Conference on Ocean Literacy Report

June 7-8, 2006
Washington, DC

Published by the National Marine Sanctuary Foundation, December, 2006.

Executive Summary

The national Conference on Ocean Literacy brought together senior government officials, experts in formal and informal education, nongovernmental organizations and industry representatives to help lay the groundwork for developing a national strategy for creating an ocean-literate society. The participants addressed formal and informal educational activities, and looked for ways to facilitate links among federal, state, local and nongovernmental programs designed to enhance ocean stewardship.

The two-day conference featured 49 high level speakers, who addressed the pressing needs and opportunities for ocean literacy from many perspectives. The majority of the speakers spoke to how their personal voyages to become ocean-literate citizens came from life-changing experiences: for the Chairman of the Council on Environmental Quality, Jim Connaughton, it was scuba diving with his son; for Sylvia Earle, it was exploring parts of the ocean never seen before; for Bob Ballard, it was being inside a submersible; and for former search-and-rescue Coast Guard skipper and current Congressman from Mississippi Gene Taylor, it was navigating turbulent brackish waters that were unimaginable before *Hurricane Katrina* destroyed his home community. These presenters spoke eloquently of how their knowledge of the ocean and ability to communicate this with others was fired by the passion arising from these experiences.

The conference highlighted the tremendous efforts underway by the marine education community to bring ocean learning into classrooms and people's lives. For example, members of the National Marine Educators Association and other partners invested countless hours drafting *The Essential Principles and Fundamental Concepts of Ocean Literacy,* to enable educators to more adequately fulfill the National Science Education Standards.

The conference provided a forum for many public and private conversations concerning how to advance ocean literacy. From these conversations arose recommendations that range from overarching principles to specific next steps. Several common themes were repeated throughout the conference, including strengthening stakeholder networks, building common messages and applying proven models.

Recommendations

To achieve a nation of ocean-literate citizens, systemic change in our formal and informal education systems is necessary. The change must occur in all aspects and levels of the education process and engage all of the stakeholders included in this process – students, teaches, parents, administrators, community members and similar audiences. The following recommendations for fulfilling the vision of an ocean-literate society were submitted by panel moderators to the community or emerged from inspirational and thought-provoking speeches and discussions.

Formal Education: Creating Ocean-Literate Students

Get involved at all levels. The ocean education community provides a wonderful resource of expertise, energy and enthusiasm. This community should participate in efforts at all levels, such as helping states develop appropriate standards and assessments, leading teacher professional development initiatives and working with curriculum developers to create engaging ocean learning experiences.

Focus on teachers. We need to support creative ideas and new models of teacher professional development, to help K-12 teachers learn ocean science concepts, skills and related pedagogy. These models should include pre- and in-service training, hands-on workshops and on-line training opportunities.

Connect to Earth system science, environmental education and other science education initiatives. These approaches can readily connect with other initiatives for science education, using the ocean as a vehicle for big ideas, scientific thinking and problem solving.

Scale up to reach larger audiences of teachers and students. We need to focus on the challenges of scaling up, with creative, large-scale and sustained efforts that reach large numbers of teachers and students. This action requires collaboration among all involved, including publishers, trainers, policymakers, funding providers and the ocean education community.

Engage and coordinate efforts of the federal government. Federal agencies should support these efforts through direct engagement with scientists, access to data and other resources, and grant opportunities at all levels, from the states to local districts to innovative developers and implementation support.

Informal Education: Creating an Ocean-Literate Society

Create and deliver unified messages. An active, energized, informal ocean science network should be formed to develop and deliver a comprehensive, well-branded two-part ocean literacy program for the public. First, a common core would be based on the ocean literacy essential principles and would engage people to understand the importance of the ocean to their daily lives. A second component would be tailored to the specific opportunities, needs, and interests of the region in which the aquarium is located. This effort could begin with a core group of six to ten aquariums or other informal education institutions that are part of the Coastal Ecosystem Learning Center network.

Building an Innovative Workforce through Diversity

Ask the right questions. What is missing in best practices is: asking the right questions, understanding that gender diversity is different from ethnic diversity, and ensuring that decision-making positions are filled with people who have the wisdom and experience to make informed decisions. Asking the right questions will lead to reasonable solutions that facilitate continuing or establishing programs that build an innovative workforce through diversity.

