Audience Favourites 2017 Biennial Conference

Monday

Michelle Fournet

Title:
Southeast Alaska humpback whales increase non-song source levels in higher natural or manmade ambient noise

Abstract:
Anthropogenic noise is a pervasive and persistent environmental feature for acoustically oriented marine mammals. Vessel noise in particular has been identified as potentially harmful to low-frequency specialists, including humpback whales (*Megaptera novaeangliae*), that produce vocalizations in the same frequency band as engine noise. On the Southeast Alaska feeding grounds, humpback whales produce a wide range of calls known as non-song vocalizations, which thus-far are poorly understood. In Glacier Bay National Park (GBNP), a collaborative two-year study aims to describe humpback whale vocalizations and investigate shifts in calling behavior that may occur in response to vessel noise. We used a four element bottom-mounted hydrophone array to [1] measure the loudness of humpback whale non-song vocalizations and [2] assess whether humpback whales adjust source levels in response to ambient noise. The average source level for humpback whale non-song vocalizations was 142 dB $_{RMS}$ re 1 µPa @ 1m (n = 179, 95% CI: 139.6, 144.0 range= 123.4:169.9 dB); this is quieter than what has been described for humpback whales in other regions. Results of a linear regression indicated that ambient noise explained almost half the variance in non-song source levels (R^2=.49, $F_{1,178}$= 172.8, p< 2.2e-16). In GBNP a 1 dB increase in ambient noise levels resulted in an average source level increase of 0.8 dB (95% C.I.: 0.7 to 0.95 dB). In this study humpback whales increased the source level of their vocalizations in response to both environmental and anthropogenic noise.

Tuesday

John Calambokidis

Title:
A high risk intertidal feeding strategy for gray whales examined with new suction-cup attached multi-sensor video tags

Abstract:
Gray whales were considered specialized feeders, almost exclusively targeting benthic amphipods in the Arctic. More recent research has revealed them to be more versatile and adaptive in their feeding strategies and variety of prey. A group of a dozen individually identified gray whales return for 2-3 months each spring to feed (some for more than 25 years) in the waters of northern Puget Sound. This location is >200 km off the migration corridor for gray whales, and they began using this area in two periods (1990-91 and 1999-2000). We examined the feeding and social behavior of this group of gray whales using data from 11 deployments of suction-cup attached multi-sensor video tags in spring of 2015 and 2016. The tags gathered 132 hours of data, including the longest deployments for a suction cup tag (>67h attachment with 38h of accelerometry data and 6h of video). Video and kinematic data revealed that gray whales fed

almost exclusively on intertidal ghost shrimp during high-tide periods when whales could access these areas. Typical dive depths during bottom feeding were 2.5-3 m (barely enough waters to swim) and some feeding areas were >2 km from deeper water. Semi-diurnal feeding periods ranged from <1h to >6h and were skewed towards the incoming period around the high tide. Gray whales spent extensive periods milling in several other areas during other periods, but the tags revealed they were not feeding. Instead they showed a high degree of social interaction, including frequent body contact with other whales, as well as sub-surface bottom resting behavior. Gray whales appear to have discovered this area during periods of food stress when they were in search of alternative prey. Despite access to foraging grounds for short periods, the nutrient-rich ghost shrimp beds appear to justify this off-migration transit and high-risk strategy.

Wednesday

Dave Rosen

Title:
Dive, Steller, Dive: New insights into how marine mammals respond to changes in prey distribution

Abstract:
The relationship among dive behaviour, physiology, energetics, and prey availability is innately complex and difficult to study in wild or aquarium animals. Yet, such information is critically important for identifying individual constraints, which will guide our predictions for outcomes of rapidly changing environmental conditions on marine mammal populations. A novel research program using Steller sea lions (*Eumetopias jubatus*) trained to swim and dive in the open ocean yielded surprising insights into both diving physiology and the potential impact of changes to the prey base on foraging behaviour and energetics. For example, the cost of exploiting prey patches is impacted by dive duration, depth, and distance travelled—often in contrasting ways—and is facilitated by flexibility in classic physiological elements of the dive response (such as bradycardia). Unexpectedly, the costs of diving also appear to reflect pre-planning, altering with expected submergence time. While foraging under normal conditions, mean dive duration is usually close to their aerobic dive limit (~3 minutes). However, sea lions respond to poor nutritional condition by foraging harder, failing to suspend digestion (thus increasing diving metabolic rate), and diving beyond their surprisingly enhanced aerobic dive limit. Thus, they effectively focus on increasing food intake at depth by sacrificing recovery times between dives. When prey densities are held constant but prey depth changes, the sea lions obtain more net energy from shallow prey patches than from deeper ones. However, the sea lions respond to reduced prey densities under all experimental conditions by making more frequent dives, and spending less time at depth, which results in them obtaining less food and having low energy efficiency. Collectively, these new insights into the physiological basis of diving behaviour further our understanding of the potential scope for behavioural responses of marine mammals to changes in density, depth, and distribution of prey triggered by environmental changes.

