**Project Summary**

No explicit empirical validation exists to support present theoretical foraging relationships between diving behavior of marine mammals and the abundance of their prey. In this proposal, we seek to address this problem by developing a comprehensive technical approach to measure the predator’s dive behavior and to establish quantitative features that define its prey field. Our research will focus on optimal foraging behaviors of Weddell seals at fine and medium temporal and spatial scales, and we shall test three hypotheses: (1) acoustic measures of fish density are good predictors of seal foraging success; (2) the foraging behavior of marine mammals is consistent with optimal foraging models based on the animal’s physiological limitations and on measures of prey density, at the level of individual dives; and (3) marine mammals adjust their foraging dive bouts to the expected benefit of finding a new prey patch. The proposed work is oriented around recent theoretical and applied models for understanding the diving behavior of air-breathing marine predators (Thompson and Fedak 2001, Mori and Boyd 2004) that combines physiological limitations of oxygen consumption with optimal foraging criteria.

Our objectives are to test these hypotheses by carrying out underwater acoustic backscatter and tracking measurements, combined with physiological and behavioral measurements, in the relatively well constrained foraging environment of Weddell seals. Their interaction with Antarctic silverfish, a keystone prey species in McMurdo Sound, and Antarctic cod is an ideal model to test and apply optimal foraging models for diving predators. For this purpose, we shall integrate well-understood technology components, such as animal-borne video and data loggers, a calibrated split-beam fisheries sonar mounted on a computer controlled pan-and-tilt assembly, a high frequency (100-300 kHz) ultrashort-baseline acoustic tracking system for seals, and 3D visualization software to combine, display and analyze the data in a synoptic framework.

**Intellectual Merit:** Weddell seals are an apex predator, and their principle prey is a keystone species to which fisheries acoustics methods have not been applied under shore-fast sea ice. The proposed research addresses key ecological interactions in McMurdo Sound with a new set of technological tools especially suited for this high Antarctic ecosystem, and an applied theoretical framework that has implications for marine diving species anywhere in the world.

**Broader Impact:** This research will result in 1) innovative new technological and analytical tools to study diving predators simultaneously with the dispersion and density of their prey, and 2) publications and presentations that link theoretical foraging principles to practical measures of diving behavior that are not limited to the particular species and interactions being used as a model system here, and can be used by policy makers to identify and manage critical habitat for diving predators, 3) training and collaboration of new students and professionals across institutional boundaries (government, academic & private sector) who can apply these tools beyond Antarctic ecosystems, and 4) exciting visualization of predator-prey interactions in marine systems for teaching and other forms of public display (websites, public presentation, media). Our long-term objectives are to extend the tools and techniques developed for work in McMurdo Sound to open ocean environments. This will involve more extensive integration of a calibrated multibeam echo-sounder with attitude and environmental sensors, coded ultrashort-baseline navigation and tracking systems that can be interrogated directly by the multibeam sonar, as well as video imagery and animal physiology measurements.