

# Educational Outreach Efforts of the Monterey Bay Aquarium Research Institute (MBARI)

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**Abstract**—An important challenge to the ocean sciences community is to engage ocean scientists in conveying the excitement of their research to ocean sciences educators, K-12 and post-secondary students, and the general public. This paper will review and preview the educational outreach efforts of MBARI; these efforts include, but are not limited to, Cruising to the Classroom expedition webpages, an active internship program, a strong link to a nonformal educational institution (the Monterey Bay Aquarium) and working with educators to facilitate access to near-real-time data. Results from the Education and Research: Testing Hypotheses (EARTH) workshop will be presented during the talk.

## I. INTRODUCTION

The Pew Ocean Commission [1] has generated a number of important objectives, one of which is to “broaden ocean education and awareness through a commitment to teach and learn about our oceans, at all levels of society”. This runs contrary to the 2003 Science Framework for California Public Schools which suggests that teachers incorporate science into the curriculum by making use of smaller blocks of time since they often don’t have the time to dedicate lessons for science – “For example, an elementary teacher and the class may have a brief but spirited discussion on why plant seeds have different shapes or why the moon looks different each week.” [2] This type of statement is not unique to California legislation nor is it surprising given the current national focus on student performance on standardized exams. This focus doesn’t address recent recommendations by the AAAS Project 2061 (“Literacy in science, mathematics, and technology is more important than ever for citizens of the 21<sup>st</sup> century. But achieving universal science literacy will require radical change in our education systems.”[3]) or by the President’s Panel on Ocean Exploration in 2000 (“We will lead the world in developing new technologies that bring scientists and engineers into formal and informal educational settings, and students, educators, and the general public into the field.”[4]). Perhaps the most influential factor in how the scientific community perceives education has been perpetuated by the National Science Foundation and their revised evaluation criteria in 1997 with criterion 2 focused on the broader impacts of the proposed activity [5].

## II. BACKGROUND

The Monterey Bay Aquarium Research Institute (MBARI) is a nonprofit research organization that was founded by David Packard in 1987 (Fig. 1). The mission of MBARI is “to achieve and maintain a position as a world center for advanced research and education in ocean science and technology, and to do so through the development of better instruments, systems, and methods for scientific research in the deep waters of the ocean. MBARI emphasizes the peer relationships between engineers and scientists as a basic principle of its operation. All of the activities of MBARI must be characterized by excellence, innovation, and vision.” General awareness about the importance of science education is increasing and MBARI’s educational outreach efforts are expanding to meet this growing need. With a staff of ~200, MBARI is organized into five divisions, one of these, the Information and Technology Dissemination (ITD) Division, was established in 1996 and has a mission to achieve the effective development, documentation, and dissemination of MBARI information and technology, internally and externally through innovative projects, communications, and collaborations.



Fig. 1. MBARI is located on the beach in Moss Landing, California approximately 40 km north of Monterey. The Monterey Submarine Canyon reaches a depth of 4000 meters 60 km offshore and the canyon head starts right in front of MBARI. With three research vessels, two remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), surface observatories, and rapid access to the deep sea, MBARI is well placed to fulfill its mission.

### III. EDUCATIONAL OUTREACH

Although MBARI had been involved in various types of educational outreach since 1987, it was with the development of ITD that the outreach efforts have become more formalized. This paper will provide a short overview of some of these efforts that are supported by MBARI funding.

#### A. Webpages

MBARI publishes real-time data and current research projects on the world wide web (<http://www.mbari.org>). The MBARI web pages are the primary mode of information dissemination to the general public and include basic background information, expedition reports, abstracts of current research projects, (science and engineering), links to news releases and publications (Fig. 2). MBARI also posts links to real-time data from moorings and satellites as well as information regarding images, video, and software. Our marine operations group also posts data about the three research vehicles, two remotely operated vehicles, and autonomous underwater vehicles. Current cruise information can be found on the “Where are our ships?” webpage (<http://www.mbari.org/cruises/both.asp>), including a display of the ships’ locations, as well as images grabbed from live video and posted approximately every five minutes.



