

Acoustics in the Cetaceans' Environment: A Multimedia Educational Package

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LONG-TERM GOALS

The Macaulay Library is home to the world's largest collection of animal sounds, including a growing collection of marine sounds whose archival is funded by the Office of Naval Research. The Macaulay Library has an 80 year history of archiving sounds and using those sounds to educate and inform the public about biological diversity and animal communication. In the last few years, the Library has added video production to its public outreach functions. This project, for which we use the working title "Sea-of-Sound" is our most ambitious video outreach project to date. We are developing a documentary on use of sound in the marine environment, both natural and anthropogenic. While many people are aware that whales produce songs, clicks, and whistles, most don't know the extent to which marine mammals use sounds to communicate, survey their environment, and find food. More surprising to many is that the sea is alive with sounds of all kinds, from bubbles in breaking waves and rumbling undersea volcanoes, to croaking fish, snapping shrimp, and rasping mollusks. The general public has a poor understanding of how the behavior of sound in marine environments compares with our terrestrial world. They also know little about the critical role sound plays in marine research and marine mammal conservation. While there is increasing public concern over rising levels of anthropogenic noise in the marine environment, there is a lack of comprehensive, broadly disseminated information about sound in the sea. This makes it difficult for the public to make informed decisions about sound-related marine issues. Working with our partners we will be creating a DVD and website for classrooms and teachers, as well as the general public. These deliverables will be available in the third year of this project, the beginning of calendar year 2007.

OBJECTIVES

Our objectives are to create the following:

- A collection of High Definition (HD) video and audio about sound in the oceans. We will record several species of marine mammals, as well as fish and invertebrates. We will also record the activities of a variety of acoustic marine research and other sound generating human activities. All recordings will be archived in Cornell University's Macaulay Library. This material will be available in perpetuity for research, education and conservation applications as part of the National Science Digital Library.
- Creation of dynamic data visualizations and compelling interactive exercises that clearly illustrate complex concepts. (In partnership with the Maas Digital and various marine researchers)

Report Documentation Page

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- The combination of the HD recordings and the data visualizations in to a cohesive 60-90 min HD surround sound documentary film on sound in the ocean.
- Creation of a DVD and curricula about sound in the sea. (In partnership with WGBH Boston Public Television and Apple Computer)
- Creation of Web-based interactive activities, such as the ability to see the effects of adding noise sources to one's own virtual sea. The web will also add deeper scientific content, with in-depth looks at active research programs and timely oceanographic news. (In partnership with WGBH Boston Public Television and Apple Computer)

APPROACH AND WORK PLAN

Our work plan is as follows:

Preproduction (8 months):

- 1) Draft a rough but cohesive narrative around which in which the science and related issues can be explored in a compelling manner.
- 2) Identify core recording opportunities based on required species diversity, logistics, permitting, and cost.
- 3) Apply for all needed permits.
- 4) Identify and obtain initial permissions on available recordings.
- 5) Design and construct recording systems and processing for underwater HD video and sound recording.
- 6) Develop surround sound processing techniques that will work for underwater recordings.
- 7) Identify and consult with a council of scientists on which scientific principles must and can be explored within this framework.
- 8) Identify and consult with education advisors to insure that materials are designed to address core curricula needs for students at various levels.
- 9) Refine the outline accordingly, draft initial script and shot lists (audio and video) for locations.
- 10) Working with science advisors, identify and obtain data sets for visualization.
- 11) Finalize working script, identify additional materials required for DVD and website creation.

Production (14 months):

- 1) Execute recording expeditions.
- 2) Log all recordings for archival and editing process.
- 3) Create data visualizations so they mesh with video recordings

Postproduction (12 months overlapping production):

- 1) Edit video and sound.
- 2) Master video and sound.
- 3) Initial website and DVD designs.
- 4) Final product development, production, and distribution occur in this project's third year which is outside of the existing grant.

Staff: Cornell's David O. Brown is principle camera, and editor on the project as well as co-writer and co-producer with the PI, Marc Dantzker. Dantzker is also the project coordinator and principle sound

recordist. Brown and Dantzker are being provided administrative assistance by Patricia Leonard. Robert Grotke, Cornell's sound engineer, and Greg Budney, Cornell's audio curator are consulting on audio systems design. Grotke is designing surround sound processing techniques. Dan Maas of Mass Digital is charged with data visualizations. Arthur Smith and Ted Sicker from WGBH will be coordinating educational consulting, DVD and web design. The following research scientists have been contacted and have agreed to serve on our scientific advisory panel. (Asterisks denotes that the individual's participation has been confirmed and they have been consulted initially on our plans.)