Link marine laboratories and minority-serving institutions (MSIs). Research experiences at the undergraduate level are the best preparation for and best predictor of graduate study. Education and research at marine laboratories and field stations, in particular, can be life changing. Based on our outcomes, linkages between marine laboratories and MSIs offers a huge potential for higher representation by underrepresented minorities in ocean sciences.

Include community colleges. In developing programs to improve ocean literacy and to generate an innovative workforce with diversity in mind, it is critical to include community colleges. In the United States, more than 1,000 accredited community or two-year colleges enroll more than 10 million students. According to the American Association of Community Colleges, 46 percent of all U.S. undergraduates, 45 percent of first-time freshmen, 56 percent of Hispanic, 57 percent of Native American, 46 percent of African American, 48 percent of Pacific Islander and 58 percent of female undergraduates enroll at these institutions (http://www.aacc.nche.edu). This is a talented student population with great potential to enter the Ph.D. pipeline.

Develop an Excellence in Science award. A conference participant proposed, as one of the conference outcomes to convene a special committee that would develop a plan for a significant Excellence in Science award to be named for Dr. Ernest Everett Just, an outstanding African American scientist and role model. Dr. Just pioneered work using marine organisms as models to understand basic cellular processes and became an internationally acclaimed scholar.

Include the disabled in the workforce. Another conference participant suggested that people with disabilities, who for a variety of reasons will never enter college, could support scientists and other advanced-level positions. Agencies like the National Science Foundation and the National Oceanic and Atmospheric Administration have funded programs for students with disabilities, including the Ocean Exploration Program's teacher of the deaf workshops. These groups should be considered when programs and activities for improving ocean literacy are developed.

Regional Approaches to Ocean Literacy

Strengthen regional networks.

- Leverage and engage audiences involved in regional programs (e.g., the Integrated Ocean Observing System, the Oceans and Human Health Initiative, the Centers for Ocean Science Education Excellence, and the Gulf of Mexico Alliance) to focus on regional issues, from nutrient-loading and hypoxia, to water quality, habitats, wetlands loss and natural hazards (such as hurricanes, tornadoes, erosion and flooding);
- Continue to increase and promote ocean, coast and watershed (to include the Great Lakes) coordination and collaboration among the public and private sectors, states, regions, scientists, formal and informal educators and federal agencies;

Develop coordinated messages.

- Develop and implement a coordinated public awareness campaign, focusing on the relevance of the world's ocean, coasts, and watersheds (to include the Great Lakes) through various approaches—e.g., the media (print, radio and television), web sites and electronic clearing houses;
- Evaluate, and then develop and/or revise, curricular materials based on "sound-science," and align these resources with *The Essential Principles and Fundamental Concepts of Ocean Literacy,* state standards, and the National Science Education Standards.

Behind the Lens: A Media Perspective on Ocean Literacy

Make it relevant to people's lives. Specify the relevance of ocean science and issues to everyday life when pitching related stories to the media. Specifically identify your target audience and make a connection to their interests and concerns. Some examples are health, weather, consumer products or the economy. Popular movies, subjects and other vehicles can also be used to obtain the public's attention and create teachable moments.

Speak their language. When working with representatives of the media, think in terms of soundbites, headlines or compelling phrases. Ocean science stories for the public should begin with the conclusions and should be direct, short, and jargon-free. Show your passion for research or a topic in interviews.

Provide imagery. Media outlets are often looking for imagery that field teams or researchers may have. Contact media representatives directly and offer images or inquire regarding what types of products they are seeking.

Stick to the science. Scientists can best serve policy debates by sticking to the science and explaining if results or research has been misrepresented. Don't shy away from controversy, doom and gloom, or the bad guys if they truly exist. Assess when controversy exists or doesn't exist, and make this clear in comments. Along with reporting problems, be sure to suggest solutions.

Invest in messaging. A growing diversity of media outlets offers great potential to improve ocean literacy; however, additional effort and resources are needed to take full advantage of the opportunities. Look to use a variety of outlets to reach different audiences over different time spans. Engage producers and editors as well as journalists or reporters, for they may decide what stories or topics will be covered.

Plenary Sessions

Use high-visibility events, such as Hurricane Katrina, to enhance awareness and understanding of the relevance of the world's ocean, coasts and watersheds by all learners.

