confined to a few 'representative' species. How an animal receives sound may influence how it uses or is impacted by sound. Here we address how a divergent species, the Yangtze finless porpoise (*Neophocaena phocaenoides asiaeorientalis*), receives sound. Noise impacts on this subspecies are a concern as they inhabit waters with many acoustic sources. Hearing was measured in two animals using auditory evoked potentials. Broadband clicks and low-, mid- and high-frequency (8, 54, 120 kHz) tone stimuli were presented at nine locations on the head and body using a jawphone transducer. Thresholds were compared to anatomical dissections, and computed tomography and magnetic resonance imaging of two finless porpoise. 'Acoustic fat' regions were confined to relatively small areas in the finless porpoise. Minimum thresholds and best hearing locations were from a cheek fat pad and distal to the porpoise bulla. However, mean thresholds were not substantially different at locations from the rostrum tip to the ear (11.6 dB). This is quite different from the bottlenose dolphin and beluga, in which 30-40 dB threshold differences were found across their heads. AEP response latencies were shortest from the cheek pad indicating a preferential sound pathway. Latencies were dependent on stimulus level suggesting hearing pathways which reduce transmission loss can result in both higher amplitude and faster auditory responses. The unique combination of anatomical and physiological data reinforces the importance of sound-conductive pathways. Finless porpoises have relatively less 'shading' of sounds and are potentially more susceptible to masking effects. The results show there are differences in how divergent odontocetes receive sound, supporting caution when applying auditory data across species.

Histological investigation of the "slip" in marine mammal tracheas

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In 1940 Scholander proposed that marine mammals have stiffened upper airways that would stay open and receive air from highly compressible alveoli during diving. However, this idealized alveoli–up system would tend to underestimate the importance of tracheal collapse or the role of the trachea at pressure. There are little data available on the structural and functional adaptations of the marine mammal respiratory system. Although biomechanical and pressure-associated changes have been measured, the aim of this research is to investigate the microscopic tracheal characteristics of five different species of diving mammals, specifically focusing on elastic fibers and distances of cartilage overlap. Our histological measurements have revealed the presence of "slip features" in both pinniped and cetacean tracheas. These "slip features" are characterized by partial or incomplete cartilaginous rings, which, at pressure, will overlap maintaining constricted airways. This finding lends evidence for pressure-induced collapse and re-inflation of the trachea. In some cases, more than one "slip feature" is present per tracheal ring, perhaps allowing for more rapid and effective compression. There is great variation in the anatomy of the "slip feature" between cetacean and pinniped, as some truly overlay one another and others are separated by elastic fibers, connective tissue and smooth muscle. There also seems to be a significant difference between the quantity of elastic fiber in pinniped species versus cetacean species, for example cetaceans tended to have more elastic fibers, perhaps correlating to deeper dive depths or higher ventilatory rates.

Bayesian state-space model of cetacean abundance trends from 1991-2008 time series of line-transect surveys in the California Current

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Estimating temporal trends in marine mammal abundance is central to their management and our understanding of their ecology. However, detecting trend estimates for marine mammals is challenging, particularly within a null hypothesis testing framework, because of variable detection rates across surveys (e.g. due to differences in observers or conditions) and low precision of individual abundance estimates. We demonstrate a Bayesian approach for estimating abundance and population trends, using a time series of line-transect data for cetaceans off the west coast of the United States. A hierarchical model is used to partition the state process of interest (i.e., population density modelled as a function of covariates and random process terms state and observation processes) from the observation process (i.e., observed counts modelled as a function of population density and detection probability using distance sampling theory). Using fin whales (*Balaenoptera physalus*) as an example, Bayesian posterior summaries for trend parameters provide strong evidence of increasing fin whale abundance in the California Current study area from 1991 to 2008, while individual abundance estimates during survey years were considerably more precise than previously reported estimates using the same data. Results for other species show a variety of population trends and are used to illustrate the broad utility of our methods. Our initial work indicates that Bayesian hierarchical modeling offers numerous benefits for analyzing marine mammal abundance trends. These include implicit handling of sampling covariance, flexibility to accommodate random effects and covariates, ability to compare trend models of different functional forms, and ability to partition sampling and process error to make predictions. Bayesian posterior distributions offer a probabilistic and intuitive means of inferring abundance trends that may be obscured by null hypothesis testing.

Got Milk? Aircraft Observations Provide Rare Glimpses into Whale Calf Nursing and Back Riding

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Nursing behavior by large cetaceans in situ is not well described. During ~30,000 km of aerial surveys off Southern California to monitor marine mammals in 2008-2011, nursing behaviors were documented for three species: Eastern Pacific gray whale (*Eschrichtius robustus*), fin whale (*Baleanoptera physalus*) and killer whale (*Orcinus orca*). Photographs, video, notes and audio recordings were used to analyze mother-calf interactions. Back riding occurred in gray and fin whales, as described for bowhead whale (*Balaena mysticetus*) mother-calf pairs by Würsig et al. (1999). During slow sub-surface travel, a fin whale calf swam alongside mother's peduncle area, touching her head-first for short (< 1 min) bouts at a 45° angle. During the sighting (~50 min) the calf switched from one side of the mother's peduncle to the other 12 times, usually by "riding" (n=8) the mother's back or swimming underneath her (n=4). Nursing was assumed based on the persistent (~1 min) position of the calf's head relative to mother's peduncle/teat area. Observations of the gray whale pair showed similar behavior (~19 min) with calf riding mother's back 3 times, except mother was resting not traveling. During nursing, the calf faced mother at a 45° angle while mother held up her flukes. Two apparent nursing positions of a traveling killer whale mother-calf pair were also photo-documented (~40 min). One position showed both whales lying parallel, facing one another, in the same orientation. The second position showed the same mother lying on her back, with calf nursing on top of mother, ventral side to ventral side. These positions were similar to those described among captive killer whales. Observations indicate nursing occurs during travel and calves of other whale species back ride. Data contribute to rare documentations of whales nursing in the wild, furthering the understanding of cetacean mother-calf interactions.

