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FINAL REPORT

GRANT #:
N00014-96-1-0593

PRINCIPAL INVESTIGATOR: DR. CHARLES H. GREENE

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GRANT TITLE: BIOACOUSTICAL OCEANOGRAPHY WORKSHOP: TOP PREDATORS AND THEIR PREY IN THE MARINE ENVIRONMENT

AWARD PERIOD: 3/1/96 - 3/31/99

OBJECTIVE: The objective of this grant has been to provide students and postdoctoral investigators with a broad understanding of the acoustic tools and techniques required to address fundamental questions pertaining to the distribution and behavior of marine mammals, their prey field, and their physical/chemical environment.

APPROACH: Summer courses were held to provide students with both a conceptual framework and opportunity to gain first-hand experience in bioacoustical oceanographic research. The format for these courses has been to offer basic and advanced courses in alternating years. The 1996 course was an advanced course at the University of Cailfornia Santa Cruz (UCSC), following up on the basic course offered during 1995 at UCSC. The 1997 course was a basic course at the UCSC, which was followed by an advanced course at the University of New Hampshire during 1998.

ACCOMPLISHMENTS: During the 1996 course, we completed data analyses from acoustic backscattering experiments conducted on Antarctic krill during the 1995 UCSC summer course. Two papers from this work have been published.

Also during the 1996 course, we verified previous observations that blue whales are targeting particular sites where the Monterey Bay Submarine Canyon walls drop off steeply and intense sound-scattering layers (SSL's), presumably krill, are present. At these locations, we detected blue whale vocalizations and conducted foraging studies, placing time-depth recorders (TDRs) on blue whales and using active acoustics to map out their 3-dimensional prey field.

During the 1997 course, we conducted acoustic surveys of the Monterey Bay Submarine Canyon system aboard the R/V Revelle. Specifically, the ship was used to map the daytime and

nighttime, 3-dimensional structure of the SSL's with a surface-towed, multi-frequency echo sounder. MOCNESS tows were used to document the composition of the SSL's. Also during the 1997 course, whale behavioral studies were conducted, including the detection and localization of blue whales with a hydrophone array towed by the R/V Dariabar.

During the 1998 course, a variety of student projects were conducted, some involving data collected during previous courses and others involving data brought to the course by the students. Projects included:

1. Multi-frequency classification of deep-water fish assemblages on Chatham Rise, New Zealand,

2. Development of improved acoustic tracking methods for studying humpback whales in Hawaii,

3. Development of improved acoustic tracking methods for zooplankton using a multibeam sonar system,

4. Development of improved geostatistical methods for volumetrically mapping zooplankton distributions using high-frequency acoustics,

5. Analysis of acoustic and MOCNESS data from previous summer's R/V Revelle survey of Monterey Bay Submarine Canyon.

CONCLUSIONS: The combination of basic and advanced bioacoustical oceanography courses worked very well. By learning the basic principles during the first year's course, students were well prepared to participate in supervised, state-of-the-art research projects during the second year's course. The results, both in terms of student training and research accomplishments has been very rewarding.

SIGNIFICANCE: Our students have had the unique opportunity to work side by side with active scientists using state-of-the-art tools and techniques. The course has acted as a research magnet, attracting top scientists to conduct their own research in a creative teaching environment that has served to catalyze interactions across the disciplines of bioacoustics, bioacoustical oceanography, and marine mammal biology.

AWARD INFORMATION: Greene was promoted to Associate Professor with tenure and awarded the 1998 J.P. and Mary Barger Excellence in Teaching Award, College of Engineering, Cornell University

PUBLICATIONS:

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6. Martin Traykovski, L.M., R.L. Driscoll, D.E. McGehee (1998) Effect of orientation on broadband acoustic scattering of Antarctic krill Euphausia superba: Implications for inverting zooplankton spectral acoustic signatures for angle of orientation. J. Acoust. Soc. Am. 104: 2121-2135.

7. Monger, B.C., S. Chinniah-Chandy, E. Meir, S. Billings, C.H. Greene, and P.H. Wiebe (1998) Sound scattering by the gelatinous zooplankters Aequorea victoria and Pleurobrachia bachei. Deep-Sea Res. II 45: 1255-1271.

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