Thursday

Casey Clark

Title:
Braving the elements: Investigating Pacific walrus life history and movements using trace elements in teeth

Abstract:
Organic structures containing incremental growth layers act as biological archives, recording and storing information throughout an organism's life. Pacific walrus (*Odobenus rosmarus divergens*) tooth cementum accrues dark and light bands seasonally. Naturally occurring trace elements are included in the cementum in concentrations reflecting those of the environment in which walruses lived and fed. By measuring element concentrations, a lifetime history of exposure can be reconstructed, providing information about the movements and life histories of individual walruses. The purpose of this study was to 1) investigate the association between trace element concentrations and seasonal growth layers in walrus teeth; and, 2) examine trends in element concentrations across the lives of individual animals. We used an Agilent 7500ce ICP-MS to measure concentrations of arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, strontium, vanadium, and zinc in modern-day walrus teeth taken during Alaska Native subsistence harvests (n = 30), historic teeth collected between 1883 and 1981 (n = 40), and archaeological teeth from the last 2,500 years (n = 20). Variability in trace element concentrations was compared with annual growth layers to identify elements associated with seasonal movements. Changes in element concentrations within the lifetimes of individual walruses were compared qualitatively. Historic and archaeological samples allowed for comparisons of walrus movements and life histories before and after the onset of recent Arctic warming. Multidimensional scaling revealed strong separation in trace element concentrations between the breeding and feeding periods (nMDS stress = 0.001), but no separation between sexes. Males and females exhibited different patterns of accumulation for some elements (*e.g.*, females tended to accumulate lead across their lives, whereas males did not), but showed similar patterns for most. These results provide novel insight into walrus biology and ecology, and demonstrate the viability of trace element analysis for studying these topics.

Friday

Ari Friedlaender

Title:
Turning left to stay right: A unique test of lateralization across the full range of three-dimensional foraging maneuvers in blue whales (Balaenoptera musculus)

Abstract:
Prey-capture tactics and their associated kinematic processes are reinforced through repetition, outcome, and prey capture success. Lateralized prey capture behaviors involving right-side dominant strategies, which utilize neurophysiological connections that increase stereotyped foraging behavior efficiency, are common across several animal taxa. However, most studies involve terrestrial animals feeding in a single plane and/or in laboratory conditions and fail to represent foraging in dynamic 3-dimensional environments that marine mammals inhabit. Using motion-sensing tag data from 58 deployments on blue whales (n=3,272 feeding events), we measured substantially different kinematic tactics from the conventional lateralized foraging

paradigm. This was only evident when their full range of foraging behaviors was analyzed in the context of empirically measured dynamic prey environments. We find population-level asymmetries in the most common feeding behaviors: a right-side lateralization bias (66% of whales) for the most common and basic feeding tactics (90° lunge feeding rolls) and a unique left-side lateralization bias (73% of whales) in the most kinematically complex feeding strategies (360°rolls). Conversely, 180°rolls show anti-symmetry, or no significant directional bias. Strong evidence ($p<0.001$) of lateralization across multiple feeding behaviors was evident within individuals. Left-side lateralized 360° rolls occur more frequently when whales target smaller and shallower prey patches from below. These acrobatic, ambush-feeding strikes occur at significantly steeper pitch angles as whales turn to the left, presumably maintaining visual connection to prey with the right eye. Although these results demonstrate both right- and left-side biased feeding behaviors, both adaptive strategies are likely driven by right-side lateralization where fine-motor activities are controlled predominantly by the left side of the brain. These data support the conclusion that visual links between right eye vision largely inform fine-scale kinematic maneuvering for predators foraging in three dimensions, but suggest that in dynamic natural environments this may manifest as a left-side kinematic bias in feeding strategies.