



## LIVING MARINE RESOURCES PROJECT 2

# The Southern California Behavioral Response Study

### 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, including the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). As part of the regulatory compliance process associated with these Acts, the Navy is responsible for implementing a marine species monitoring program to assess potential impacts from Fleet and Systems Command (SYSCOM) military readiness activities involving active sonar and the use of explosives/explosive munitions.

To meet regulatory requirements, the Navy needs direct, empirical information about how protected marine species respond to sound exposures. The Navy's Living Marine Resources (LMR) program funds applied research to support the goals of the Navy's fleet and SYSCOM monitoring by demonstrating and validating new technologies and methods to gain vital information about marine mammal species and how they interact with their environment. The results contribute to baseline data on movement and acoustic behavior of poorly known or unknown species as well as individual high-resolution measurements of behavioral changes during experimentally controlled sound exposure. To understand and predict the type and probability of behavioral changes, it is important to understand details about species differences in general responsiveness and how individual response probability is affected by the exposure context, including animal behavioral state (e.g., foraging, mating, etc.), source type, received exposure level and other features, source-animal distance and relative orientation, and prey distribution.

### THE SOLUTION

The Southern California Behavioral Response Study (SOCAL-BRS) is an interdisciplinary, multi-year collaboration designed to increase understanding of marine mammal reactions to sound and provide a more robust scientific basis for estimating the effect of Navy mid-frequency active sonar (MFAS) on marine mammal behavior. The project is designed to provide the type of baseline data and experimental sound exposure methodology needed to provide the best-available direct measurements of response to meet these regulatory requirements. It incorporates controlled exposure



Research team preparing to dual deploy tags on a blue whale in 2014.

experiments (CEEs) that can include playback of pre-recorded, simulated military sonar sounds, as well as the first-ever use of real MFAS from operational Navy vessels in a controlled, experimental context.

### THE METHODOLOGY

The overarching approach includes a number of research objectives:

1. Tag a variety of species and obtain baseline behavioral data.

2. Conduct CEEs to obtain direct measurements of potential response.
3. Derive adaptive BRS configurations for simulated MFAS sources and actual military MFAS sources.
4. Obtain basic biological, behavioral, and foraging ecology data for marine mammals to support range monitoring efforts and/or habitat models.

The SOCAL-BRS project evolved from previous research at the Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas in 2007-08, and in the Mediterranean Sea in 2009. Fieldwork conducted between 2010 and 2014 has occurred in coastal areas from San Diego to Santa Barbara and in offshore areas of the Channel Islands, including around the U.S. Navy's training range near San Clemente Island. All work is conducted within the terms of applicable federal and state permits and significant effort has been made to ensure transparency regarding methods and public communication of results.

Research teams employ a wide range of expertise and tools in field measurements of behavior and CEEs. These include visual observers, tagging teams, sound source engineers, and fisheries acoustics biologists who use photo identification, passive acoustic monitoring, and geographical information system (GIS) tools.

Prior to CEEs, tags are applied on focal animals and underwater acoustic monitoring is conducted with towed hydrophones, fixed range hydrophones when available, and/or sonobuoys. Visual observers monitor the area to assess focal and other animals and determine if particularly vulnerable animals (e.g., neonate calves) are present. During exposure experiments the teams follow explicit start-up, exposure,

and shutdown protocols. These include visual surveys and focal follows maintained before, during, and after sound exposure.

As new data are collected and analyzed, the teams refine methodologies as needed to reflect new knowledge, technology and opportunities. For example, utilizing smaller and faster boats improved tagging options, increased flexibility in scheduling, and reduced field costs.



Tagged Risso's dolphin in the SOCAL-BRS project.

SOCAL-BRS has produced significant new data for a range of species (including several novel yet very important species about which nothing was known) on diving, foraging, social, and vocal behavior of focal marine mammal species, including CEE measurements in targeted behavioral contexts. Over 150 tags have been deployed on nine species and over 65 CEEs using simulated and real MFAS sources have been conducted, comprising by far the largest data set for any BRS conducted to date. These data have already resulted in ten peer-reviewed publications and five technical reports on baseline behavior and response to MFAS, with at least eight additional publications in review or preparation.

