

## **Discovery of Sound in the Sea 2012 Annual Report**

Kathleen J. Vigness-Raposa, Ph.D.  
Marine Acoustics, Inc.  
809 Aquidneck Ave.  
Middletown, RI 02842

phone: (401) 847-7508 fax: (401) 847-7864 email: [kathleen.vigness@marineacoustics.com](mailto:kathleen.vigness@marineacoustics.com)

Subcontract Number: 041012/0003152

Gail Scowcroft  
Graduate School of Oceanography  
University of Rhode Island  
Narragansett, RI 02882

phone: (401) 874-6724 fax: (401) 874-6486 email: [gailscow@gso.uri.edu](mailto:gailscow@gso.uri.edu)

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### **LONG-TERM GOALS**

The long-term goal of this effort is to educate the public on the basic science of sound in the sea; how people and animals use underwater sound to accomplish many of the tasks for which we use light in air; and how sound in the ocean affects marine life. The products of this effort include an interactive on-line resource, a CD-ROM, and printed materials.

### **OBJECTIVES**

The objective of this effort is to develop and maintain resources that address the long-term goal. The resources include a website (Figure 1), an educational CD-ROM, a tri-fold educational pamphlet, and an informational 16-page booklet.

### **APPROACH**

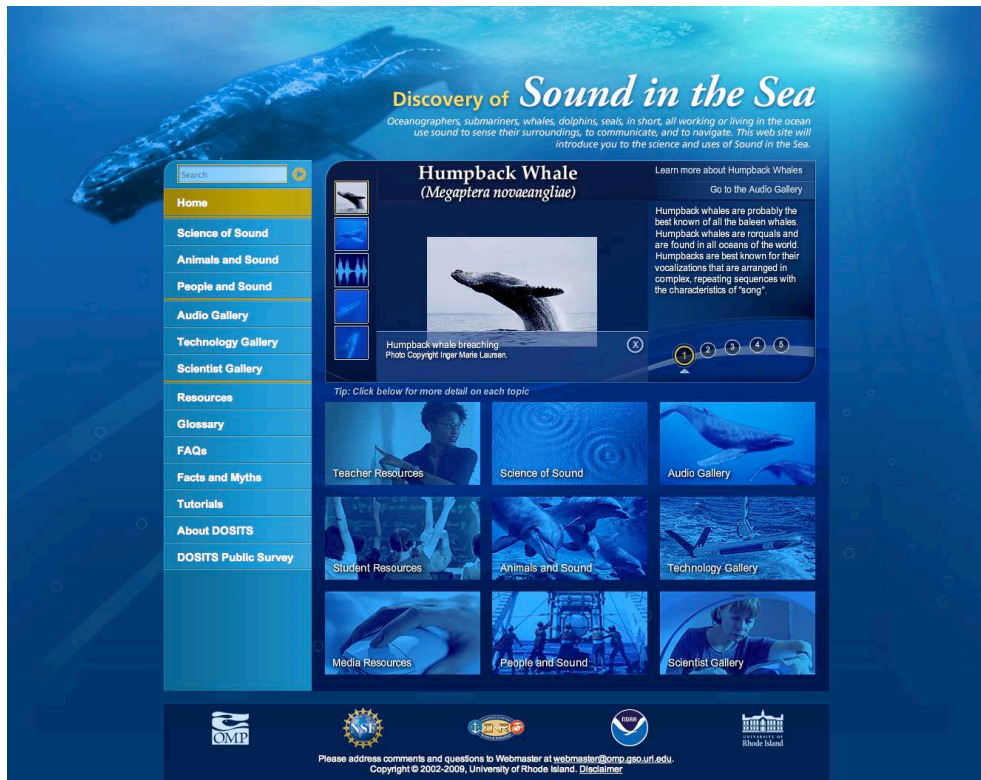
Efforts have focused on enhancing and expanding the scientific content of the *Discovery of Sound in the Sea* website that was launched in November 2002. During the past ten years, Marine Acoustics, Inc. (MAI) and the University of Rhode Island's Graduate School of Oceanography (GSO) have developed a successful working relationship to create the website, an educational CD-ROM, and associated printed materials. These resources undergo regular updates and rigorous scientific review by a panel of scientists in the field, led by Drs. Peter Worcester (Scripps Institution of Oceanography), Jim Miller (University of Rhode Island), and Darlene Ketten (Harvard University Medical School and Woods Hole Oceanographic Institution). MAI and GSO make all final decisions on the site content.

