The Research Vessel Odyssey: A Unique Platform for Marine Mammal Toxicological Research and Education

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The research vessel Odyssey is a 93-foot ketch motorsailer. It is equipped with state-of-the-art acoustic and sampling equipment for tracking and biopsying marine mammals, particularly whales. She is also equipped with state-of-the-art equipment for toxicological studies including cell culture and environmental sampling (water, air and prey). Odyssey sleeps 12 people and can stay offshore for weeks at a time. Thus, this vessel is a unique research platform for studying the toxicological impacts of environmental pollutants on whales and other marine mammals. However, Odyssey also has an important educational mission, engaging a broad spectrum of students in studying and understanding marine toxicology. For example, on her most recent voyage investigating the Gulf of Mexico oil crisis, 15 students worked at sea. Many more were engaged through working on field samples in the land laboratory or through daily logs sent out from the boat. Some students took online courses and stayed on board for the entire voyage while others rotated in for a leg of 1-2 weeks. Students were responsible for managing and performing all scientific aspects of the expedition as well as learning to work and sail the boat and raise funds for the expedition. One undergraduate, a rising freshman, setup the cell culture laboratory (the only one of its kind at sea) and became the first person in history to culture whale cells at sea and the first to culture fin whale cells. One undergraduate was a primary biopsier and collected more than 50% of the biopsies taken and ran the air-sampling program. Another undergraduate ran the water and sediment sampling program. All gained firsthand experience in working at sea, and in understanding the impacts and importance of toxicology in general and marine toxicology in particular, making Odyssey's educational and scientific missions a significant success.

New insights on the taxonomy and population structure of "Bryde's whale" species across the Indo-Western Pacific

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A phylogenetic and population-level analysis was conducted for two species of Bryde's whales, *Balaenoptera brydei* ('ordinary' form) and *B. edeni*('small' form), using new genetic data from across the Northern Indian Ocean (Oman, Maldives, Bangladesh) combined with existing data from the Eastern Indian Ocean (EIO), Coast of Japan (CoJ), and the north and central west North Pacific (NWNP, CWNP). The objectives of this study were to i) determine the putative taxonomic units of each region and their relationship to one another through phylogenetic analyses and ii) undertake a population-level analysis to provide updated management recommendations. A total of 79 biopsy samples from Bangladesh, eight samples from the Maldives and 18 from beach-cast whales in Oman were combined with Genbank data from the EIO (n=27), CoJ (n=16), NWNP (n=194) and CWNP (n=116). A total of 49 haplotypes were identified from a total sample of 410 individuals. Nine discrete diagnostic characters were detected via Population Aggregation Analysis and used to define operational taxonomic units for *B. brydei* and *B. edeni* in the Indo-Western Pacific. Population-level analyses consisting of haplotype reconstruction using a Maximum Parsimony network and genetic diversity and differentiation indices, provide evidence of strong differences in the genetic diversity and structure between *B. brydei* and *B. edeni*. Recommendations are made for the recognition of two species of Bryde's whale in the Indo-Western Pacific and the independent designation of multiple management units for each species both within and across ocean basins.

Hearing Loss in Harbor Seals: Differential Diagnoses of Conductive and Sensorineural Losses via Auditory Evoked Potentials (AEP), Otoacoustic Emissions (OAE), and Computerized Tomography (CT)

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As concerns for noise impacts continue, more species and individuals are being tested to determine hearing ranges and peak sensitivities. In employing these results, it must be considered that data, particularly from stranded wild animals, older individuals, or high noise areas, may reflect abnormal hearing. Case studies demonstrate pinnipeds sustain a wide range of conditions that may impair hearing. Approximately 20 % of stranded seals have ear infections which if undetected and untreated may lead to septicemia. In this study, 5 harbor seals (*Phoca vitulina*) with overt or suspected infections were examined with CT, OAE, and AEP to determine the form, severity, and progress of pathologies and attendant hearing loss over time. CT scans were obtained prior to and during the hearing tests. For OAEs, the scans were used to assure that the ear canal remained open during testing and for measuring distance from the probe microphone tip to the eardrum. OAEs were obtained between 0.5-15 kHz. AEPs were obtained using surface electrodes with tones from 1-30 kHz. CT, AEP, and OAE results were assessed independently. Four animals had moderately elevated thresholds but normal brainstem responses, consistent with CT findings of conductive loss from occluded middle ears but normal inner ears. Differences in percent occlusion over time and across individuals were consistent with interaural threshold differences of 20-25 dB or more, progressing to a 55 dB deficit and retrograde loss in one case. A fifth animal with no overt infection had scans showing aggressive inner, middle, and external ear disease and no responses within 70 dB of normal response ranges. These techniques are useful for treatment and rehabilitation decisions, providing information on hearing losses that may be significant for foraging, navigation, and social interactions. [Supported by the Office of Naval Research Marine Mammal Program and the Mellon Foundation]