Support the No Child Left Inside movement to increase the opportunities for out-of-class exploration and discovery in nature that are essential for instilling ocean literacy.

Continue to develop The Essential Principles and Fundamental Concepts of Ocean Literacy to be closely integrated with the public's daily life and, thus, to serve as guidelines for public ocean literacy.

Identify and capitalize on key leverage points to make systemic changes in formal and informal education. Leverage points are areas where a small effort results in broad changes.

Take advantage of the communication revolution and new technologies, such as telepresence, to engage and excite students.

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Introduction

As part of their commitment to carry out the actions identified in the President's *U.S. Ocean Action Plan,* federal ocean agencies sponsored the national Conference on Ocean Literacy (CoOL). The two-day conference was convened to help lay the groundwork for developing a national strategy for strengthening ocean science education and increasing ocean literacy. Senior government officials, experts in formal and informal education, nongovernmental organizations and industry representatives addressed formal and informal education activities, and looked for ways to facilitate links among federal, state, local and nongovernmental programs and to continue the growing dialogue on the importance of education to achieving the goals of ocean stewardship.

Coordinated by the National Marine Sanctuary Foundation in partnership with the White House Council on Environmental Quality and the White House Office of Science and Technology Policy, CoOL brought together stakeholders to discuss key recommendations of the U.S. Commission on Ocean Policy Report *An Ocean Blueprint for the 21st Century,* and the President's *U.S. Ocean Action Plan* to promote lifelong learning about the ocean, coasts, and watersheds and to increase coordination and collaboration of efforts toward achieving an ocean-literate society. Participating sponsors of the conference included the National Oceanic and Atmospheric Administration (NOAA), the National Oceanographic Partnership Program (NOPP), the National Science Foundation (NSF), the Department of the Interior (DOI), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the Centers for Ocean Sciences Education Excellence (COSEE), Coastal America, the Consortium for Oceanographic Research and Education (CORE), Marine Technology Society, Sea Grant Association, and The Ocean Foundation.

In addition, to the national conference, which was held in Washington, DC, five aquariums around the country hosted Regional Workshops that included satellite broadcasts of the national speakers, and their own discussions on regional aspects of promoting ocean literacy. Conference attendees included about 200 people in Washington, DC, and an additional 300 participants at the five Regional Workshops.

This report provides a brief summary of the conference's many important presentations and discussions. Additional links to conference activities and presentations can be found at http://www.nmsfocean.org/chow2006/cool.html.

Section I. Plenary Presentations

Creating an Ocean-Literate Society: A National Perspective

Mr. James Connaughton, *Chairman, Council on Environmental Quality (CEQ)*

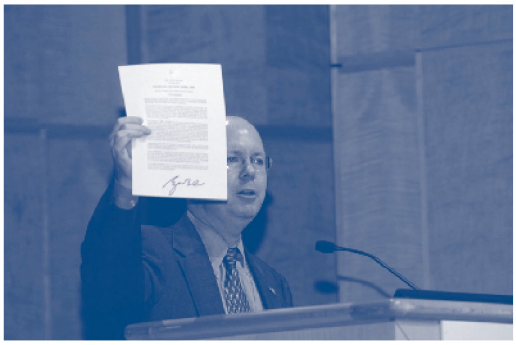
The Honorable Thad Cochran *(R-MS), U.S. Senate*

Mr. Tom Luce, *Assistant Secretary, U.S. Department of Education*

Mr. Jean-Michel Cousteau, *President, Ocean Futures Society*

CEQ Chairman James Connaughton opened the conference by presenting a Presidential Proclamation, officially designating June 4–10, 2006, as National Oceans Week. The Proclamation recognizes the importance of the ocean to our national heritage, economy and security and encourages partnerships to foster effective conservation.

Senator Cochran spoke about his interest in ocean policy and noted that the CoOL effort is important because it reminds us of Americans' limited knowledge of the ocean and its value. He called for agencies to submit a unified ocean budget request and noted that an increased focus on ocean education in our schools will encourage young Americans to appreciate the role of the ocean in our everyday lives.

