9:50

**3aABa9. Planning for a pilot census of marine life in the Gulf of Maine: The role of acoustics.** Kenneth G. Foote (Woods Hole Oceanogr. Inst., Woods Hole, MA 02543, kfoote@whoi.edu)

Preparations are being made for a pilot census of marine life in the Gulf of Maine ecosystem. The role of acoustics as a rapid, remote sensing tool is elaborated. Potential target organisms for acoustic surveying range from mesozooplankton and macrozooplankton to fish and cetaceans. A number of methodological problems must be addressed. These are illustrated for the echo integration method as applied to a stock of Atlantic herring (*Clupea harengus*) [J. Acoust. Soc. Am. **105**, 995 (1999)]. Particular problems of determining target strength and compensating for possible behavioral effects are also general to the method. [Work supported by the Alfred P. Sloan Foundation.]

10:05

**3aABa10. Localizing marine animals and how marine animals might localize sound.** Gerald L. D'Spain and Paul A. Lepper (Marine Physical Lab., Scripps Inst. of Oceanogr., La Jolla, CA 92093-0704)

We can locate vocalizing marine animals, and the animals themselves might locate sound sources, in one of several ways. Time-of-arrival (phase) differences and amplitude differences of a single arrival between spatially separated ''ears'' are well-known techniques. However, they become ineffective in multipath environments and as the frequency of the sound and/or spatial separation between ears decreases. Another approach is to sense properties of the acoustic field in addition to acoustic pressure. This approach, based on a simple Taylor series expansion of the field and ''$f=ma$,'' apparently is exploited by fish, making them biological equivalents of DIFAR sonobuoys. However, do they also measure acoustic strain rate? An additional method, used by humans, is to take advantage of time-of-arrival (phase) differences between multipath arrivals. The information on source location contained in the resulting interference patterns can be understood in terms of waveguide invariants. These speculations will be illustrated with numerical simulations and actual ocean acousic data. [Work supported by ONR.]

10:20

**3aABa11. Acoustic identification of female Steller sea lions.** Gregory S. Campbell (Cetacean Behavior Lab., San Diego State Univ., San Diego, CA 92182-4611), Robert Gisner (Code 342, Office of Naval Res., Arlington, VA 22217), and David A. Helweg (Code D351, SPAWARSYSCEN San Diego, San Diego, CA 92152)

Steller sea lions (*Eumetopias jubatus*) breed and rear their young in coastal rookeries dispersed along the northern tier of the North Pacific. Population densities are high and no allomaternal behavior occurs, providing strong selection pressure for mother–pup recognition processes. Mothers and pups establish and maintain contact with individually distinctive vocalizations. Our objective is to understand the acoustic features that serve to identify individual females, and develop a ruggedized computer system to perform acoustic recognition of females in the field. We have cataloged almost 2000 contact calls from 46 females in 1998 and 25 in 1999. Each female is visually identified by marking patterns, which provides the ground truth for acoustic identification. Acoustic properties of the calls were measured and presented to several statistical classifiers. Representations of the calls had to be robust with respect to acoustical variability introduced by motivational changes as the mother and pup regained proximity. The calls, classifiers, and results of generalization tests will be described, and a concept for the field system will be discussed. [Research supported by ONR Research Opportunities for Program Officers award N00014-00-1-0114 to R. H. DeFran, Cetacean Behavior Laboratory, SDSU.]

WEDNESDAY MORNING, 6 DECEMBER 2000 SCHOONER/SLOOP ROOMS, 10:50 TO 11:55 A.M.

## Session 3aABb

## Animal Bioacoustics: General Topics in Bioacoustics

Lawrence F. Wolski, Chair

*Hubbs-Sea World Research Institute, 2595 Ingraham Street, San Diego, California 92109*

**Chair's Introduction—10:50**

### *Contributed Papers*

10:55

**3aABb1. Infrasonic and low-frequency vocalizations from Siberian and Bengal tigers.** Elizabeth von Muggenthaler (Fauna Communications Res. Inst.)

Tigers have many vocalizations including chuffling, growling, prusten, gurgling, grunting, and roaring. It has been well documented that the tiger's high-amplitude, low-frequency roars, which are thought to be territorial in nature [C. Packer and A. E. Pusey, Sci. Am. **276**, 52–59 (1997)] transmit for miles. It has been suggested that because some tigers inhabit dense jungles with limited visiblity, the capacity to hear low frequency may be beneficial for sensing and locating prey [G. T. Huang, J. J. Rosowski, and W. T. Peake, J. Comp. Physiol. A (2000)]. In an effort to understand more about these low-frequency vocalizations and to provide data to other researchers testing hearing in anesthetized felids, 22 tigers, both Siberian and Bengal, are being recorded. A portable system can record from 3 Hz to 22 kHz. On-site real-time analysis of vocalizations is performed using a portable computer. Real-time and edited playback of sonic and infrasonic tiger vocalizations is facilitated by car audio speakers capable of producing frequencies from 10 Hz–22 kHz. Initial findings have documented fundamental frequencies of some roars at 17.50 Hz. Other vocalizations, including chuffling, have fundamental frequencies of 35 Hz $\pm 5$. Playback of both real-time and edited vocalizations appear to illicit behavioral responses, such as roaring, from male tigers.

11:10

**3aABb2. On the sound of snapping shrimp: The collapse of a cavitation bubble.** Michel Versluis, Anna von der Heydt,[a)] Detlef Lohse (Dept. of Appl. Phys. and J. M. Burgers Res. Ctr. for Fluid Dynam., Univ. of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands), and Barbara Schmitz (TU Munchen, 85747 Garching, Germany)

Snapping shrimp produce a snapping sound by an extremely rapid closure of their snapper claw. They usually occur in large numbers providing a permanent crackling background noise, thereby severely limiting the use of underwater acoustics for active and passive sonar, both in scientific and naval applications. Source levels reported for *Alpheus hetero-*

3a WED. AM