hypaxial muscles and the testes or uterus. Colonic temperatures within the region of the heat exchanger were maximally 1.3°C cooler than temperatures in front of and behind this region in bottlenose dolphins. Temporary heating and cooling of the dorsal fin and flukes affected colonic temperatures at the heat exchanger, but had negligible effect on colonic temperatures outside this region. In manatees, the distal colon follows the left lateral margin of the abdominal cavity and passes over the region occupied by a venous plexus that is supplied with cooled blood from the skin. On either side of the body, these paired cooled venous plexuses function as direct heat exchangers between the hypaxial muscles and the epididymides or ovaries. Colonic temperatures adjacent to the heat exchanger were maximally 3.7°C cooler than colonic temperatures measured in front of and behind this region in male Florida manatees. The temperature distribution changed as the colon shifted when the animal was rolled on its axis. In summary, we have shown that seals, dolphins, and manatees display regional heterothermy that reflects convective thermoregulation of their reproductive tissues. Individual temperature profiles may change with season, physical activity, posture, and handling. Consideration of these normal healthy profiles should be given when measuring and explaining body temperatures of diving mammals. Clinical interpretation of temperature profiles may provide valuable insights for assessing health and physiological state of marine mammals.

Collagen Aging in the Bowhead Whale (*Balaena mysticetus*)

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Age in marine mammals may be determined by various methods, ranging from simple photo re-identification to such methods as ear plug growth layer measurement, tooth growth layer group quantification, aspartic acid racemization in the teeth and eye lens nucleus, and the aging of baleen. In bowhead whales (*Balaena mysticetus*), teeth are not present, ear plugs do not appear to form and baleen aging is reliable only up to eleven years of age due to wear at the distal ends of the baleen plates. This study evaluates the potential to age whales via the analysis of a small amount of skin (from a biopsy dart sample or collection at necropsy). Manifestations of aging are most pronounced in the extracellular matrix, the primary component of which is collagen. Skin undergoes dramatic age-related changes in its mechanical properties, including changes in tissue hydration and resiliency. Collagen cross-links increase with age and advanced glycation end-products, such as pentosidine and carboxy-methyl lysine (CML), accumulate in long-lived tissue proteins. Methods employed as indicators of aging include measuring the level of pentosidine and other collagen related chemicals in the skin. Pentosidine, a marker of glycoxidative stress in skin collagen, forms at a rate inversely related to maximum life span across several mammalian species. Pentosidine is one of the advanced products of the Maillard reaction and is an indicator of the extent of