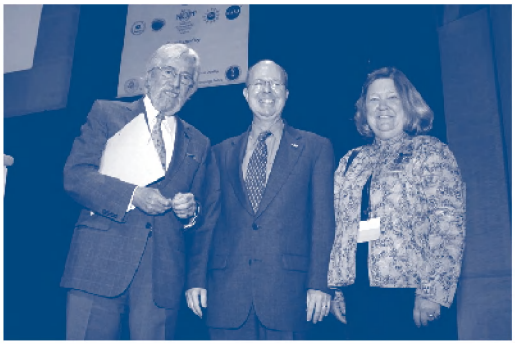


CEQ Chair James Connaughton displays the National Oceans Week proclamation during his remarks.

Assistant Secretary Luce described the Cabinet-level Academic Competitiveness Council, recently established by the White House. The Council is addressing important issues, such as low teacher content-knowledge in the sciences. Today's high school graduates need to understand science and technology, whether they are going directly into the workforce or on to college. Integrating the ocean into classroom content encourages the interest of young adults, while giving the ocean community a voice for ocean and science literacy.

Senator Thad Cochran (Mississippi) discusses his support for the Joint Ocean Commission Initiative's Sea to Shining Sea report, which identifies ten priorities including education.

Renowned ocean explorer Jean-Michel Cousteau described the critical role of education in reducing the decline in coastal habitats, such as mangroves, coral reefs and marshlands. He expressed concern that an estimated 30 percent of the world's coral reefs, which provide food and protection from severe storms, have died off in large number. He recommended using the tools of the communication revolution to connect ocean preservation and conservation to every human being, particularly young people and educators.



Jean-Michel Cousteau, James Connaughton and Dr. Sharon H. Walker.

Ocean Literacy: The Link to Economic Vitality

The panelists recognized the important links between economic prosperity and environmental protection. Americans make 910 million trips to coastal areas each year, contributing $44 billion annually to the economy. In 2000, the ocean economy alone employed about 2.3 million people and contributed $117 billion to the national economy.

Congressman Taylor represents a district in coastal Mississippi where the power, complexity and opportunity of the ocean, its coasts and watersheds converge. He shared his experiences during Hurricane Katrina, in which ocean and coastal vulnerability clearly translated to economic vulnerability. Long before *Katrina*, levees built for flood protection created an ecological disaster by reducing coastal marsh replenishment that led to a dead zone at the mouth of the Mississippi River. The ocean is also an important factor in U.S. economic strength and national competitiveness.

Deputy Secretary Scarlett and Assistant Administrator Grumbles spoke of the federal government's vast and varied ocean and coastal responsibilities. Ocean literacy is needed to inform federal managers of our Nation's coastal lands, fisheries, transportation and energy sectors, and emergency response systems. Knowledge is a fundamental foundation of stewardship for our national resources and helps us to understand concepts of complexity and uncertainty. To better educate the public federal agencies have developed innovative partnerships with the Girl Scouts, The Weather Channel, and other organizations.

Dr. Colwell identified biotechnology as a sophisticated tool that allows us to explore the extraordinary diversity of the world. We turn to the sea for medicinal compounds, cosmetic ingredients and artificial materials, as well as for clues to blood pressure control or neurotransmitters in the human brain. Science and discovery are particularly exciting in the interfaces among the disciplines of physical sciences, biology, technology and engineering,

Deputy Secretary of the Department of the Interior Lynn Scarlett discusses the importance of ocean literacy and our economy.

Ray Ban provided insight from the efforts of the atmospheric community. Raising public awareness through the media is an effective way to increase ocean literacy. Because Americans do not want to be subjected to lectures, we must identify compelling and entertaining ways to reach them. For example, Earth Gage provides weather forecasters with important information they can simultaneously link to the weather and educate their viewers.

Ms. Lynn Scarlett,
Deputy Secretary,
U.S. Department
of the Interior

The Honorable
Gene Taylor *(D-MS),*
U.S. House of
Representatives

Mr. Ben Grumbles,
Assistant Administrator,
U.S. Environmental
Protection Agency

Dr. Rita Colwell,
Professor Emeritus,
University of Maryland

Mr. Ray Ban,
Executive Vice President,
The Weather Channel

Luncheon Keynote: The Power of the Ocean

Richard Louv,
Author

Mr. Louv's book, *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder,* created a national conversation about the implications of disconnecting children and nature. Parents cite "stranger danger" and lack of access to nature for disconnecting their children from the outdoors, while some children spend as much as 44 hours a week plugged into electronic media. To further compound the problem, 40 percent of school districts in the country have either cut back or eliminated recess, and entire school districts are now constructed with no playgrounds.

