Estimation of food consumption by Hawaiian monk seals relative to ecosystem biomass and fisheries overlap in the main Hawaiian Islands

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Hawaiian monk seals (*Monachus schaunislandi*) are critically endangered: only ~1,100 individuals remain and the species is declining across most of its range. However, a small population in the main Hawaiian Islands has been increasing in recent years. While encouraging for the species, the increasing seal population, combined with a continuing decline in fishery catch, has raised public concerns about the impact of monk seals on the ecosystem and on species targeted by humans. There are many misconceptions about the magnitude of seal consumption, often fueled by a lack of broader ecological context, which can lead to animosity and even intentional killing of monk seals. This study used disparate data sets to make calculations that are explicit with assumptions and sources of error to give context to monk seal consumption, with reasonable estimates of ecosystem biomass and other species' consumption. We estimate that the current population of ~200 seals in the main Hawaiian Islands eats a maximum of ~0.007% of the available biomass. We estimate that other apex predatory fish around Hawaii consume at least 50 times more biomass than monk seals. Nearshore recreational and commercial fisheries are estimated to land ~3 times more than seals consume. At most, ~27% of commercial landings, and ~40% of recreational landings (excluding pelagic species) are from fish families also found in monk seal diet. Given imperfect data sets, we show that it is still possible to provide the public and stakeholders with reasonable estimates that are rooted in the best available science. On an ecosystem level, there is no support for assertions that monk seals have significant negative effects on the marine ecosystem. The Hawaiian Monk Seal Recovery Program continues to work to identify potential localized effects and mitigation of direct interactions through improved communication with fishermen and direct observation of seal foraging behaviors.

Sex specific differences in the ranging patterns of Indo-Pacific bottlenose dolphins in southwest Australia.

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The analysis of ranging patterns is important to the understanding of species ecology, population dynamics and social and genetic structure. Ranging patterns are influenced by social systems, predation risk, foraging strategies and resource availability. Bottlenose dolphins display a high degree of variability in population structure among different geographic locations. In this study, we investigated differences in ranging patterns between adult male and female Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in a temperate environment in Bunbury, Western Australia. To achieve this, we conducted systematic boat-based surveys (n>530) along pre-determined transect lines throughout the 540 km^2 study area. Photo-identification data were collected year-round over six consecutive years (2007-2013). More than 1280 dolphin groups were encountered, where over 440 dolphins were catalogued by distinctive fin markings and sex was determined for 55 males and 140 females through genetic analysis or visual observations. A sensitivity analysis was carried out to determine the minimum number of sightings required to most accurately portray range size. Results from minimum convex polygons and fixed kernel estimators revealed that adult males had larger ranges than females and several key areas for females were highlighted. We hypothesize that adult males range further in search for potential mates and that female range patterns are affected by ecological parameters, such as, availability of resources and protection from predators. The key areas identified may be of interest for conservation and management purposes.

Variable influence of regional vs. global climate dynamics on marine mammals in open and semi-closed systems: Case for a paradigm shift in climate change based conservation

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Climate change has been implicated in impacting marine mammal abundance and distribution. Although climate dynamics are often examined at the global scale, all global warming impacts are local. Fortunately, use of high resolution climate data to explain regional variability in marine mammal populations is yielding promising results. But we also need to consider if and how anthropogenic stressors and ecosystem change exacerbate climate impacts or cause region-specific effects on marine mammals. Previously, we qualitatively evaluated relationships between regional and global climate and oceanographic variables and potential declines in dusky dolphin (*Lagenorhynchus obscurus*) encounter and feeding rates in the semi-enclosed, wintertime habitat of Admiralty Bay, New Zealand. Results indicated that regional climate-ecosystem dynamics were more influential on dolphin feeding and occurrence patterns than global climate indicators. Here, we quantitatively determine the effects of global and regional climate dynamics on dolphin occurrence in the year-round, open ocean habitat off Kaikoura, New Zealand. We used tour boat data (1995-2006) to calculate dolphin sightings per unit effort (SPUE = num. groups sighted per year/num. tour days per year). We correlated SPUE with total and anomaly data for region-specific oceanographic and climate variables (sea surface height, sea surface temperature (SST), wind stress, ocean velocity, sea surface salinity, chlorophyll) and global climate variables (Southern Oscillation Index, SST Niño-3.4). Unlike Admiralty Bay, regional and global SST anomalies were significantly correlated (r = -0.61, $p < 0.05$). However, we found no correlation between dolphin SPUE and regional or global climate or oceanographic variables (all $p > 0.05$). In contrast to Admiralty Bay, we suggest that fine-scale variability in dolphin behavior off Kaikoura may be more strongly influenced by ecosystem changes and/or anthropogenic stressors rather than climate variability. The ability of ecosystems to integrate weak climate links should be considered for further data gathering and ecosystem-climate interaction studies.

