9:25

2aAB4. Narrow band pulses as stimuli in an auditory brain stem recording study with a harbor porpoise. Kristian Beedholm and Lee A. Miller (Inst. of Biol., Univ. of Southern Denmark, Campusvej 55, DK-5230 Odense M, Denmark, lee@biology.sdu.dk)

We have studied several aspects of hearing by a harbor porpoise using the ABR method with pulsed stimuli. Experiments were conducted on a male porpoise in collaboration with Fjord and Baelt, Kerteminde, Denmark. The animal had suction cups containing silver electrodes placed near the blowhole and near the dorsal fin. When fitted with the electrodes he moved to an underwater listening post where his outgoing sonar signal could be used to trigger a phantom echo. EEG signals were amplified differentially and averaged over a variable number of presentations depending on trial duration and experiment. For studying the frequency/intensity response, narrow band pulsed stimuli were generated and presented in several ways. One way was to use the impulse response of a B&K 1/3 octave filter bank (set to 80, 100, 125, or 160 kHz) as a stimulus. This stimulus was presented in both a passive hearing task, when a signal generator triggered the echo, and in an active experiment, where the echo was time locked to the animals emitted signal. Our results show the best response at 125 kHz and indicate a slight, but significantly higher response in the active mode. The latter has a methodological explanation. [Work supported by ONR.]

9:50

2aAB5. Auditory evoked potentials (AEP) methods for population-level assessment of hearing sensitivity in bottlenose dolphins. Dorian Houser (BIOMIMETICA, 7951 Shantung Dr., Santee, CA 92071) and James Finneran (Space and Naval Warfare Systems Ctr., San Diego, CA 92152)

A portable system for recording auditory evoked potentials (AEP) was developed to rapidly assess the hearing sensitivity of dolphins in air. The system utilizes a transducer embedded in a silicone suction cup to deliver amplitude modulated tones to the dolphin through the lower jaw. Frequencies tested range from 10–150 kHz and testing of both ears is completed within 90 min. AEP-determined thresholds from one subject were benchmarked against that subject's direct field behavioral audiogram to quantify variation between the two methods. To date, AEP audiograms have been obtained from over 30 bottlenose dolphins. Considerable individual variation in frequency-specific hearing sensitivity was observed. Some high-frequency hearing loss was observed in relatively young (early 20s) and old (35+ years) animals; conversely, age was not necessarily related to hearing loss as several animals greater than 40 years of age had good hearing sensitivity across the range of tested frequencies. Profound hearing loss typically occurred at higher frequencies. Decline in sensitivity was rapid in all cases and began between 50–60 kHz. Increased sample size of hearing sensitivity in dolphins suggest that the use of audiometric functions from single animals as representative of population level audiometry might be misleading.

10:15–10:30 Break

10:30

2aAB6. Electrophysiological methods for hearing assessment in pinnipeds. Colleen Reichmuth Kastak, David Kastak (Univ. of California Santa Cruz, Long Marine Lab., 100 Shaffer Rd., Santa Cruz, CA 95060, coll@ucsc.edu), James J. Finneran (SPAWARSYSCEN San Diego, San Diego, CA 92152), Dorian S. Houser (BIOMIMETICA, Santee, CA 92071), and Alexander Supin (Inst. of Ecology and Evolution, 119071 Moscow, Russia)

Studies of auditory sensitivity in marine mammals generally rely on behavioral psychophysical methodologies. While these studies are the standard for hearing assessment in marine mammals, data are limited to only a few individuals representing a small proportion of species. Accumulating research on dolphin auditory physiology has resulted in the refinement of electrophysiological methods appropriate for odontocete cetaceans and an increase in available audiometric information. Electrophysiological methods have also been used with pinnipeds, but there are significant gaps in our understanding of pinniped auditory physiology that must be addressed before such appoaches can be broadly applied to investigations of pinniped hearing. We are taking a bottom-up approach to developing suitable methods for evoked potential audiometry in pinnipeds, including technology transfer from studies of cetaceans and other mammals, mapping of response amplitude with respect to recording positions on the skull, characterization of responses in relationship to various stimulus types and presentation parameters, and determination of whether useful frequency-specific data can be reliably obtained using electrophysiological methods. This approach is being taken with representative pinniped species including California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), and northern elephant seals (*Mirounga angustirostris*) using both training and chemical immobilization techniques. [Work supported by NOPP.]

10:55

2aAB7. Ground-truthing evoked potential measurements against behavioral conditioning in the goldfish, *Carassius auratus*. Randy J. Hill (College of Marine Sci., Univ. of South Florida, 140 7th Ave. S., St. Petersburg, FL 33701) and David A. Mann (Univ. of South Florida, St. Petersburg, FL 33701)

Auditory evoked potentials (AEPs) have become commonly used to measure hearing thresholds in fish. However, it is uncertain how well AEP thresholds match behavioral hearing thresholds and what effect variability in electrode placement has on AEPs. In the first experiment, the effect of electrode placement on AEPs was determined by simultaneously recording AEPs from four locations on each of 12 goldfish, *Carassius auratus*. In the second experiment, the hearing sensitivity of 12 goldfish was measured using both classical conditioning and AEP's in the same setup. For behavioral conditioning, the fish were trained to reduce their respiration rate in response to a 5 s sound presentation paired with a brief shock. A modified staircase method was used in which 20 reversals were completed for each frequency, and threshold levels were determined by averaging the last 12 reversals. Once the behavioral audiogram was completed, the AEP measurements were made without moving the fish. The recording electrode was located subdermally over the medulla, and was inserted prior to classical conditioning to minimize handling of animal. The same sound stimuli (pulsed tones) were presented and the resultant evoked potentials were recorded for 1000–6000 averages. AEP input–output functions were then compared to the behavioral audiogram to compare techniques for estimating behavioral thresholds from AEP data.