Jack Bradbury, Cornell *
Chris Clark, Cornell *
Grant Deane, Scripps Institute of Oceanography *
William Ellison, Marine Acoustics Incorporated *
James Miller, University of Rhode Island
Brandon Southall, NOAA

The coming year will see us complete the activities described above for pre-production and begin production on the project.

WORK COMPLETED

In the first five months of this grant we have made significant progress in our preproduction however much remains to be done. Our accomplishments include the following.

- 1) We have drafted our initial narrative outline complete with an initial "story" and collection of principles that can be taught in each section.
- 2) We have identified our core recording opportunities, and we have built a preliminary calendar of recording expeditions. They are as follows.
 - a. Canadian arctic, May 28 – June 18, 2005. Targets for recording: Beluga, Narwhal, various pinnipeds, native hunters, bio-acoustics work. Outfitted by Arctic Kingdom expeditions.
 - b. Coastal Massachusetts, July 2005 and other dates to be determined. Targets for recording: North Atlantic Right Whale, Humpback whales, research activities. Coordinated with the research projects of Dr. David Wiley and Dr. Charles Mayo as appropriate.
 - c. Gulf of Mexico, August 24-28 2005 and other dates to be determined. Targets for recording: Snapping shrimp, Damselfish, Croakers, Durms, Triggerfish, (as well as other acoustically active reef life), energy exploration and development activities. Coordinated with staff of the Flower Gardens Bank National Marine Sanctuary.
 - d. Hawaiian Islands, January 2006. Targets for recording: Humpback Whales, Butterfly fish, Green Sea Turtles, Navy vessels, Personal Water Craft, Bioacoustics work. Coordination with Dr. David Matilla and the staff of the Hawaiian Islands Humpback Whale National Marine Sanctuary and others working in the area.
- 3) We have worked extensively with NOAA and have applied for all required permits. We are working with researchers to coordinate our permit requirements with their existing activities. We are now confident that our activities will be permitted in time for our recording expeditions.
- 4) Identified and begun negotiations for Sperm Whale HD video recordings. Worked with Macaulay Library audio archival staff to identify available sounds from the collection.

- 5) We have designed, purchased, and trained on our underwater HD video recording unit. We have an initial design for our audio recording unit and have purchased key components. We are working with staff of Amphibico to design an underwater housing for this equipment. And we are working with the Bioacoustics unit here at the Lab to design new hydrophone arrays that will allow us to capture sound in a more engaging way.
- 6) We have experimented with existing audio recordings from various hydrophone arrays and have developed an effective processing method to extract a surround sound field from these recordings. This work informs our design of our systems to insure that we collect appropriate materials in our field work.
- 7) Our next step is to return to our council of scientists and our educational advisors and coordinate work with them on our outline to develop our detailed shot lists and an initial script.

RESULTS

As we are in the pre-production and planning stage, there are no results to report yet.

IMPACT AND APPLICATIONS

Science Education and Communication

This project will answer the need for comprehensive, top-quality outreach materials with which to tell the story of sound in the sea, helping to develop a more informed public about the role people play in managing a healthy ocean, for all species.

TRANSITIONS

Economic Development

The Macaulay Library is a major resource of sound and video recordings for public and commercial media, museums, zoos and aquaria, producers of products reproducing animal sounds, wildlife identification devices, CD and DVD nature productions, sound effects for the movie industry, etc. The recordings from this project will be available to others as part of this Library.

Initial discussions of hydrophone design include the possibility of building a production unit that could be marketed to other underwater video recordists.

Science Education and Communication (Delete this section if there are none)

Macaulay Library is one of the world's primary resources for archived sounds of animals and is thus widely used by scientists, teachers, and students. It is also an active member of the National Science Digital Library program.

RELATED PROJECTS

Macaulay Library also has a concurrent grant from the NSF-funded National Science Digital Library program to maintain an NSDL portal and web pages that will maximize access and utilization of the animal sound and video collections for education at all levels. The materials collected in this project will be available through this portal. The Library has a second NOPP grant that is funding the development of online tools for sound annotation and feature extraction. Sounds recorded for this

project will be included in the Library on which these tools will be used. ONR is supporting generously the archival of the last half-century's accumulated field recordings of marine animals at the Macaulay Library. This project will rely on that Library as a source of some of the needed sound recordings.