Nature deficit disorder has remarkably far-reaching implications for children's physical, mental and even spiritual health, not to mention the future health of the planet. Studies repeatedly document that contact with nature helps to:

- quickly improve the symptoms of attention-deficit disorder in inner-city children;
- dramatically reduce stress in children (and adults);
- improve cognitive development;
- reduce childhood obesity; and
- create life-long environmental awareness and values.

Woods: Saving Our Children from Nature Deficit Disorder.

Studies demonstrate that when children learn and play in a natural environment rather than on a concrete playground, they are far more likely to invent their own games, be cooperative, and be interested in conflict resolution.

Mr. Louv closed his well-received speech by issuing a call to reconnect our children to the very source of their life support and to join a Leave-No-Child-Inside movement—a movement that is rapidly gaining momentum in America. For example, the state of Connecticut recently created a successful *No Child Left Inside* campaign to attract children to the underutilized

Understanding Ocean Literacy

Ms. Sarah Schoedinger,
President, National Marine Educators Association (NMEA)

VADM Conrad C.Lautenbacher,
U.S. Navy (retired), Under Secretary of Commerce for Oceans and Atmosphere

RADM Richard West,
U.S. Navy (retired), President, Consortium for Oceanographic Research and Education

President Sarah Schoedinger presented the results of recent efforts by NMEA and partners to define the *Essential Principles and Fundamental Concepts of Ocean Literacy* (National Geographic Society, 2005). Ocean literacy is an understanding of the ocean's influence on us, and our influence on the ocean. An ocean-literate person:

- understands the Essential Principles and Fundamental Concepts about the functioning of the ocean;
- can communicate about the ocean in a meaningful way; and
- is able to make informed and responsible decisions regarding the ocean and its resources.

For more information on this effort and to see how the *Essential Principles and Fundamental Concepts* align with the National Science Education Standards, please go to www.coexploration.org/oceanliteracy.

An informed society underpins all that NOAA does, from weather and climate prediction to ecosystem management and habitat protection, according to VADM Lautenbacher. To promote education at NOAA, he established an education office, instituted an education plan and policy, and is creating partnerships through an environmental literacy grants program. Education programs throughout NOAA are using the *Essential Principles and Fundamental Concepts of Ocean Literacy* to promote awareness and understanding of the world's ocean, coasts, and watersheds.

RADM West pointed to the large gap between the high-tech, science-based missions of the federal government and the public's understanding of them. He added that we must invest in education now because it can take a generation to change public understanding and behavior.

Live from the Mediterranean: A Conversation with Dr. Robert Ballard

Congressman Frank Wolf, Chairman of the House Appropriations Subcommittee on Science, State, Justice and Commerce, expressed the importance of maintaining U.S. competitiveness in science and technology. The Nation's economic strength, values and national security are at stake if U.S. competitiveness is lost to other nations that do not share our values. Leaders of major scientific groups believe the country is in a stall, ready to go into decline or already in decline in the areas of math and science education. As a Nation, we need to take this problem seriously.

Dr. Ballard was on an expedition in the Mediterranean. Through telepresence technology, the audience was able to experience a live conversation between moderator Kris Ludwig and Dr. Ballard. Their goal is to use the excitement and sense of adventure conveyed by this technology to motivate the youth of America to learn more about science and technology and to inspire them to pursue Science, Technology, Engineering and Mathematic (STEM) fields that will ensure our future economic competitiveness. Dr. Ballard and Dr. Coan launched the Immersion Presents Program to reach children outside the classroom. They are collaborating with the Boys and Girls Clubs of America and several school districts that have significant after-school and out-of-school learning programs.

The Honorable Frank Wolf.

