

Bridging the Gap Between Scientists and Educators: Developing Collaborations To Address Ocean and Marine Science Illiteracy

MIKE SPRANGER

Sea Grant

University of Florida

PO Box 110405

Gainesville, Florida 32611 USA

msspranger@mail.ifas.ufl.edu

THE ISSUE OF OCEAN AND MARINE SCIENCE ILLITERACY

"...*What we know is a drop. What we don't know is an ocean...*" (Isaac Newton). No matter where we live, the ocean affects our daily life. It influences our weather and climate, provides food for much of the world's population, serves as a conduit for global commerce, and may be a potential new source of new pharmaceuticals. It also is used as a place for recreation, relaxation, and wonder. Yet we know less about this resource that covers over 70 % of our planet than we do about the moon (Grace 1997).

Ocean and marine science illiteracy is an issue for both the science and education communities. Scientists, and educators from a variety of disciplines, agencies and institutions are increasingly concerned and becoming proactive and vocal about dealing with this issue. What are the issues and what steps can scientists and educators play in helping to increase the appreciation, understanding and knowledge of the ocean and its resources among our youth and adult populations? One of the first things that is needed is to have a better understanding of each other. It appears that both the education and science communities are in a state of chaos and change in dealing with ocean science illiteracy.

The education community is increasingly faced with school reforms, funding challenges, over-crowded classrooms, science illiteracy among its students, and teachers unqualified to teach ocean science. In the United States, there have been a number of landmark studies such as *A Nation At Risk* (Dept. of Education 1983) and *Educating Americans for the 21st Century* (National Science Board 1983) that have pointed out that students graduating from public schools, when compared to those educated in many other countries are not competitive in math and science.

Among the general populace in the United States, only 15 percent of adults profess that they are well informed about science and technology issues. The understanding of and appreciation for technology and science, specifically the oceans is critical for a nation's citizenry. The Pew Oceans Commission indicates the United States' coasts are "more densely populated than the rest of the country with half the U.S. population living in the one-fifth of our land area along the coasts; by 2025, demographers anticipate three quarters of the U.S. population will reside in coastal regions." (Pew Oceans Commission 2003).

These citizens need a better understanding of the ocean and ocean sciences so they can make informed decisions on issues that impact these coastal areas.

Additionally, many teachers in the United States are inadequately prepared to teach science. As a result, many teachers choose not to attempt to teach science in their classrooms, ultimately resulting in less science being taught at this level nationally. For those educators that do teach science in their classrooms, a recent study indicated that 37 % in high school, 83 % in middle school, and practically all at the elementary school level lack science degrees. (NSTA 2000) To compound this problem, the majority of those that have a science degree have not studied marine or ocean science. In fact, these content areas are barely mentioned in the *National Science Education Standards*, an influential report that was released by the National Research Council in 1996.

Within the science community, there are similar challenges. Financial issues are a continued concern, with less support from both public and private sources going to fund ocean and science research. There also continues to be a shortage of scientists in key marine and aquatic science topical areas. Additionally, there are new mandates for scientists to not only conduct the research and provide their findings to their peers, but also to provide their findings into the educational and general public communities, areas beyond their normal professional and technical audiences. National Science Foundation (NSF) reports such as *National Science Foundation in a Changing World* (1995) and *Shaping the Future: New Expectations for Undergraduate Education in Science, Math, Engineering and Technology* (1996) have this expectation. Recent call for proposals from the NSF and other funding organizations mandate that this new approach to reach beyond their scientific peers be incorporated into research proposals, and that this new focus will be considered in the final decision-making process on which projects will be funded. Providing research information and results to educational audiences is an area that most scientists have little background or understanding. The pedagogy (teaching strategies) in the classroom and national and state education standards are new terminology to most scientists.

The 1999 Kellogg Commission Report, *The Future of the State Land-Grant Universities*, also stresses that scientists must find paths for spreading their research findings to the general public. The report also urges all educational institutions to enrich students' experiences by bringing research and "engagement" into curricula and offering practical opportunities for students to prepare for the world they will be entering as professionals.

Similarly, reports such as the *National Science Education Standards for Professional Development* (National Research Council, 1996) conclude that teachers must have a better understanding of science content and research methodology. Effective teacher training programs should include the learning of science content through inquiry; the integration of science that demonstrates science relevance to students when teaching; and the building of science understanding and abilities for lifelong learning which are coherent and integrated. Like the scientists trying to understand the world of education, the educators are having a difficult time trying to understand the world of the science.

BRIDGING THE GAP

Over the last decade rich opportunities have been missed by both the education and ocean and marine sciences communities by not having a proactive, coordinated education program (Haynes, 2000). Clearly there is an opportunity and need to bridge the gap between scientists and educators, and to find ways to work together to address the issue of ocean science illiteracy. New partnerships and collaborations, leveraging of research and education funds, and the commitment and personal involvement of educators, scientists and administrators are emerging. In these efforts, there are some common themes that have been identified.

