the presence of a human operator. Recordings collected using seafloor instruments do not have associated visual observations, so species must be identified based on their calls. Visually validated acoustic recordings are necessary for training acoustic species classifiers and so most are trained using data collected near the sea surface. The suitability of using classifiers trained using surface recordings to analyze recordings obtained at depth is unknown. To investigate this, we used a vertical array of four Ecological Acoustic Recorders (EARs) spaced 90 m apart to record delphinids at different depths. The same whistles were measured from each EAR and median values of 17 spectrographic variables were compared among EARs for six acoustic encounters. For five of the encounters, there were significant differences in whistle variables among EARs, most commonly in frequency variables. When a random forest classifier was used to identify these whistles to species, the same five encounters were classified as different species when recorded at different depths. These results suggest that caution should be taken when applying classifiers developed using surface data to whistles recorded at depth.

1:30

2pABa3. There must be mucus: Using a lumped-parameter model to simulate the "thump" and "ring" of a bottlenose dolphin echolocation click. Lester Thode (Los Alamos, NM), Aaron Thode (SIO, UCSD, 9500 Gilman Dr., MC 0238, La Jolla, CA 92093-0238, athode@ucsd.edu), and Whitlow Au (Marine Mammal Res. Program, Hawaii Inst. of Marine Biology, Kaneohe, HI)

Bottlenose dolphin echolocation clicks display a great diversity in temporal and spectral structure, with both unimodal and bimodal spectra observed (Houser *et al*., JASA, 1999). Wavelet scalograms applied to data collected by the Navy Marine Mammal Program and the Bioacoustic Measuring Tool (BMT) (Martin *et al*., JASA, 2005) show that echolocation clicks can display two distinct phases: an initial "thump," followed by an extended "ring" that is adequately modeled by a damped harmonic oscillator. The thump and ring can display either similar or different spectral characteristics, giving rise to a unimodal or bimodal spectrum. A three-mass lumped parameter model, adapted from the speech processing and terrestrial bioacoustics literature, has been used to simulate the oscillation and collision of the dorsal bursae in a dolphin's nasal passage. The three-mass model reproduces many of the time and frequency domain features of entire click trains as well as individual clicks, including unimodal and bimodal spectra. A key insight of the models is that some slight adhesion between the faces of the colliding bursue seems necessary in order to reproduce the high-frequency click structure. A viscoelastic mucus coating could provide one possible mechanism for this required adhesion force. [Data provided by Steve Martin, NMMF.]

1:45

2pABa4. Inter and intra specific variation in echolocation signals among odontocete species in Hawaii, the northwest Atlantic and the temperate Pacific. Tina M. Yack, Kerry Dunleavy, and Julie N. Oswald (Bio-Waves, Inc., 364 2nd St., Ste. #3, Encinitas, CA 92024, tina.yack@bio-waves.net)

Odontocete species use echolocation signals (clicks) to forage and navigate. The aim of this study is to explore inter- and intra-specific variation in clicks among odontocete species in the Northwest Atlantic, Temperate Pacific, and Hawaii. Clicks were examined for seven species of delphinids in the Northwest Atlantic; common dolphin, Risso's dolphin, pilot whale, rough-toothed dolphin, striped dolphin, Atlantic spotted dolphin, and bottlenose dolphin. Newly developed PAMGuard tools were used to automatically measure a suite of click parameters. Five parameters were compared among species; duration, center frequency, peak frequency, sweep rate, and number of zero crossings. Significant differences in duration, center and peak frequency were evident among species within this study area (Dunn's test with Bonferroni adjustment $p < 0.05$). Geographic variation in click parameters among the three study regions was compared for five species; bottlenose dolphin, common dolphin, striped dolphin, pilot whale, and Cuvier's beaked whale. Significant differences in several parameters were found for all species among the regions (Dunn's test with Bonferroni adjustment $p < 0.05$). These results suggest that there are species specific differences in clicks among delphinids and that geographic variation exists for multiple species. The ecological significance of these findings will be discussed along with implications for classifier development.