In 2013, SOCAL-BRS researchers conducted groundbreaking research using real MFAS sources by working

in coordination with the Navy ships USS Dewey (DDG 105) and USS Cape St. George (CG 71). This was the first-ever use of full-scale operational Navy mid-frequency (MFA) sonar systems (SQS-53C) in the context of a controlled exposure experiment. Using data tags with suction cups that can remain attached for 24 hours or longer, the team tagged two blue whales, two Risso's dolphins, a fin whale and a Cuvier's beaked whale. Navy vessels were positioned using site-specific sound propagation modeling to result in received levels on focal animals that match those levels previously tested using scaled sound sources. Changes in behavior from baseline movement and/or acoustic behavior were measured as a function of sound exposure. Initial results suggests that responses to distant MFA from actual sources appeared less evident than closer scaled sources in some conditions. However, additional data will be acquired to further test this observation, which may have significant implications for Navy environmental assessments.

## THE SCHEDULE

The project began in 2010 and has conducted annual fieldwork with extensive ongoing data analysis and publication. The 2015 field season is ongoing and in March 2015, field teams were able to deploy a tag on a blue whale and completed a CEE with the USS William P. Lawrence (DDG 110). Additional field efforts in 2015 are planned for August and October.

During the remaining 2015-16 fieldwork, efforts will primarily focus on realistic scenarios using full-scale Navy sources, as available, while maintaining a secondary scaled-source option. That will be followed during 2017 by data analysis with an emphasis on comparing



USS Cape St. George (CG 71).

MC1 David Kolmel



USS William P. Lawrence (DDG 110).

MC3 Timothy Schumaker

data from real versus scaled MFAS, and transitioning results into use in Navy environmental assessments.

## NAVY BENEFITS

SOCAL-BRS is significantly improving our direct understanding of marine mammal behavioral reactions to sound, including the first-ever direct measurements of responses to known MFAS events for Cuvier's beaked whales, which appear to be among the most sensitive to Navy sonar. The results are provid-



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NMFS Permit 14534

Group of Cuvier's beaked whales in which one individual was tagged during a the first-ever CEE with this species.

ing a more robust and direct scientific basis for estimating the affects of Navy mid-frequency sonar. The response relationships identified when using increasingly realistic operational scenarios will support Navy environmental compliance requirements, as well as supporting improvements in regulatory assessments of potential effects.

## TRANSITION

The SOCAL-BRS will increasingly provide direct measurements of marine mammal response to Navy training in realistic scenarios. The direct data on actual behavioral responses in known, controlled conditions are already being applied within, and will continue to support, the environmental impact assessments the Navy prepares for training and testing permit applications and other legal requirements. The outcomes will not only inform legal requirements but also broaden the scientific and public understanding of marine mammal behavior. Study results will continue to be published in the peer-reviewed scientific literature, presented at technical meetings, and discussed directly through dedicated outreach efforts with the scientific, regulatory, and environmental communities concerned with these issues.

## ABOUT THE PRINCIPAL INVESTIGATORS

**Principal Investigator:** Brandon Southall has been President and Senior Scientist for Southall Environmental Associates, Inc. since 2009 and is a research associate with the University of California, Santa Cruz and the Duke University Marine Laboratory. He has an extensive background in both laboratory and field research on the effects of noise on marine mammals. From 2003 to 2009, Southall was a fisheries research biologist and director of NOAA's Ocean Acoustics Program.



**Co-Principal Investigator:** John Calambokidis is a Senior Research Biologist and co-founder of the non-profit Cascadia Research in 1979. He has directed long-term research on the status, movements, and underwater behavior of blue, humpback, and gray whales. His primary interests are the biology of marine mammals and the impacts of humans.



## 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](mailto:exwc_lmr_program@navy.mil) or visit [www.lmr.navy.mil](http://www.lmr.navy.mil).