Fig. 2. Top left: The subject of MBARI’s home page (<http://www.mbari.org>) changes frequently providing access to the latest research topic or event. There are several links across the header and the footer, one of which is the link to the Data and Images webpage (right and at <http://www.mbari.org/data>). MBARI’s Expedition web pages (<http://www.mbari.org/expeditions>) are posted when the RV Western Flyer is on an extended cruise. These pages include brief biographies, cruise information, and daily logbooks posted by researchers onboard the Western Flyer via a satellite uplink.

#### B. Internship Program

Since 1997, a formal MBARI internship program has been running during the summer months. It is a 10-week program for 10-14 interns and it is open to all undergraduate or graduate students as well as teachers. The program is a full-time stipended research experience that focuses on providing maximum benefit to the intern. The internship program includes training and discussions on a variety of topics as well as the opportunity to meet with MBARI Board members and other visitors to the Monterey area (Fig. 3). MBARI has consistently received over 250 applications for the intern positions and the program has been of great value to those participating (both interns and mentors). Research projects are provided by mentors early in the application process and applicants are asked to specify a particular project as part of their application. There have been 68 interns over the past 6 years with another 12 interns starting their program in 2003.



Fig. 3. The 1998 interns were invited to participate in the National Ocean Conference, hosted in Monterey (top) which enabled interns to listen to Vice-President Al Gore and other dignitaries. Below: Sarah Carr (2003 intern) listens to MBARI Board Member Eric Hartwig (Naval Research Laboratory) as another intern, Brandon deKock (foreground), converses with another MBARI staff member during our annual Day of Science and Technology reception, where the interns have an opportunity to interact with the MBARI Board of Directors.

### C. Seminar Program

The MBARI seminar program is open to the general public and is free of charge as space permits and usually takes place at MBARI in the main seminar room at least every other Wednesday at 3 pm. The seminar topics are posted on the web and are also provided in an electronic and/or hard copy form to interested parties that have signed up for the notices. The speakers are selected from MBARI staff recommendations and are asked to provide a 45-50 minute presentation suitable for a diverse audience. MBARI supports this program by providing funds for travel, housing, and food. These seminars are an important method of providing enrichments for MBARI staff as well as being informative for external parties. Average attendance at these seminars is around 50.

### D. Annual Open House

This 5-hour event is held during the summer and provides access to MBARI facilities and accomplishments to almost 5000 individuals (<http://www.mbari.org/news/oh-tours.html>). For the past three years, MBARI and Monterey Bay Aquarium (MBA) have been holding a joint open house where the public can access information about current research and projects at both organizations as well as job and career information (Fig. 4). MBARI vehicles, technology, science, and engineering are put on display often with an interactive component. MBA brings activities, a favorite being the “Build your own remotely operated vehicle”, which has been an enormous success over the past two years.



Fig. 4. (clockwise from the top left). MBARI engineers demonstrate how the manipulator arm works on the ROV *Tiburon*. An audience member is then selected to try to pick up an object to the amusement of all. 2001 intern Virginia Rich and MBARI research technician Christina Preston are staffing one of the biology tables that focuses on microbial diversity in the deep sea. Two young attendees escape the clutches of the giant squid that MBA brings to the Open House. Patti Allen (MBA) shows two other attendees how to steer a model of the ROV *Tiburon* (worn by an intern).

### E. Products

As a non-profit research organization, MBARI does not market products for sale, but has developed a number of products that have been popular among educators and researchers. These include brochures, an annual report, educational slide sets, and GIS CD-ROMS (Fig. 5). These datasets are available on the web (<http://www.mbari.org/data/mapping/mapping.htm>). Brochures featuring MBARI, the research vessels, and remotely operated vehicles are often requested by educators as are the educational slide sets. The latter are sold below cost and feature MBARI facilities and tools, MBARI midwater tools and organisms, and MBARI benthic tools and organisms. MBARI issues an annual report both in hardcopy and on the web that provides a synopsis of the past year's efforts (<http://www.mbari.org/news/publications/pubs.html>).

