(blimp-cam) at a height of 50m. Using a remote control, I used this equipment to scan large herds of dugongs and to follow focal individuals for set periods of time. To assess the risks of boat disturbance and boat strikes, the behaviour of the dugongs was observed while boats were passing opportunistically (eg. recreational boats using the area) and during experimental trials. Observations of boats passing opportunistically at a range of speeds showed that dugongs have a delayed response to boats and thus are particularly vulnerable to being hit by boats travelling fast. During the experimental trials, an aluminium dinghy with a 20 HP engine was driven past the edge of a dugong herd within the regulated speed limit, either once or five times to determine whether repeated passes caused a higher level of disturbance. No significant relationships were found between the distance of the boat from the focal animal and the duration, distance, or direction of its subsurface behaviour. The percentage of time spent feeding and travelling by individual dugongs over a 4.5 min interval was also unaffected by the boat's passing, the number of passes made, or the focal individual's position in the herd relative to these two factors. Thus any response to the boat was delayed and short. These results suggest the risk of vessel strike is greater than the risk of disturbance and support the use of speed restrictions for boats in important dugong areas. The blimp-cam footage provides graphic proof of the risk of vessel strike to dugongs and has a potential role in public education and policy development.

Stable Isotope Analysis of Bottlenose Dolphin Teeth: Indications of Habitat and Life History

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Stable isotope analysis of teeth is providing valuable information about the population structure and life history of bottlenose dolphins. We measured stable isotope ratios of $\delta^{13}C$, $\delta^{15}N$, and $\delta^{18}O$ as part of a study on stock structure of dolphins along the Atlantic coast of the U.S. For $\delta^{18}O$, measured tooth values from crushed, homogenized tooth tissue correlated well with the $\delta^{18}O$ values of ocean water where the animals stranded. In addition, negative (<-3 per mil) $\delta^{18}O$ values allowed for the identification of a group of individuals (n=31) that likely spend the majority of time in an estuary in N.C., providing the first evidence of this resident group. Whole teeth were also subsampled. Samples from the outer part of teeth had significantly higher $\delta^{15}N$ values than the inner portions of the same teeth (mean $\delta^{15}N$=17.6 and 16.8, respectively; n=60; P<0.001); 57 of the 60 teeth analyzed had higher $\delta^{15}N$ values in the outer tooth relative to the inner. As the outer part of teeth was deposited early in life and the inner later in life, the significant difference indicates that, overall, the diet of young animals is higher in $\delta^{15}N$ compared to adult diet. It is well documented across species that there is an approximately 3 per mil increase in $\delta^{15}N$ per trophic level. Thus, tissue formed in utero (*e.g.*, enamel) would be predicted to be higher in $\delta^{15}N$ than a corresponding adult diet because the fetus is "feeding on" the mother's tissues. Similarly, as bottlenose dolphins nurse, growth layers deposited in teeth of calves seem to isotopically reflect the time period during which the young animal is nursing. These results indicate that stable isotope analysis can provide valuable information regarding the life history and population structure of bottlenose dolphins.

Sound Localization of Aerial Pure Tones by Pinnipeds

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Pinnipeds use airborne sounds for intraspecific communication and predator avoidance. While both of these functions depend on sound localization as well as sound detection, there have been few systematic comparative investigations that quantify the ability of pinnipeds to localize sound sources in air. A recent study showed that three species of pinnipeds were capable of resolving aerial broadband signals to within five degrees (Holt *et al.*, 2003, JASA, 113). While these data demonstrate abilities comparable to some terrestrial carnivores, it remains unclear which frequencies of sounds are particularly important for localization in these animals. Most mammals typically use interaural time differences to localize low frequency sounds and interaural level differences to localize high frequency sounds in the horizontal plane. In this study, we investigated whether pinnipeds use such dual processing of auditory information to localize airborne pure tones. We tested a harbor seal (*Phoca vitulina*) and a California sea lion (*Zalophus californianus*) in a hemi-anechoic chamber at frequencies ranging between one and 16 kHz. A left/right procedure was used to measure the minimum audible angle (MAA) at 75% correct discrimination for each subject at each frequency tested. MAAs ranged from approximately four to thirteen degrees in the harbor seal and approximately six to thirteen degrees in the sea lion, with smaller MAAs measured at the extreme frequencies for both subjects. The results showed that these pinnipeds localized both low and high frequency pure tones relatively well, while their performance suffered at intermediate frequencies. This suggests that pinnipeds, like many other terrestrial mammals, use time-based cues to localize low frequencies and intensity-based cues to localize high frequencies. Current testing with a northern elephant seal (*Mirounga angustirostris*) will provide further insight on the use of binaural cues and the effects of head size with respect to this auditory ability.

Avoidance of Shallow-Water Blackout in Fur Seals

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Studies of diving physiology have primarily been concerned with threats to deep-divers. However, the primary threat to a shallow-water diver is latent hypoxia or shallow-water blackout. This is caused by the reversal of the oxygen gradient at the blood-lung interface during the final phase of ascent, causing blood oxygen depletion and consequent blackout. We used video (n=3), acoustic (n=2) and electromagnetic field sensors (n=29) to investigate this in Antarctic fur seals (*Arctocephalus gazella*), which make repeated bouts of shallow dives (0-100 m). Fur seals were observed to consistently and continuously exhale for the final three-quarters of the ascent of all dives. Bubbles were observed visually and audibly to increase in volume during the ascent. Models of the increase in air volume with reduction in ambient pressure during ascent correspond well with the recorded variation in amplitude of bubble-sounds. Orientation-sensors showed that this bubble-blowing occurred while the animal faced upwards but stopped if the animal turned to face downwards. The depths at which the first bubbles were observed coincided well with expectations based on simple models of lung dimensions and assuming maintenance of lung contraction during the ascent. Maintaining lung contraction would serve to prevent air exchange during decompression, bypassing any threat of latent hypoxia and maximising the blood oxygen content. Such a mechanism, although unrecorded until now, may be common to other shallow water divers such as penguins or other otariid seals.

The Relationship Between Body Condition, Temperature Regulation and Convective Heat Loss In 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 Steller sea lion (SSL) population. This hypothesis suggests that energy intake is insufficient to meet daily energetic demands and that nutritionally stressed juveniles, foraging in subarctic waters, would have to tap their energy reserves, thereby reducing insulation and increasing thermoregulatory costs. This could contribute to the onset of a downward spiral of reduced body condition and increased energy deficit, until energy balance could not be maintained. To assess the potential significance of thermoregulatory costs incurred by juvenile SSLs, metabolic rate (MR) was determined by measuring oxygen consumption rates of juvenile captive animals (n=4, 104-137 kg) held in a temperature-controlled swim flume at the Vancouver Aquarium. MR was measured in post-absorptive animals over a combination of water temperatures (2, 4, 8 °C) and speeds (0, 0.5, 1.0, 1.2 m/s) to examine the interaction of temperature and convective heat loss as a function of water flowing past the