The Honorable
Frank Wolf *(R-VA),*
U.S. House
of Representatives

Dr. Robert Ballard,
President,
Mystic Aquarium and
Institute for Exploration

Kris Ludwig,
Student and former
JASON Argonaut,
University of Washington

Dr. Steve Coan,
Chief Operating Officer,
Mystic Aquarium and
Institute for Exploration

Section II. Moderator Reports

The panelists on the formal education, informal education, diversity, regional approaches and media panels were asked to address a set of questions related to the status of, challenges to, opportunities for, and future steps to enhancing ocean literacy. Panel moderators were asked to provide a report on their respective panels, including recommendations derived from the presentations and discussions.

Formal Education: Creating Ocean-Literate Students

Moderator
Daniel Barstow,
TERC

Introduction
Dr. Sylvia Earle,
National Geographic Society

Panelists
Dr, Gerald Wheeler,
National Science Teachers Association

Mr. Richard Steinke,
Maryland Department of Education

Dr. Gerald Lieberman,
State Education and Environment Roundtable

Mr. Larry Snowhite,
Houghton-Mifflin

The Formal Education Panel thanked the scientists and educators who developed the Ocean Literacy Standards, which have the support of NOAA, the National Geographic Society, the National Marine Educators Association, the National Marine Sanctuary Foundation, and the Centers for Ocean Science Education and Excellence, and align with the National Science Education Standards. The panel noted that the standards, with their seven essential principles and underlying fundamental concepts, make a major contribution by establishing a common framework.

The panel then addressed the next big challenges: How can we best integrate these standards into formal education? How can we ensure that our Nation's K-12 students engage with ocean science; learn to appreciate the ocean's essential role in our lives; explore its dynamics, its physical features and the life it supports; and understand its integral role in the Earth system? How can we spark students' interest in the ocean, and use the ocean as a context for science inquiry, exploration and discovery? In short, how can we make the standards real?

Panelists

The Formal Education Panel was asked to confront challenges and opportunities from several perspectives. Each panel member represented a "sphere of influence," presenting both a current status report and a set of recommendations. The audience also contributed ideas.

Dr. Sylvia Earle, distinguished oceanographer and explorer, spoke with inspiration about the vital importance of ocean literacy and the power of the ocean to engage young people and incite their spirit of exploration.

Daniel Barstow, Director of TERC's Center for Earth and Space Science Education, put ocean literacy in the context of a larger revolution in Earth science education and provided a state-by-state status report. He also described a NOAA-funded initiative to create a national model for ocean education, featuring inquiry-based learning, the space-age perspective and understanding the role of the ocean in the full Earth system.

Dr. Gerald Wheeler, Executive Director of the National Science Teachers Association (NSTA), identified four S's for creating ocean literacy in children: *scale* (we are reaching too few teachers), *science* (teachers don't understand the science they've been assigned to teach), *standards* (there is a misalignment between standards and assessment), and *sustainability* (the sustainability of ocean science programs needs to be ensured). Dr. Wheeler emphasized the challenges of

Dr. Gerald Wheeler.

professional development for the large number of teachers of science in K-12 classrooms, and the opportunity afforded by Internet-supported training opportunities.

Richard Steinke, Maryland's Deputy State Superintendent for the Office of Instruction, noted the central role of state-based science education standards and testing, and illustrated Maryland's approach to professional development with compelling examples.

Larry Snowhite, Vice President for Government Relations at Houghton-Mifflin, described the process of aligning textbooks with 50 different state standards, while maintaining internal integrity and flow. He also noted that most textbooks go well beyond the basic standards, contributing to deeper learning experiences.

Dr. Gerald Lieberman, Director of the State Education and Environment Roundtable, shared his experiences establishing an environment-based education program for the State of California, working closely with the California Environmental Protection Agency, California Department of Education and many other organizations. This "Education and the Environment Initiative" can be connected to some of the ocean literacy principles.

Status Report

In a NOAA-funded study, TERC (an educational nonprofit organization) reviewed all 50 state science education standards, to assess how well they align with the ocean literacy standards. (The study focused on the standards *per se*, since most states have not yet finalized the state science tests.) NOAA will soon release the full report; some initial findings are presented here:

- All state standards include ocean concepts at some point in the K-12 curriculum.
- None of the states includes the full ocean literacy standards, though several have close approximations of the seven essential principles.

- Most state standards cite the importance of under standing Earth as a dynamic interconnected system, of which the ocean forms an essential part.
- Few state standards cite the space-age technologies that provide rich new ways for students to investigate ocean science concepts.
- Several states undermine progress by excluding Earth science as a "lab science" at the high school level.

