

# **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 Maas Digital and various marine researchers)
- The combination of the HD recordings and the data visualizations into a cohesive 60-90 minute HD surround sound documentary film on sound in the ocean.

- Creation of a DVD and curricula about sound in the sea.
- 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.

## **APPROACH AND WORK PLAN**

Our work plan is below. We are roughly on schedule, currently in the last months of our Production phase.

Preproduction (8 months):

- 1) Draft a rough but cohesive narrative 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) Design and construct recording systems and processing for underwater HD video and sound recording.
- 4) Develop surround sound processing techniques that will work for underwater recordings.
- 5) Refine the outline accordingly, draft initial script and shot lists (audio and video) for locations.
- 6) Working with science advisors, identify and obtain data sets for visualization.
- 7) 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) Refine script based on results of expeditions.
- 4) 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. Ian Fein recently joined the project as production assistant and assistant audio engineer. 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 Maas Digital is charged with data visualizations. This year we lost WGBH's interactive group from the project. This loss is substantial but as most of their work was to be completed in the third year of the project, we are confident that we can replace their functions with other partners. The loss of WGBH opens up other broadcast opportunities for the final documentary in addition to PBS.

## WORK COMPLETED

In the first year and five months of this grant we have made significant progress. In addition to the accomplishments enumerated in our 2005 report, our accomplishments this past year include:

- 1) We have designed a second HD camera system capable of remote recording of shy fish behaviors as well as use as a dip-cam. This technology was not available until the later half of this year.
- 2) Our basic story is complete. Final story and narration is contingent on available footage so the final "script" is not done until post-production. Storyboards have been prepared for visualizations which will begin production soon.
- 3) We executed successful recording expeditions in two of our four principle locations. Planning for the other two locations is complete and these expeditions will be conducted in the next few months.
  - a. Canadian arctic, Completed May 28 – June 18, 2005. We recorded surround audio and HD video of Beluga, Narwhal, Ringed and Bearded Seals, and Polar Bears. The best covered of these, surprisingly, were Narwhal and Polar Bears with whom we recorded extensive encounters. We recorded key scenes showing the use of bioacoustic equipment in the relatively pristine arctic. We also recorded some traditional Inuit activities, though these were less fruitful than we had hoped.
  - b. Gulf of Mexico, Completed October 6-15, 2005. Our Gulf trip had two goals, first to document the anthropogenic sources of noise surrounding both energy development and commercial shipping, and second to record Caribbean reefs and soniferous fishes. Hurricane Rita delayed our trip for a month and limited access to some areas. However, our trip was successful on both fronts. We extensively filmed both oil infrastructure and shipping activities both at sea and on shore. The Port of Huston was particularly helpful by allowing us to film port activities from one of their vessels. This provided spectacular opportunities to illustrate the reliance of society on our use of the oceans. Our pursuit of biological targets, corals and fishes, was aided by our partners from NOAA Sanctuaries who invited us on a research cruise to the Flower Gardens Bank National Marine Sanctuary. There we recorded HD video for more than 40 species of fish, including many soniferous species. Highlights include the territorial display of Bi-Color Damselfish, booming Black Grouper, as well as images of the endemic golden morph of the Smooth Trunkfish. Both synchronous audio recording on the HD camera, and separate surround recordings bore some fruit, however, other fishes we recorded will have to be mated to sound in post-production. Fortunately recordings of many of these species are already in the Macaulay Library's marine archive.
  - c. Hawaiian Islands, Upcoming January 1-24 & March 7-22, 2006. We have many goals for this pair of recording expeditions and we are confident we will achieve them. The itineraries for both trips are set and almost all logistics and permitting are arranged. In January we will work off of Maui where we will spend one week pursuing soniferous fish displays and two weeks with Dr. David Matilla recording Humpback whales. In March, we will spend one week working with Dr. Charles Greene to record the activities of his bioacoustics course, and one week with Dr. Ania Driscoll-Lind recording spinner dolphin and other soundscapes around the Big Island of Hawaii. Again our partners at NOAA Sanctuaries, this time the Hawaiian Islands Humpback Whale National Marine Sanctuary, have been critical in facilitating this work.
  - d. Coastal Massachusetts, February-April 2006. We had hoped to complete this work in 2005 but permitting did not come through in time. We did execute one brief recording cruise in '05 to obtain HD video of bioacoustics equipment deployment. This year all required permits are in

order. We will be deploying on research cruises with Dr. Charles Mayo and Dr. Chris Clark. Using our new HD dip-camera, we hope to record the highest resolution video images of the North Atlantic Right Whale ever made. These videos will serve as behavioral data as well as for outreach and education. We will also be working more extensively with Drs. Clark and Mayo to document their work activities for story elements of the production.

- 4) We have identified sources for required stock footage and have worked with Macaulay Library audio archival staff to identify available sounds from the collection.

## **RESULTS**

See descriptions above under work completed.

## **IMPACT AND APPLICATIONS**

### **Science Education and Communication**

This project will answer the need for comprehensive, top-quality science education and outreach materials telling the story of sound in the sea. The result will be a more informed public able to better understand the science of sound in the ocean and the role people play in managing healthy oceans 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, and more. The recordings from this project will be available to the public as part of this Library.

### **Science Education and Communication**

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.