The Evaluation of Olfaction in Stranded California Sea Lions (*Zalophus californianus*) and Relevance to Domoic Acid Toxicosis

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Domoic acid (DA) is a neurotoxin, produced by the diatom *Pseudo-nitzschia* that bio-accumulates in the food chain and affects multiple species of marine life. In the past two decades, DA toxicosis has been linked to neurologic disease and reproductive failure in California sea lions (*Zalophus californianus*) along the California coast. The most severe effect of DA is hippocampal necrosis following binding of DA to glutamate receptors on neurons. In some intoxicated sea lions, necrotic neurons have been observed throughout the cortical and thalamic limbic system, including the pyriform lobe, rostral thalamic nuclei, and olfactory bulb. Although acute exposure to DA can lead to epilepsy and death, the distribution of these lesions suggest that sublethal effects could include disruption of olfaction, which in turn could impact establishment of the mother/pup bond. In this study, a simple behavioral assay was used to assess olfactory function in California sea lions using a differential response to a scented and non-scented stimulus. Forty California sea lions stranding from May 2009 to June 2010 were tested. Individuals with DA toxicosis had hippocampal atrophy diagnosed by magnetic resonance imaging or histology. The other animals tested ("controls") were suffering from malnutrition, trauma, or cancer, and had presumably normal hippocampal morphology. Time spent exploring a fish-scented object and a matched non-scented object was recorded to video, and each session was reviewed. Control sea lions spent significantly more time with the scented object than with the non-scented, demonstrating the utility of this method. Comparisons between the control animals and those diagnosed with DA toxicosis will be presented to evaluate the hypothesis that the affected animals will demonstrate a weaker differential response to the test objects due to the occurrence of damage to areas of the brain associated with olfactory processing.

Spatio-temporal Modeling of the Eastern Pacific Gray Whale's (*Eschrichtius robustus)* Migration through California, Oregon, and Washington

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Gray whales (*Eschrichtius robustus*) undertake one of the longest annual migrations of any mammal, traveling from wintering grounds off Baja California, Mexico to summer feeding grounds in the Bering, Beaufort and Chukchi Seas. The nearshore migration corridors used by most gray whales often coincide with heavily urbanized coastal areas which vastly increases the likelihood of exposure to anthropogenic threats such as fishing gear entanglements, vessel collisions, industrial/commercial noise, and water-borne contaminants. Gray whales have the highest reported number of entanglements and ship strikes of any large whale species along the U.S. west coast. To assess this risk, a spatio-temporal model was developed that incorporates density and seasonal distribution data from shore-based surveys combined with telemetry derived swim speed estimates during southbound and northbound phase A (mainly adults and juveniles) and B (mainly cow/calf pairs) migrations. The model was verified by choosing random dates from NMFS/SWFSC 2010/2011 survey data collected during southbound and northbound migrations off central California. Gray whale migration data were animated using ArcGIS time layer properties, which can be adjusted to account for "early" or "late" migrations. Visualization of the co-occurrence of gray whales with commercial fishing grounds or areas of high shipping traffic, as is provided by this model and animation, is critical for conducting a risk-assessment. The ability to identify spatial or temporal "hot spots," where gray whales and potential threats overlap, can help minimize or mitigate related impacts. This model is broadly applicable to other species and serves as a valuable tool for the management of marine ecosystems and marine spatial planning efforts.

The metabolism of vitamin A in Northern elephant seals differs from terrestrial mammals

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Northern elephant seal (*Mirounga angustirostris*) (NES) females fast during lactation. The dramatic mobilization of blubber lipids that occurs during that period may be associated to the release of fat-soluble molecules and their transfer into the milk. We conducted a longitudinal study of the changes of a fat-soluble vitamin, vitamin A, in the tissues of NES females captured at early and late lactation in order to (1) understand the metabolism of this essential fat-soluble nutrient during fast and milk production and (2) compare its dynamics to those of other fat-soluble nutrients (vitamin E) as well as fat-soluble pollutants (PCBs and DDTs). On average, milk vitamin A concentrations were 6 times higher at late lactation as compared to early lactation. This pattern differs dramatically from terrestrial mammals, which are characterized by higher vitamin A levels in colostrum than mature milk. Vitamin A concentrations also significantly increased in inner blubber throughout lactation, whereas they remained constant in outer blubber. Inner blubber contained from 4.5 to 7.5 times higher vitamin A levels than outer blubber. Inner blubber appears to be an important vitamin A storage site in seals and a direct transfer of vitamin A to the mammary gland may occur. The storage of vitamin A as retinyl esters in the adipose tissue and variations in fatty acid profiles might explain differences of vitamin A status between the 2 layers. Vitamin A changes throughout lactation exhibited intriguing similarities with those of PCBs and DDTs. On the contrary, the pattern differed from the one of vitamin E. There was a significant drop of milk vitamin E concentration between early and late lactation, which is the usual pattern in terrestrial mammals. The distribution of vitamin E throughout blubber layers also differed from those of vitamin A, suggesting different mechanisms of mobilization and transfer into the milk.