### F. Media

MBARI receives numerous requests for images, video, and content, only a small number of which we are able to fulfill. Press releases help us remain proactive with the media rather than reactive (<http://www.mbari.org/news>). MBARI research is covered by the local, national, and international press as well as by several broadcast agencies (e.g. BBC, National Geographic, Discovery, CNN, NPR). In 2002, MBARI provided live footage from the deep-sea to an estimated 7 million views in England (<http://www.bbc.co.uk/nature/programmes/tv/abysslive/>) via a BBC program entitled *The Abyss Live* (Fig. 6).



Fig. 5 – CD-ROMs developed at MBARI featuring bathymetric data (except for one CD which has research data from an experiment in 2000) from Monterey Bay, Hawaii, Monterey Bay, Santa Barbara Basin, Northern California, Monterey Upper Water Column Science Experiment (research data), and West Coast Seamounts).



Fig. 6. Randy Kochevar (left, MBA) and Nick Baker (right, BBC) look at the split-screen display used in the 2002 BBC broadcast (*The Abyss Live*) on the stage that was erected at MBARI. The live image is in the top left quadrant and (clockwise) a video segment is playing in the upper right, a live feed from the RV *Western Flyer* at sea is in the lower right, and the feed from the BBC web page is in the lower left. The monitor below the split screen is displaying an interactive touchscreen linked to over 300 digital video and still clips (developed as part of the joint MBA/MBARI *Exploring Monterey Canyon* Exhibit accessible to the public in the MBA Auditorium)

#### G. External Collaborations

Collaborations are an essential part of any educational outreach effort and MBARI has a large number of external collaborators. These include formal research collaborations (not covered in this paper) and a large number of both formal and informal educationally focused collaborations. Foremost among these is the special relationship that MBARI has with its sister organization, the Monterey Bay Aquarium (MBA) [6]. One of the significant projects generated by this joint partnership is the *Exploring Monterey Canyon* exhibit where live images from an ROV in the deep sea are sent to MBA via a microwave link. These images are interpreted live in the MBA auditorium to over 1000 visitors a day. Most recently, MBARI and MBA collaborated on a series of teacher workshops that focused on the need and the usefulness of real-time data. Results from the Education and Research: Testing Hypotheses (EARTH) workshop (June 2003) will be presented at the Oceans 2003 conference.

MBARI staff members serve the research and educational communities on review panels, boards, by providing lectures (over 40 invited lectures were given in 2002), and by mentoring 65 students ranging from high school to postdoctoral fellows in 2002. This is with a total staff number of ~200.

MBARI staff members serve as adjunct faculty at local community colleges and universities. On an institutional level, MBARI is part of the national Consortium for Oceanographic Research and Education (CORE - <http://www.coreocean.org/>) as well as the regional Monterey Bay Crescent Ocean Research Consortium (MBCORC) which was formed in 1998 (<http://www.mbari.org/~andrea/MBCORC/MBCORC.htm>)

#### IV. Conclusion

MBARI has risen to the challenge of conveying excitement and enthusiasm about oceanographic research to ocean science educators, K-12 and post-secondary students, and to the general public. Essential to MBARI's success with educational outreach is the encouragement and guidance provided by the MBARI Management Team and Board of Directors. Even in the face of difficult economics, MBARI still values and supports programs like internships, seminars, an open house, and a proactive media approach. The special partnership that we share with the Monterey Bay Aquarium enhances the capabilities of both institutions. The results from the Education and Research: Testing Hypotheses (EARTH) workshop held in June, 2003 will be discussed at the Oceans 2003 meeting in September, 2003 along with an overview of where MBARI is heading in the future.

#### Acknowledgments

Thanks are given to the MBARI Board of Directors and Interim Director Ross Heath who created the Information and Technology Dissemination Division in 1996. MBARI's current CEO Marcia McNutt, division directors, and Board members have consistently supported and promoted these educational outreach efforts. This work and paper would not have been possible without the funding provided to MBARI by the David and Lucile Packard Foundation. The MBARI staff members are also acknowledged for their never-ending support and time that they provide for education and outreach. Comments from J. Connor and K. Matsumoto have greatly enhanced this manuscript.

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