# Report Documentation Page

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**Figure 1: Interactive front page of “Discovery of Sound in the Sea” website (<http://www.dosits.org>)**

## WORK COMPLETED

During the tenth year of research, MAI and GSO focused on several tasks to enhance and expand the website that was launched in November 2002, and to reach additional audiences that have not been targeted in the past. These tasks included the following:

1. Increases of readily available resources for educators. The DOSITS site is used in many classrooms around the country and teachers are continually expressing their appreciation of the resources available to them through our Teacher Resources section.
  - A. Added two new activities to the Teacher Resources section: *Stirring up Sound* and *Sound Off!* Both activities were developed by the DOSITS team and presented at the National Science Teachers Association (NSTA) and National Marine Educators Association (NMEA) annual conferences. *Stirring up Sound* examines the effects of temperature, bubbles, and other particles on underwater sound. *Sound Off!* is a memory-based game that examines relationships between hearing sounds and viewing spectrograms.
  - B. Continued coordination with educators on the outreach tool “Featured Teachers”. Teachers that are using DOSITS resources in their education programs will be highlighted on the DOSITS website with a brief description of their curriculum and how DOSITS is used. As successive teachers are featured, the previous examples will become a new component of the

Teacher Resources section, enhancing the site long-term. By highlighting Featured Teachers, the number of teacher activities available on the website will also increase.

- C. Reviewed and updated DOSITS Facts and Myths and Frequently Asked Questions (FAQs). To increase accessibility to DOSITS content, 11 FAQs highlight major topics from the DOSITS site, such as how marine animals use sound underwater. Under each FAQ, a summary of content is provided as well as links back to relevant pages on the DOSITS website. The DOSITS Facts and Myths is a quiz on important concepts of underwater sound and its potential effects on marine life. Facts and Myths challenges the user to determine whether each statement is true or false. In addition to providing the answers, links back to relevant content on the DOSITS website are also included. It is important that both the FAQs and Facts and Myths remain consistent with updated content on the DOSITS site.

## 2. Updates to the *Science of Sound in the Sea* section.

- A. Developed new content on underwater explosive sound sources. The Advisory Panel suggested this content be added to the DOSITS site. This new section will address the issue of sound propagation from underwater explosive sources, from the initial incoherent shock wave to the transition to a coherent sound wave. The new content will include various diagrams that illustrate the mechanics of sound production via underwater explosions, new glossary terms, and links to other, relevant DOSITS pages. The Advisory Panel also suggested a new Advanced Topic on underwater explosions to be developed to discuss the complex physics of explosive sound sources. Another Advanced Topic, *Blast Injury* (under Animals and Sound) will also be developed as an extension of this new content.
- B. Developed a new Advanced Topic, *What is intensity?* As new content was developed to discuss the detection of the particle motion and/or pressure components of sound by animals, it became clear that an Advanced Topic on intensity was needed on the DOSITS website. Content and advanced equations discussing the relationships between intensity, pressure, and particle velocity, will be discussed. Extensive cross links to other content areas on the DOSITS site, including newly created content on geophones and vector sensors in the Technology Gallery, will also be included.

## 3. Updates to the *Animals and Sound in the Sea* section.

- A. Revised and updated Animals > Effects > Marine Mammals > Masking
- B. Revised and updated Animals > Effects > Marine Mammals > Hearing Loss
- C. Revised and updated Animals > Effects > Fish > Hearing Loss
- D. Developed a new Advanced Topic, *How did odontocete hearing evolve?* Working with Dr. Darlene Ketten, a member of the DOSITS Advisory Panel, the DOSITS team has developed an advanced topic that highlights the adaptations of odontocetes for hearing underwater. In addition to in-depth content and new glossary terms, animations and 3D imagery from Dr. Ketten's Computerized Scanning and Imaging Facility at the Woods Hole Oceanographic Institution will also be included.
- E. Developed a new Advanced Topic, *What components of sound are used for hearing?* After reviewing new content on how humans and animals hear sounds, the Advisory Panel

determined it would be useful to develop an Advanced Topic on how animals use pressure and/or particle motion to detect underwater sound. This is a very complex subject, as scientists are trying to unravel which of these aspects of sound different species can detect.

