Session 1pNS

Noise, Animal Bioacoustics, and ASA Committee on Standards: Bioacoustic Metrics and the Impact of Noise on the Natural Environment

Michael Stocker, Chair
Ocean Conservation Research, P.O. Box 559, Lagunitas, CA 94938

Chair's Introduction—1:25

Invited Papers

1:30

1pNS1. Predicting the effects of masking noise on communication distance in birds. Robert J. Dooling (Dept. of Psych., Univ. of Maryland, College Park, MD 20742), Marjorie Leek (Portland, OR 97225), and Ed West (West Ecosystems Anal., Inc., Davis, CA 95616)

Anthropogenic noise (e.g., highway noise) that exceeds natural ambient sound levels potentially can mask important acoustic signals used by birds during communication. Signals degraded by masking can in turn adversely affect critical behaviors such as mate attraction, territorial defense, parent-offspring communication, predator avoidance, and prey detection. The amount of masking depends not only on the physical characteristics of the noise (intensity, frequency, temporal pattern, etc.) but also the auditory capacity of the species, the acoustic structure of their vocal signals, the proximity of the birds to the noise source and each other, and the sound attenuation properties of the habitat. Here we present a quantitative model for predicting effective communication distances between birds subject to different levels and types of anthropogenic noise. Cross-species analysis shows that communication distances are largely context /environment dependent and species specific. Extrapolation of noise impact distance estimates even within groups of similar species should be exercised with caution. This model should be useful in environmental impact analysis of anthropogenic noise on birds and other wildlife, particularly species of conservation concern.

1:50

1pNS2. Metrics for characterizing the sources of ocean anthropogenic noise. John A. Hildebrand (Scripps Inst. Oceanogr., Univ. of California, San Diego, La Jolla, CA 92092-0205)

Decibels are the standard shorthand for describing acoustic intensity and sound pressure level, but may lead to misunderstanding when applied as bioacoustic metrics. Acoustic power and source transmission energy are alternate metrics with intuitive appeal. Acoustic power, calculated from the acoustic intensity multiplied by the emitted solid angle, yields units of watts. Likewise, the energy per source transmission, given by multiplying acoustic power by the duration of the transmission, yields units of joules. For continuous (or quasicontinuous) signals, the standard procedure is to measure the root-mean-square (rms) of the signal. However, this presents problems for short duration signals where the duration of the signal being measured is an important parameter. In these cases it may be more appropriate to measure the peak-to-peak signal, rather than rms. Bandwidth is another important component of how the signal is described, typically in a narrow-band for ambient noise and broad-band for discrete sources. The characteristics of ocean anthropogenic noise sources in terms of these metrics will be discussed.

2:10

1pNS3. Marine mammal noise exposure criteria: Initial scientific recommendations. Brandon L. Southall (NOAA/NMFS Ocean Acoust. Prog., 1315 E-W Hwy. #12539, Silver Spring, MD 20910), Ann E. Bowles (Hubbs-SeaWorld Res. Inst., San Diego, CA 92109), William T. Ellison (Marine Acoust., Inc., Middletown, RI 02842), James J. Finneran (Space and Naval Warfare Sys. Ctr., San Diego, CA 92152), Roger L. Gentry (ProSci. Consulting, LLC, Dickerson, MD 20842), Charles R. Greene, Jr. (Greeneridge Sci. , Inc., Santa Barbara, CA 93110), David Kastak (U.C. Santa Cruz, Santa Cruz, CA 95060), Darlene R. Ketten (Woods Hole Oceanog. Inst., Woods Hole, MA 02543), James H. Miller (Univ. of Rhode Island, Narragansett, RI 02882), Paul E. Nachtigall (Hawaii Inst. of Marine Biol., Kaneohe, HI 96744), W. John Richardson (LGL Ltd., King City, ON, Canada), Jeanette A. Thomas (Western Illinois Univ.-Quad Cities, Moline, IL 61265), and Peter L. Tyack (Woods Hole Oceanog. Inst., Woods Hole, MA 02543)

An expert panel reviewed the expanding literature on marine mammal (cetacean and pinniped) auditory and behavioral responses to sound exposure to develop comprehensive, scientifically based noise exposure criteria [Aquatic Mammals **33**(4)]. They used precautionary extrapolation procedures to predict exposure levels above which adverse effects (both physical and behavioral) could be expected. Due to the paucity of data on long-term exposures, criteria were developed for single exposure events only. Marine mammals were broken into functional hearing groups. Exposure types were lumped into three broad classes (single pulses, multiple pulses, and nonpulses). Levels estimated to induce permanent noise-induced hearing loss were determined for each of 15 sound type/animal group combinations. For example, injury criteria for pinnipeds in water exposed to multiple pulses were 186 dB re 1 μPa^2 -s (weighted SEL) and 218 dB_{pk} re 1 μPa (unweighted peak SPL). Discrete behavioral disturbance thresholds could only be determined for exposure to single pulses. For other exposures, available data on behavioral responses were ranked by severity and significance. This severity scaling and the resulting conclusions will be described. New research required to improve criteria and to assess cumulative and ecosystem-level effects will also be considered, along with current policy and/or regulatory applications.