First, a common, unified voice is emerging from leaders from all sectors of the marine and ocean science education community. They agree that increasing ocean science literacy is critical. This movement to ocean literacy also goes beyond the classroom, and involves more than just public exposure and awareness. Literacy requires that students and citizens have enough understanding of the science and issues to be able to communicate this information to others.

Second, a need exists for increased collaboration between the education and scientific communities. Having working scientists involved in educational efforts is important. Not only are these scientists in a position to provide both content and materials for the classroom, but they also can provide personal experiences, serve as role models, and offer teachers, students and the public opportunities to visit their site facilities. Scientists can show how real science is done, and how it is utilized.

Third, if ocean and marine science concepts and processes are to be incorporated into the classrooms (at least in the United States), they must be linked to both national and state science education standards that are now commonplace across the country. These standards are used for teacher accountability and student assessment. These concepts and processes also need to be incorporated into teacher training programs and professional development programs for those already in the education profession, or for those training to be educators.

Finally, there is an underlying need to insure that ocean and marine science literacy reaches all segments of the population in the United States, and beyond. Many of the historically under-represented populations (i.e. African Americans, Native Americans, Hispanics/Latinos, women of all ethnicities) in the United States have been ignored. These groups should be approached and offered to increase ocean literacy in ways that are culturally relevant and suggest that a career in the ocean sciences may be an option for any student that desires it.

GULF OF MEXICO – COSEE: AN EXAMPLE OF COLLABORATION

There are a number of examples of where scientists and educators have come together in a collaborative effort to deal with this issue of ocean and marine science illiteracy. One example found in the Gulf Caribbean Fisheries Institute's region is the Gulf of Mexico – Center for Ocean Science Education

Excellence (GOM-COSEE) project. This project is designed to enhance the ocean literacy of teachers, students and general citizenry within five Gulf of Mexico states (Alabama, Florida, Louisiana, Mississippi, Texas) by "bridging the gap" between researchers' ocean sciences results and the interpretation and relevance of those data.

This GOM-COSEE effort is a collaborative effort that involves many partners. Primary partners include the University of Southern Mississippi and J.L. Scott Marine Education Center and Aquarium located in Biloxi, MS; the Mississippi-Alabama Sea Grant Consortium (MASGC); the Dauphin Island Sea Lab (DISL) Research Consortium on Dauphin Island, AL; the Florida Sea Grant College Program, and the Florida Museum of Natural History located on the University of Florida campus in Gainesville, FL, the University of Florida Seahorse Key Marine Laboratory, in Cedar Key, FL; and the Louisiana Universities Marine Consortium (LUMCON) in Cocodrie, LA. This project includes both institutions of higher learning and informal science education centers that have documented and successful histories of working with the various audiences in the development, delivery and evaluation of marine and ocean science programs. Other key GOM-COSEE partners include the National Marine Educators Association (NMEA), the U.S. Navy, specifically, the Naval Meteorology and Oceanography Command (NAVMETOPCOM); and the Naval Oceanographic Office (NAVO); the Center for Educational and Training Technology, the Digital Research and Imaging Laboratory of the School of Architecture and the NSF Engineering Research Center (NSF ERC) at Mississippi State University in Starkville, MS. Funding is provided by the National Science Foundation, Office of Naval Research and National Sea Grant Program.

WHY THE GULF OF MEXICO?

The GOM-COSEE takes both a thematic and regional approach that focuses on the Gulf of Mexico to deliver technology-enriched, ocean sciences education-based on "sound" science—to cadres of precollege teachers, undergraduate students, university and community college faculty, informal educators, underrepresented groups, and interested public. Although the Gulf of Mexico is a small body of water as compared to the Atlantic and Pacific Oceans, it is the drainage basin for the largest (Mississippi River) and the fourth largest (Mobile-Tensaw) river systems in North America. This basin drains two-thirds of the land mass of the continental United States. As reported by EPA (1990) the Gulf of Mexico is a national treasure in the United States deserving of time, attention, and best stewardship efforts due to the following resources it provides:

- i) Annually more finfish, shrimp, and shellfish than the South and Mid-Atlantic, Chesapeake, and New England Regions combined;
- ii) Shrimp fishery which is among the most U.S. valuable fisheries;
- iii) Critical habitat for 75% of the migratory waterfowl traveling the U.S.;
- iv) Half of the national U.S. coastal wetlands total;
- v) One-sixth of the U.S. population lives in the Gulf Coast states;

- vi) 90% of the U.S. offshore oil and gas production;
- vii) Ports handling 45% of the U.S. import-export shipping tonnage;
- viii) More than \$76 billion in federal revenues were generated as a result of Outer Continental Shelf oil and gas development in the Gulf between 1956 and 1984. This was second only to the federal income tax as a revenue source for the U.S. Treasury; and
- ix) Tourism-related dollars annually contributed \$20 billion to the economy, drawing millions of sport fisherpersons and beach users.