Field Use of Auditory Evoked Potential Technology to Acquire Audiograms from Stranded Odontocetes

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The technical aspect of acquiring marine mammal auditory evoked potential (AEP) audiograms combined with the logistical challenges in field deployment of AEP equipment have largely limited the ability to gather AEP data to captive and rehabilitation situations, with few qualified researchers to conduct the tests. As a result, live strandings of marine mammals have remained a relatively untapped source of hearing data for many species. Two portable evoked potential measurement systems were constructed for use by stranding networks to determine the feasibility of non-expert collections of cetacean audiometric data. The systems were based on a customized version of the Evoked Response Study Tool (EVREST) with a simplified user interface designed for testing odontocetes. Stranding network personnel were provided one day of training on the system. Given the high annual rate of live odontocete strandings on Cape Cod Massachusetts, USA, one unit was deployed to this area for use by the International Fund for Animal Welfare's (IFAW) Marine Mammal Rescue and Research program. Between January and April 2010, the IFAW team attempted unsupervised AEP measurements on six live stranded odontocetes: harbor porpoise (*Phocoena phocoena*, n=1), common dolphins (*Delphinus delphis*; n=3) and Atlantic white-sided dolphins (*Lagenorhynchus acutus*, n=2). Full or partial audiograms were obtained from the common and white-sided dolphins. The poor skin condition of the harbor porpoise inhibited consistent electrode contact during testing and the small size prevented proper jaw phone attachment; no audiogram was obtained from this animal. Audiograms were typically dolphin in nature with an upper frequency limit approaching 160 kHz. Stranding network success at collecting odontocete AEP audiograms demonstrates that hearing tests can be conducted by non-expert operators with a streamlined and simplified testing system. This approach provides access to species not previously examined and will increase the rate at which audiometric data are collected from marine mammals.

Late-season abundance and seasonal trends of humpback whales on three important wintering grounds for Pacific herring in the Gulf of Alaska

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Humpback whale (*Megaptera novaeagliae*) populations in the North Pacific Ocean have made a remarkable recovery from heavy commercial exploitation during the 1900s. As populations rebound, their ecological impact increases, as does their ability to influence their prey through top-down forcing. Using boat-based surveys, photographic identification, and mark-recapture models, we estimated humpback whale abundance at three late-season (mid-September through mid-March) feeding areas (Prince William Sound, Lynn Canal, and Sitka Sound) in the Gulf of Alaska known for large aggregations of wintering Pacific herring (*Clupea pallasii*). Seasonal trends in whale abundance were similar between Lynn Canal and Sitka Sound peaking earlier in the fall, whereas whale numbers in Prince William Sound remained high into mid winter. In Prince William Sound and Lynn Canal, presence of whales was strongly associated with large shoals Pacific herring. In Sitka Sound, whales were not consistently linked to herring during the fall and winter months. During this study we identified four whales in Prince William Sound and two whales from Sitka Sound that skipped the annual migration to lower latitudes (i.e. over-wintered in Alaskan waters), but none in Lynn Canal. The trend of late-season whale abundance corresponded with the formation of herring aggregations in PWS and Lynn Canal, and are consistent with the hypothesis that humpback whales could be impacting these struggling herring populations.

A spatial abundance-habitat model for a common Gulf of Mexico cetacean: do oil/gas rigs matter?

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The bottlenose dolphin (BD) is a protected species and the most wide-spread cetacean in the northern Gulf of Mexico (nGOM). Thirty-eight stocks are identified for management purposes from inshore to oceanic waters. Current management models do not incorporate habitat predictors and lack spatial resolution, particularly on the continental shelf. This limits conservation of important habitat and evaluation of environmental impacts on dolphin populations. Our main goals were to use vessel transect data and environmental data to: 1) determine significant environmental predictors of BD abundance in the nGOM and 2) characterize BD responses to environmental predictors at fine scale. Environmental predictors included: oil/gas rigs; distance to the coast; depth; sea surface temperature; chlorophyll, which was used as an indicator of biological productivity, and several other habitat attributes. We used GIS, density surface and generalized additive modeling techniques (Distance, R mgcv package) to fit the BD habitat-abundance model on the nGOM continental shelf. Total dolphin abundance in the nGOM was estimated as 52,699 (CV = 0.16) yielding higher precision than previous design-based models. Using a 20 km by 20 km prediction grid for summer environmental conditions, we found that the median number of dolphins per cell was 15 dolphins. The