- F. Reviewed recently published, peer-reviewed literature to update existing scientific content, particularly the effects of underwater sound on marine life.
4. Expansion of the Audio and Technology Galleries. Contacts are continually made with researchers studying and using underwater sound, to provide material for revising and expanding the existing content in the Audio Gallery and Technology Gallery. Since these sections attract a high volume of web traffic, they need to be revised and updated on a timely basis.
    - A. New sounds added to the DOSITS Audio Gallery include underwater recordings of icebergs colliding, crabeater seal vocalizations, and mantis shrimp “rumbles”. New content on wind turbine operations, pile driving, Dall’s porpoise vocalizations, and sounds produced by the American lobster are also in development. Longer audio files continue to be added when possible.
    - B. New sections added to the Technology Gallery highlight vector sensors and geophones. The DOSITS Advisory Panel suggested these sections be added to the Technology Gallery to support the newly developed Advanced Topics on particle motion vs. pressure detection.
  5. Enhancements to the Audio Gallery. Raytheon Web Solutions (RWS) improved the sound visualization tool in the Home Page interactive and Audio Gallery interactive. When a user chooses to play a sound, the interactive now displays a spectrogram of the sound and the waveform of the sound as the sound plays (the old visualization displayed a bar graph spectrum that was generated in real time as the sound played). The method used to display the spectrogram allows the DOSITS team control over the appearance of the spectrogram and labels. Additional controls for items in the interactive Audio Gallery were also added, giving the DOSITS team greater control over the appearance and location of multimedia resources in the interactive display.
  6. Continued addition of cross-links between existing content. While an attempt was made to integrate new material with existing content, additional cross-references were needed among content pieces to provide a broader understanding of underwater sound. In addition, with ten years of detailed web traffic data, cross-links from web pages that receive high amounts of web traffic, such as the Audio Gallery, can draw the user into pages that have traditionally received less traffic.
  7. Produced a CD and updated associated PowerPoint files. The DOSITS site has been well received by the education community in part due to the production of an educational CD-ROM that has been widely distributed. In the past, the DOSITS CD-ROM has contained the full contents of the website with some expanded video material as well as PowerPoint presentations on each of the four major DOSITS themes. Since the size of the website and the number of PowerPoints included on the CD-ROM have expanded over the years, and Internet connectivity in classrooms has increased, the need to distribute the website on the CD-ROM no longer exists. Therefore, the CD-ROM now includes the latest version of the DOSITS Audio Gallery along with all of the PowerPoints and classroom activities available on the DOSITS website.

8. Conducted a DOSITS media needs assessment to determine usage of the DOSITS CD-ROM and gauge interest in a potential DOSITS App, interactive iBook, and/or web application. Thirty-three respondents completed the survey. Most of the respondents used DOSITS in their classrooms and/or education programs more than once each year and most have been using DOSITS for at least 2 years. Respondents mostly used the Science of Sound (76%), Animals and Sound (85%), and/or Audio Gallery (73%) sections of the DOSITS website. When it came to what digital media would be useful to these DOSITS users, a web app was deemed *very useful* or *somewhat useful* by 85% of respondents. While 55% of respondents indicated that an iOS App and an iBook would be useful, 28% indicated an iOS App would not be useful and 23% indicated an iBook would not be useful.
9. Conducted a DOSITS needs assessment for undergraduate faculty to investigate how the DOSITS website could be further developed to better serve this teaching community. A total of 35 respondents completed the survey. The respondents were mostly from 4-year colleges and universities (77%) and most (71%) were in a biology department. The most commonly used subsections of DOSITS by this user community are Science of Sound (64%), Animals and Sound (79%), and the Audio Gallery (50%), and the Power Points from the Resources Section (55%). Undergraduate faculty would like to see more case studies, problems sets, and undergraduate laboratory extensions available on the website. They would also like to see an expansion of Advanced Topics in Science of Sound and Animals and Sound. A majority of respondents also indicated that an interactive iBook or an App for iOS devices would *not* be a useful resource.
10. Reviewed and printed an informational booklet and tri-fold educational pamphlet. During 2005, the DOSITS team produced two valuable public affairs publications. The tri-fold pamphlet introduces the public to the issues and science content of DOSITS. The second publication is an educational booklet that provides an in depth look at Sound in the Sea and targeted issues for interested stakeholders, policymakers, and the public. In 2011, the booklet was expanded to 16 pages to include additional content on animals, people, and the effects of sound on marine life. Newly revised versions of these publications are now available.
11. Translated the DOSITS informational booklet to Spanish. As discussed in the 2011-2013 proposal, the DOSITS site needs to be serving Spanish-speaking communities, providing marine science resources to students, teachers, and the public for which English is not their primary language. The Spanish-version of the booklet helps meet this need and will be available for download from the Teacher Resources section of the DOSITS website.
12. Conducted peer review of the website. Review meetings with the advisory team were held at URI during November 2011 and May 2012 to review the draft revised version of the website. All new and revised content created for the website underwent peer review during this time period. In addition to the advisory team, the DOSITS scientific content has been reviewed by over 40 scientific experts (see <http://www.dosits.org/about/> for a complete list).

## RESULTS

The “Discovery of Sound in the Sea” website has received an overwhelming response. It was first launched in November 2002. Through September 2012, DOSITS has had more than 54 million hits (Figure 2). In March 2010, a new site design was launched. The new design, along with a promotional push, saw the site traffic grow substantially. From January 2012 to September 25, 2012, DOSITS has had 6.7 million hits, 455,000 page views, and served 120GB of data.