Passive acoustic monitoring of beaked whales and other cetaceans off Cape Hatteras, North Carolina

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The continental shelf break and slope off Cape Hatteras, NC supports one of the most diverse cetacean faunal assemblages in the western North Atlantic. Ongoing aerial and vessel-based surveys are characterizing the distribution and density of cetaceans in this region, but these surveys are limited by weather, daylight, and cryptic animal behavior. Passive acoustic monitoring (PAM) provides a rich picture of patterns of occurrence, acoustic behavior, and foraging ecology, particularly for deep-diving odontocetes such as sperm whales (*Physeter macrocephalus*) and beaked whales (*Ziphius* and *Mesoplodon*spp.). During March-April 2012, we collected the first PAM recordings from this site using a bottom-mounted High-frequency Acoustic Recording Package (HARP) moored at 950 m depth and sampling at 200 kHz. We analyzed the recordings by visually inspecting long-term spectral averages (LTSAs) and spectrograms. Odontocete clicks, whistles, and burst-pulse sounds occurred every recording day and across 77% of recording hours. Sperm whale clicks were present on 96% of recording days; the occurrence of these clicks did not differ significantly between day and night, in contrast to the diel pattern observed elsewhere along the southeastern U.S. coast. We identified several beaked whale click events; spectral click parameters and inter-click intervals suggest that these clicks were produced by two species, likely *Ziphius cavirostris* and *Mesoplodon europaeus*. Each click event was short in duration (4-20 min), but beaked whale clicks were detected on nearly 40% of recording days, underscoring the value of PAM in monitoring the occurrence of these cryptic species. In addition, we detected frequent calls of fin (*Balaenoptera physalus*) and minke (*B. acutorostrata*) whales. We are collecting year-round recordings off Cape Hatteras, which will generate baseline data and allow further comparisons of seasonal and diel patterns in the occurrence and acoustic activity of cetacean species at this site.

Trained vocal production learning in a captive grey seal (*Halichoerus grypus*)

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In vocal production learning, signals are modified in form as a result of experience with sounds of other individuals. This can lead to signals that are either similar or dissimilar to the model. Evidence for vocal production learning is rare among non-human mammals but the ability is a crucial factor in communication complexity. Anecdotal evidence for vocal production learning exists for a harbour seal that spontaneously copied human speech sounds. Here we used a novel playback method to study vocal learning in a captive juvenile grey seal more systematically. The seal was trained using positive reinforcement (small pieces of fish) to vocally imitate played stimuli. Playback stimuli were created from recordings of the seals' own calls and were digitally altered to vary in time and frequency. These stimuli were presented in sequences ranging between one to eight calls, and varied in frequency, duration and inter-call interval. Based on a sample of the seal's responses (n=721), the seal successfully imitated several parameters of the playback stimuli. Accuracy was measured by calculating the standard deviation of each call parameter and marking the seal's call as correct if it was within one standard deviation of the played call. The seal successfully matched peak frequency (77%), fundamental frequency (64%), duration (67%) and inter-call interval (79%). When examining the calls as a sequence, the seal accurately imitated the number of calls (72%) and the changes in peak frequency (75%) but was less accurate following changes in the fundamental frequency (52%). This suggests the seal matched call frequency by varying how energy was distributed throughout the call, rather than by changing the fundamental frequency. These results demonstrate grey seals are capable of vocal production learning, and present a novel method for testing vocal production learning.

Mysticetus: All-in-one field/analysis/GIS/mapping software including a new tested method for simple calculation of platform observation height and position

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Mysticetus software is designed for field data collection, real-time tracking/mapping of animals and objects, data-logging, GIS analyses and GIS compatible field formats. It was developed specifically to provide an "all-in-one", simple-to-use tool that can be modified by the user. It operates on PCs, laptops, touch-screen tablets, and iPad/iPhones. Mysticetus has been successfully used in over 20 marine animal surveys since 2010. The birth of Mysticetus was guided by the needs/requests of marine mammal biologists using boat, aerial, passive-acoustic monitoring (PAM), and shore-based (e.g., theodolite) platforms (but can also be applied to terrestrial systems). Data collected simultaneously from visual and acoustic line-transect surveys (e.g., sightings, towed hydrophone array and sonobuoy data) have been integrated and mapped in real time. Mysticetus can share data across multiple computer displays via AIS and/or LAN. Users can easily configure Mysticetus to: (1) customize data sheets, (2) select measuring units, (3) summarize effort by a user-defined variable (e.g., km, nm, hour, type, Beaufort), (4) summarize sightings by user-defined variables (e.g., species, depth, slope, distance from shore) (5) plot sightings/effort on report-ready bathymetric maps, (6) edit data (in Mysticetus), (7) export data to various formats (e.g., Microsoft-Excel, Microsoft-Access, MATLAB, in csv, txt, shp, kml format, and; (8) post-process/link previous (non-Mysticetus) data to geographic or oceanographic attributes. GPS coordinates are automatically recorded. Determining the elevation of a shore-station platform is often a tedious and complex calibration method requiring a visible shoreline. Mysticetus can simply integrate and incorporate hundreds of WAAS-enabled GPS positions to obtain an elevation and a measure of its accuracy. A free trial of Mysticetus is available at www.mysticetus.com. Examples of Mysticetus capabilities will be demonstrated for this presentation.

Genetic identity of humpback whales migrating past New Zealand

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The relationship of migratory corridors to breeding ground destinations is poorly understood in humpback whales. Here we compare genotypes from individual humpback whales on their northbound migration through Cook Strait, New Zealand (n=173) to breeding grounds in Oceania (n=1,171) and a migratory corridor along east Australia (n=856).The individual