Passive Acoustic Density Estimation of Baleen Whales: Using Sonobuoys to Estimate Call-Rate Correction Factors
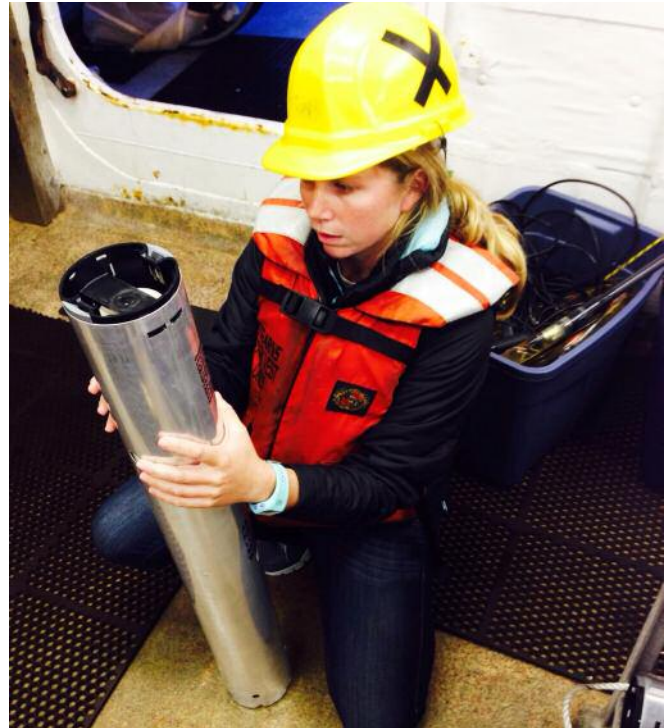
THE NEED

The Navy is responsible for compliance with a suite of Federal environmental laws and regulations that apply to marine mammals and other marine protected species. As part of the compliance process associated with these regulations, the Navy is responsible for implementing a marine species monitoring program to assess potential impacts from Fleet and System Command military readiness activities involving active sonar and underwater detonations from explosives and explosive munitions. Passive acoustic monitoring (PAM) is a proven means of detecting and classifying vocally active marine mammals, as well as a number of fish species. While the Navy uses PAM data for many environmental monitoring purposes, the ability to derive improved density estimates for species of concern is perhaps the most powerful and beneficial application of PAM. At present, there are many Navy sites where density estimates are either not available, or are derived from large area visual surveys that are not sufficiently accurate (particularly in inclement weather).

Acoustician Arial Brewer prepares a sonobuoy for deployment during the 2014 CalCurCEAS survey, a marine mammal assessment survey conducted by SWFSC and NOAA.

THE SOLUTION

This project team, led by Shannon Rankin of the Southwest Fisheries Science Center (SWFSC), is using sonobuoys to conduct PAM monitoring during a large-scale cetacean survey being conducted by National Oceanic and Atmospheric Administration (NOAA). The California Current Cetacean and Ecosystem Assessment Survey (CalCurCEAS) is a survey designed specifically to estimate cetacean density and abundance.

THE METHODOLOGY

The team will estimate the density of calls (number of calls per unit area per unit time) for several baleen whale species using sonobuoys equipped with signal processing technology that works in conjunction with PAMGuard, a widely used marine mammal passive acoustic processing program. They will then use the estimated density of baleen whales from visual sighting surveys which, under appropriate conditions, are considered the 'gold standard' for cetacean population estimation. This will enable them to estimate the correction factor that would convert this call rate density into whale density. The density of whales will be compared over the entire study area using visual line-transect survey methods during daylight hours and acoustic point-transect survey methods during night hours.

THE SCHEDULE

The survey portion of phase one is now complete. A total of 215 sonobuoys were deployed systematically and opportunistically during sightings of baleen whales. Two sonobuoys were deployed each evening, approximately one nautical mile apart. Detection of specific stereotyped baleen whale calls was made by experienced acoustic technicians and by automated detectors.

Most of the costs of phase one were covered by NOAA, the Bureau of Ocean Energy Management, and Navy. The data analysis portion of this phase, now underway, is being funded by LMR.

The second phase will include a smaller-scale survey within the Southern California Offshore Range intended to implement the analysis methods developed during the first phase, estimate the detection range of sonobuoys for known calls, and evaluate the effect of sampling design on the density estimation.

NAVY BENEFITS

Efforts to use PAM for density estimation of cetaceans are complicated by the wide variation in hydrophone platforms as well as the long lead times needed to implement studies. Deployment of sonobuoys requires minimal experience and can be conducted from a variety of platforms (airplanes, helicopters, ships), which allows for opportunistic monitoring. Given the Navy's global supply of sonobuoys and their control over this commodity, it is possible to initiate data collection for PAM density estimation of baleen whales on relatively short notice. Data collection can be conducted in real-time, allowing for a short turnaround between identifying a need and

obtaining data and density estimates for baleen whales in a given area.

TRANSITION

This study will provide a density estimate for fin whales and blue whales for the overall California current and for a smaller region of interest to the Navy. (The California current is a southward flowing offshore current that traverses the west coast of North America from Canada to Baja California.)

The software used for analysis, PAMGuard, is open-source freeware. The signal processing module within PAMGuard is expected to be distributed in the open-source version by 2016. This module requires purchase of an existing software component, or the Navy could develop their own using the open source nature of PAMGuard software. Methods and results will be disseminated as NOAA technical memoranda; results will also be published in peer-reviewed publications.

ABOUT THE PRINCIPAL INVESTIGATOR

Shannon Rankin has worked as a wildlife research biologist with SWFSC since 2000, studying marine mammal sounds and how we can use passive acoustic monitoring for population studies. She has a Master's of Science in Wildlife & Fisheries Sciences from Texas A&M University, where she studied the effects of sounds from seismic exploration on marine mammal populations.

About the LMR Program

The Living Marine Resources (LMR) program seeks to develop, demonstrate, and assess data and technology solutions to protect living marine resources by minimizing the environmental risks of Navy at-sea training and testing activities while preserving core Navy readiness capabilities. For more information, contact the LMR program manager at exwc_lmr_program@navy.mil or visit www.lmr.navy.mil.