While this study provided an essential view on the state standards, it did not look into how well the standards translate to classroom practice and, in turn, into growth in student learning. Other studies, such as the bi-annual comprehensive report on science education by the Council of Chief State School Officers, reveal that only 28 percent of our Nation's students take Earth science at the high school level, pointing out how far we still need to go toward making ocean literacy a widespread reality.

Opportunities

- We all need to recognize that ocean literacy standards are not just a list of essential principles; they embody our deep interconnections with the ocean, and the crucial role of the ocean and ocean literacy in our Nation's future.
- Learning about the ocean has value not just in its own right, but also as the context for larger ideas in Earth system science, and provides opportunities for students to develop scientific thinking skills.
- States have the central role in making the standards real. Hence, each state should review and revise its standards to strengthen treatment of ocean literacy, and should ensure that statewide science tests include ocean literacy concepts and related scientific thinking skills.
- Developers should revise, enhance or create new curricula, textbooks and other learning materials that feature the essential principles of ocean literacy. These materials should especially incorporate the latest understandings from science, new tools of technology, and the broader issues of Earth system science and global climate change.
- The *Essential Principles and Fundamental Concepts of Ocean Literacy* make a major contribution to efforts to align ocean content with science standards. They should be reviewed periodically to ensure that they reflect the evolving state of the art, and embody not just the ocean science concepts and skills, but also calls to action for helping sustain the world's ocean in a balanced and healthy state.

Recommendations

Panel members made several recommendations, with additional ideas suggested by the audience during the question and answer period. While the panel did not formally approve a set of recommendations, we list here the major ideas discussed.

Get involved at all levels. The ocean education community provides a wonderful resource of expertise, energy and enthusiasm. This community should participate in efforts at all levels, such as helping states develop appropriate standards and assessments, leading teacher professional development initiatives and working with curriculum developers to create engaging ocean learning experiences.

Focus on teachers. We need to support creative ideas and new models of teacher professional development, to help K-12 teachers learn ocean science concepts, skills and related pedagogy. These models should include pre- and in-service training, hands-on workshops and on-line training opportunities.

Connect to Earth system science, environmental education and other science education initiatives. These approaches can readily connect with other initiatives for science education, using the ocean as a vehicle for big ideas, scientific thinking and problem solving.

Scale up. We need to focus on the challenges of scaling up, with creative, large-scale and sustained efforts that reach large numbers of teachers and students. This action requires collaboration among all involved, including publishers, trainers, policymakers, funders and the ocean education community.

Engage and coordinate efforts of the federal government. NOAA, NSF, NASA, DOI, the Department of Education, the U.S. Navy, EPA and other agencies should support these efforts through direct engagement with scientists, access to data and other resources, and grant opportunities at all levels, from the states to local districts to innovative developers and implementation support.

In all of these initiatives, we celebrate the ocean as a wonderful, fascinating, beautiful, dynamic, engaging focus for inquiry, exploration and discovery—and as an essential element of our Nation's renewed focus on science education for our future.

Informal Education: Creating an Ocean-Literate Society

Moderator
Mr. Ted Beattie,
John G. Shedd Aquarium

Panelists
Dr. Jerry Schubel,
Aquarium of the Pacific

Dr. Paula Coble,
University of South Florida

Dr. Jackie Ogden,
Disney's Animal Kingdom

Ms. Julie Scardina,
Sea World-Busch Gardens

How Are Informal Educational Institutions Contributing to Ocean Literacy?

We heard from our panelists about a wide variety of programs that contribute to ocean literacy, from exhibits and animal shows to art and field study programs. The speakers demonstrated great creativity and enthusiasm about their programs, including

- connecting people to nature through field trips and stewardship projects, both to exotic places and to local wetlands and beaches;
- bringing scientists, journalists, photographers, cinematographers and explorers to share their work with the public;
- taking exhibits to malls, fairs, cultural festivals and other community activities;
- providing interesting activities for schoolchildren, such as designing sustainable communities;
- offering behind-the-scenes tours that allow visitors to interact with our staff;
- offering classroom, lab and field studies programs in which students work with aquarium research and conservation staff;
- developing campaigns and involving local businesses, such as seafood restaurants, in the sustainable seafood campaign;
- engaging families and communities by adopting a local school or hosting events for students, their parents and their teachers;
- integrating ocean literacy with social sciences, arts and mathematics and developing video games around ocean themes; and
- using NASA satellite imagery.