## **IMPACT/APPLICATIONS**

The “Discovery of Sound in the Sea” website and printed publications are resources for educating and exposing the public to the basic science of sound in the sea and how it is used to communicate, navigate, and explore the oceans. By providing information in multiple formats, teachers can bring this content into their classrooms; public affairs personnel can inform themselves of controversial issues and provide materials to Congress; and the public can begin to include science in their decisions. DOSITS is recognized as a resource by established journal outlets, as evidenced by our involvement in the January 2011 issue of National Geographic “The Big Idea” section (<http://ngm.nationalgeographic.com/2011/01/big-idea/noisy-ocean>).

## **TRANSITIONS**

DOSITS is recognized as the world leader in education and outreach on underwater acoustics. With the appropriate permissions, the National Oceanic and Atmospheric Administration has incorporated components of the DOSITS Audio Gallery into its exhibit “Sounds of the Sea” for the Smithsonian Institution’s National Museum of Natural History Ocean Hall “Oceans Today” kiosks. These kiosks are located at the entrance to the Ocean Hall, thereby making it one of the first components that visitors to this newly constructed exhibit will encounter. This prominent placement ensures a very broad impact from the work of the DOSITS team.

## **RELATED PROJECTS**

None

## **PUBLICATIONS**

“Discovery of Sound in the Sea” website

“Discovery of Sound in the Sea” CD-ROM

Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2011. Discovery of Sound in the Sea. University of Rhode Island. (16-page information booklet)

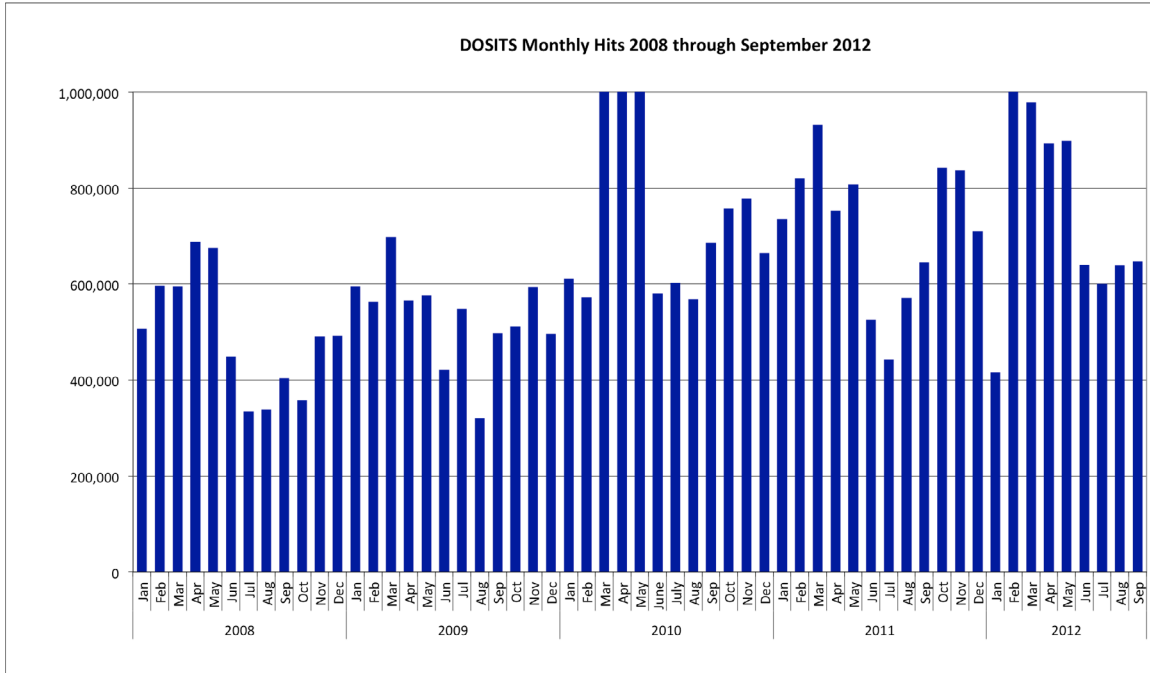
Scowcroft, G., Vigness Raposa, K., Knowlton, C., and Morin, H. 2010. Discovery of Sound in the Sea. University of Rhode Island. (tri-fold pamphlet)

Vigness-Raposa, K.J., Scowcroft, G., Miller, J.H., and Ketten, D.R. 2012. Discovery of Sound in the Sea: An on-line resource. *In: The Effects of Noise on Aquatic Life* (Arthur N. Popper and Anthony Hawkins, eds.). Springer, New York.

Vigness-Raposa, K.J., Scowcroft, G., Knowlton, C., and Worcester, P.F. 2008. Discovery of Sound in the Sea Website: An educational resource. *Bioacoustics* 17: 348-350.

## **HONORS/AWARDS/PRIZES**

2007 Acoustical Society of America Science Writing Award for Media other than an Article



**Figure 2: The “Discovery of Sound in the Sea” website (<http://www.dosits.org>) has received over 54 million hits since it was first launched in November 2002.**