2:00

2pABa5. Relative abundance of sound scattering organisms in the Northwestern Hawaiian Islands is a driver for some odontocete foragers. Adrienne M. Copeland (Univ. of Hawaii at Manoa, P.O. Box 1106, Kailua, HI 96734, acopelan@hawaii.edu), Whitlow W. Au (Hawaii Inst. of Marine Biology, Kailua, HI), Amanda Bradford, Erin Oleson, and Jeffrey Polovina (Pacific Islands Fisheries Sci. Ctr., NOAA, Honolulu, HI)

Previous studies in the Northwestern Hawaiian Islands (NWHI) focused on shallower communities in and near reefs and did not investigate the organisms living in deeper waters that some apex predators rely on for food, e.g., some odontocetes forage at depths greater than 400 m. To examine the relationship between deep-diving odontocete predators and prey, a Simrad EK60 echosounder operating at 70 kHz collected acoustic abundance throughout the NWHI from May 7 to June 4, 2013. Visual and passive acoustic surveys for marine mammal presence were conducted concurrently with the echosounder. Two broad scattering layers were found, a deep layer from 325 to 670 m and a shallow layer from 0 to 195 m. The highest densities of both deep and shallow scattering organisms were associated with deep slopes of banks and atolls. Beaked and short-finned pilot whale sightings occurred in locations of high scattering density associated with slopes of atolls and banks. It is hypothesized that the high scattering organisms associated with these features are similar to the mesopelagic boundary community found in the Main Hawaiian Islands and support a food web representing the prey of the cetaceans.

2:15

2pABa6. Beaked whale acoustic versus visual detection. Odile Gerard (DGA Naval Systems, Ave. de la Tour Royale, Toulon 83000, France, odigea@gmail.com)

Because of their sensitivity to anthropogenic noise, research on beaked whale habitat is particularly important. During 2010 and 2011, NATO Undersea Research Centre (NURC) conducted sea trials dedicated to marine mammals, in areas of potential beaked whale habitat. The first one took place in North Eastern Atlantic Ocean, Southwest of Portugal, and the second one took place in the Gulf of Genoa, Mediterranean Sea. For both trials: weather conditions allowing, during daylight there were two teams of visual observers, working in two shifts, scanning the horizon and taking note of marine mammal encounters. Acoustic data were collected with the CPAM (Compact Passive Acoustic Monitoring), designed by NURC. The total usable bandwidth is up to 80 kHz. The CPAM was deployed at a depth between 100 and 200 m for about 20 h a day Beaked whale detection obtained by visual observers and by passive acoustic are analyzed. The number of detections and the information obtained by each method are compared. The advantages and drawbacks are highlighted.

2:30

2pABa7. Seasonal variability in distribution of fin whales around Wake Island. Julia A. Vernon and Jennifer L. Miksis-Olds (Graduate Program in Acoust., Appl. Res. Lab, The Penn State Univ., State College, PA 16803, jav232@psu.edu)

Passive acoustic monitoring in population density estimation of marine mammals provides an efficient and cost-effective alternative to visual surveys. However, one challenge that arises with this method is uncertainty in the animal distribution. Information about distribution is needed in order to account for spatial variability in the probability of detection. Consideration also needs to be given as to how distribution varies between seasons, as seasonal variability also needs to be incorporated into the density estimation. This paper presents bearing estimates of fin whales around Wake Island in the Equatorial Pacific Ocean, using low-frequency ambient noise data (5–115 Hz) acquired by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) International Monitoring System. Bearings were initially calculated using time delay information from the cross-correlation of received signals. However, a simple cross-correlation is not a viable option for many calls, due to distortion of the waveform as a result of modal dispersion, and alternate methods of determining time delays of received signals are discussed. Bearings were calculated for individuals detected over a period of three years: May 2007 to May 2010. Seasonal variability in distribution is presented. [This work was supported by the Office of Naval Research.]