

seals can use hydrodynamic trail following for finding conspecifics under the non-visual conditions they often encounter in their natural environment.

Contingency Learning in Animal Sound Production: Vocal Control and Plasticity in the Walrus

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Classical ideas about acoustic communication in nonhuman mammals are based on the notion that most vocal communication is ritualized and non-modifiable, with emotional constraints, anatomical limitations, and genetic predispositions the most significant features in mammalian communication systems. More recently, this view has been challenged by the discovery that some cetaceans, like humans and some birds, are capable of vocal learning through mimicry. Further, there is evidence that the natural vocalizations of some mammals can be operantly conditioned, that is, they come to reliably occur in the presence of specific arbitrary stimuli and typically do not occur in the absence of those stimuli. The significance of operant conditioning, or contingency learning, in vocal development was highlighted in studies showing that the songs of male cowbirds are shaped through social feedback from conspecific females. These studies were recently extended to show that the vocal development of human infants can also be influenced by a process of selective shaping using social reinforcement. Thus, contingency learning using biological or conditioned reinforcers extends models of vocal development based on innate/emotive sound production and imitative learning. The current study examines the extent to which sounds produced by captive walrus are subject to operant control and selective shaping. Walrus are unique subjects for such experiments due to their natural potential for social learning during an extended period of maternal dependency, their large sound repertoire, and their multiple modes of sound production which include manipulation of the larynx, lips, mouth, nose, tongue, and pharyngeal pouches. Selective shaping using food reinforcement resulted in the acquisition of at least eight discriminative vocal operants in two adult walrus and revealed a degree of vocal plasticity previously unreported for mammalian species. These findings are relevant to the role of contingency learning in the evolution of communication systems including human speech.

An Epidemiological Framework for Analyzing Spatial and Temporal Health Trends for Free-Ranging Bottlenose Dolphin Populations Along the Southeast U.S. Coast

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Bottlenose dolphin (*Tursiops truncatus*) Unusual Mortality Events linked to epizootic disease, marine biotoxins, and potentially, exposure to chemical pollutants, have occurred along the US coast. Such events, and the concern that the disease and toxins affecting coastal dolphin populations could also affect humans, indicate a need to establish baseline health information, develop an understanding of spatial and temporal trends, and determine correlations of dolphin health with environmental

variables. We present an epidemiological framework that uses standardized protocols and common health and exposure endpoints across multiple dolphin capture-release studies to allow for the conduct of meta-analyses. The collective data provide for the assessment of spatial trends, but also increase effective sample sizes and broaden gradients of exposure, thereby increasing statistical power for testing correlations. We define a number of health panels (e.g. hepatic, renal, immune, endocrine) based on select subsets of haematology, blood chemistry and endocrine parameters, then combine data (N=172) from bottlenose dolphin capture-release studies in six coastal sites (St. Joseph Bay, FL; Sarasota Bay, FL; Charleston, SC; Holden Beach, SC; Beaufort, NC; Cape May, NJ) to establish baseline distributions. As an example application of the framework, we examine differences between study populations based on the number of individuals having scores above or below our established baseline percentiles for one or more panels. We find that hepatic panels suggest impaired liver function for many of the dolphins sampled near Cape May, NJ and immune panels suggest a higher level of parasitic infection or inappropriate immune response in the St. Joseph Bay population, for which 82% (CI=48%-98%) of the sampled individuals present eosinophil counts above the baseline 90th percentile. We further discuss the correlation of health panel scores with specific exposure endpoints and plans to expand dolphin health assessments in order to document health trends along the entire southeast US coast.

Bayesian Estimation of Richards Growth Curve Parameters for the Florida Manatee (*Trichechus manatus*)

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Growth curve models provide information on differences in life-history strategies, environmental conditions, and exposure to toxins. They can also, in a limited capacity, estimate age from other morphometric data, such as length or weight. However, growth curve parameters for large mammals can be biased, particularly when age estimation contains error. Bayesian analysis, allowing for the incorporation of age estimation error and prior information, was used to assess Richards growth curve parameters for the Florida manatee to fulfill two objectives: describe regional and gender differences in manatee growth curves, and provide a model to estimate carcass age from length. Body lengths and ear bone age estimates of 1,661 carcasses collected from 1978-2003 were used. Only eight carcasses of known true age were available and used as prior information. Process error was additive and normally distributed with $\mu = 0.0$ and unknown variance. Age estimation error was multiplicative and lognormally distributed with unknown mean and variance. Priors were uniform, restricting unknown age error to 0.5-2.0. Results showed ear bone ages generally underestimated true age. Incorporation of age estimation error led to an increase in growth period, but no other parameters were affected. Posterior distribution of the Richards shape parameter indicated little-to-no preference for any simplified form of the Richards curve. In general, Atlantic animals have a shorter growth period, and males have a shorter asymptotic length than females. Atlantic and Northwest males may be shorter at birth compared to other groups. Since the sample was of dead animals, apparent gender and regional differences could be confounded by the relationship between age, length, and cause of death. Although the ability to determine age from length varies for each group, lengths > 250 cm generally provide poor resolution. An increase in the number of carcasses of known age would greatly improve parameter estimates.

Manatee Population Trends in Sarasota County: Analysis of Aerial Survey Data from 1987 to 2004

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We analyzed aerial survey data from Sarasota County, Florida to assess temporal and spatial trends in manatee counts between 1987 and 2004. Surveys generally occurred twice per month. Three primary regions were