

## MULTI-SCALE BEHAVIORAL RESPONSE STUDIES OF CETACEANS AND MFAAS ALONG THE US EAST COAST

B.L. Southall<sup>1,2</sup>, D.P. Nowacek<sup>2,3</sup>, N.J. Quick<sup>2</sup>, and A.J. Read<sup>2</sup>

<sup>1</sup> *Southall Environmental Associates, Aptos, CA*

<sup>2</sup> *Marine Science and Conservation, Nicholas School of the Environment, Duke University Marine Lab*

<sup>3</sup> *Electrical and Computer Engineering, Pratt School of Engineering, Duke University*

Recent experimental studies and opportunistic observations of cetacean behavior in the presence of naval mid-frequency active sonar (MFAS) have improved our understanding of the effects of sonar exposure. Key studies include short-term, high-resolution measurements individual animal responses, including recent experiments with real Navy MFAS. Additionally, longer-term, lower-resolution monitoring of individual behavior near sonar operations has provided data on broader time and spatial scales. Thusfar, however, no studies have combined experimental approaches linking fine-scale, short-term reactions with longer-term responses using real Navy MFAS sources, which have the potential to impact the fitness of individuals over biologically meaningful time scales.

To address this need for sampling on multiple spatial and temporal scales within realistic MFAS exposure contexts, we plan to conduct a series of controlled exposure experiments (CEE) with two focal species, Cuvier's beaked whales (*Ziphius cavirostris*) and short-finned pilot whales (*Globicephala macrorhynchus*) off Cape Hatteras. Each CEE will involve a focal individual of each species equipped with digital acoustic recording tags (DTAG) and several animals carrying satellite-linked, time-depth recorders (SLTDR). The DTAG samples fine-scale movement and acoustic exposure/response for <24 hours, and the SLTDRs sample relatively course scale movements, diving behavior and locations over periods of weeks. Sonar transmissions during CEEs will occur according to standard Navy protocols, and will occur for £60 minutes, unless any strong contra-indicators are evident. Target received levels for the focal animals will be 120-160 dB<sub>RMS</sub> with lower starting levels in beaked whales than pilot whales, at least in initial. Our experimental design will result in a variety of received levels for other individuals carrying satellite tags. We plan to conduct four field seasons of experiments over the next two years.