The states that border the Gulf of Mexico are also experiencing one of the most rapid population growths in the United States. Many new residents, both youth and adult, are unaware of the unique aspects of the Gulf of Mexico, and ocean sciences in general. The Gulf of Mexico is also experiencing many environmental stresses. Pollution, depletion of fish and other living resources, habitat destruction and degradation, and introduction of invasive, non-native species are impacting the Gulf of Mexico.

The Gulf of Mexico and its adjacent watersheds and riverine systems, offer unique research and educational opportunities for students, formal and informal educators, and interested public—from the five Gulf of Mexico states—to learn, thereby enhancing their understanding of scientific principles using ocean sciences as the theme.

The COSEE-Gulf of Mexico project addresses three broad, scientific thematic areas to form the core course of study to teach ocean science literacy among its participants. These thematic areas are coastal processes (i.e. physical, biological, chemical parameters), coastal habitats and organisms (i.e. estuaries, mudflats, barrier island and mainland beaches, vertebrate and invertebrate species) and ocean technologies (i.e. ocean observing systems and observatories). These themes provide teachers, their students and the general citizenry not only an appreciation and understanding of the Gulf of Mexico, but also better awareness of the relevance of the oceans to their everyday lives and the interconnectedness of all species on this watery planet.

HOW GOM-COSEE WORKS AND ITS POTENTIAL IMPACTS

Annually, over the next five years, each site in their respective states will host a two-day, Informal Educators' Workshop for 45 educators. These workshops will focus on current coastal and oceanic research being conducted in each state. Ocean scientists will also be invited to participate. The ocean sciences researchers, educators, and students will then interpret and communicate the research results to the interested public through their respective marine, environmental, and oceanic agencies. Additionally, a fifteen-day COSEE Institute for 20 middle school teachers and scientists will be held at each COSEE site. Five days of each Institute will be spent introducing participating teachers to field-based aspects of ocean sciences and the impacts these habitats have on the environment; facilitating the infusion of existing materials into classroom course work following state and National Science Education Standards. Scientists will also be invited to participate to share their research, and also to gain a better understanding of the pedagogy in the

classrooms and state standards. The remaining ten days will be facilitated electronically communicating through virtual conferencing, and other forms of online electronic communications to provide ocean sciences content, pedagogy, (instructional strategies), and additional "hands-on" activities to all COSEE-Gulf of Mexico teacher and scientist participants.

Over this five-year period - by using existing ocean sciences facilities in each of the five, Gulf Coast states - this collaborative will reach 600 "first-tier" teachers and their 90,000 students, the potential 12,000 "second-tier" teachers and their 1.8 million students, hundreds of researchers, 1,750 informal educators, 90 undergraduate students, and approximately two to three million interested public, thereby creating an improved understanding of the oceans' dynamics and the scientific research being conducted within the partnering institutions and outreach facilities. Each of the satellite COSEE facilities has ocean scientists, graduate and undergraduate students, and ocean sciences educators who will implement the objectives of this effort.

THE CHALLENGE TO GCFI

According to the Gulf and Caribbean Fisheries Institute's (GCFI) charter, it was founded to promote the exchange of current information on the use and management of marine resources in the Gulf and Caribbean region. From its beginning, GCFI has endeavored to involve scientific, governmental, and commercial sectors to provide a broad perspective on relevant issues, and to encourage dialogue among groups that often operate in relative isolation from one another. It has largely been a scientific group, exchanging information among scientific peers and resource managers around the region.

The challenge is for GCFI and participating scientists and resource managers to extend their activities to work with the education communities within the region in a coordinated basis to deal with this issue of ocean and marine science illiteracy. Through collaborations, partnerships, and the sharing of expertise and resources, we can work together to address this issue in our schools and among our citizenry. There are existing education networks available. For example, within the GCFI region, there is a newly created chapter of the National Marine Educator's Association. (United States). The Caribbean and Western Atlantic Marine Educators Association (CARIBWAMEA) chapter has members from the educational community throughout the Caribbean, Bahamas, and Bermuda. Also, the National Sea Grant Program is working with a number of countries that are interested in creating their own "sea grant programs" that bridge science, education and community activities. These countries include Ecuador, Nicaragua, Honduras, and Costa Rica. There most likely are other educational networks and interested educators in the region that GCFI can rely upon in dealing with the issue of ocean and marine illiteracy.

To conclude, ocean illiteracy is a problem that crosses all national boundaries. Scientists, and educators from a variety of disciplines, agencies and institutions are increasingly concerned and becoming proactive and vocal about dealing with this issue. By working together and leveraging funds and

expertise, we can work toward addressing this problem. The challenge is for us to step forward and move beyond dialogue to action.

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