Opportunities

Use aquariums, zoos and science centers to reach millions. There are 36 stand-alone aquariums in this country, attracting 41 million people every year. Combined with zoo visitors, this figure approaches 130 million per year. This is a wonderful opportunity to develop an ocean-literate public.

Focus on learning, not teaching, by providing experiences to the public. If a picture is worth 1,000 words, then an experience is worth 1,000 pictures. Experiences are not only hands-on, but minds-on and hearts-on, as well.

Be creative. Regional issues, current events, community activities, cool science and technology are effective tools for engaging the public.

Use entertainment. Disney went from a static exhibit at its Living Seas facility to interactive presentations,

Pete the Penguin entertains the audience.

NEMO graphics and an animated talking sea turtle named Crush. As a result, the satisfaction ratings from the public doubled from about 40 percent to 80 percent, and the public understanding of what people can do to help ocean conservation rose from 35 percent to 70 percent.

Connect to people emotionally. Animals can be used to tell powerful stories about ocean literacy. Animals connect people to the living world and inspire them to make a difference. Connect, inspire and make a difference are the messages we are communicating.

Develop consistent messages. There are multiple opportunities throughout the various programs offered at a facility to reinforce consistent messages.

Involve the conservation community. Informal educators should work with the conservation community, which is often working on similar efforts and also has public outreach programs.

Engage federal agencies. Informal educational institutions should ask federal ocean education coordinating groups, such as those under the White House Committee on Ocean Policy or the Ocean Research and Resources Advisory Panel (ORRAP), to expand efforts to include ocean messaging.

Recommendations

Create and deliver unified messages. An active, energized, informal ocean science network should be formed to develop and deliver a comprehensive, well-branded, two-part ocean literacy program for the public. First, a common core would be based on the ocean literacy essential principles and would engage people to understand the importance of the ocean to their daily lives. A second component would be tailored to the specific opportunities, needs and interests of the region in which the aquarium is located. This effort could begin with a core group of six to ten aquariums or other informal education institutions that are part of the Coastal Ecosystem Learning Center (CELC) network.

Building an Innovative Workforce through Diversity

The panel addressed the following questions: Why is ocean literacy important to building a diverse and innovative work force? Where are we now and what are the obstacles to building a diverse and innovative ocean workforce? What are some of the best practices, examples, models and guiding principles employed to promote ocean literacy and build such a workforce?

Why Is Ocean Literacy Important to Building a Diverse and Innovative Ocean Workforce?

The Navy's Perspective

Rear Admiral Fred Byus began by sharing Navy perspectives regarding diversity and ocean literacy, highlighting the Navy's desire to have leaders for and from every part of the Navy. He relayed the Chief of Naval Operations' (CNO's) challenge to improve diversity in the Navy, especially in leadership positions, and the requirement for a human capital strategy to achieve that goal.

Admiral Byus stressed three themes: a diverse entry pool, continued career progression and workplace empowerment and treatment. He noted that the Navy and the Nation are in competition with technology and global markets that are increasingly becoming more diverse. We must ensure that we remain competitive for future generations of marine scientists. The admiral noted the perishable nature of ocean literacy in that as one gets away from the small buffer of land where people are living and experiencing the ocean on a daily basis, interest in the ocean drops off. When this interest drops off, so does the number of people interested in ocean-related education, ocean-related technology, ocean-related jobs and careers in naval oceanography.

Some Navy successes of the past few decades were highlighted to include the increase of African American and female officers selected to significant leadership positions within the Navy. Increasing efforts to foster future success were highlighted, including the CNO's formation of a diversity directorate and senior advisory group and regular meetings of a senior leadership diversity council from both the civilian and the uniformed parts of the Navy. The admiral also mentioned the merger of the Navy's manpower and training and education organizations into a single office, allowing for a single, more responsive organization to establish goals and changes necessary for Navy diversity into the future.

Panel listens to Dr. Maria Alvarez.

What Are Model Programs?

The following model programs were identified by panelists during their presentations.

University Programs

Dr. Brian Bingham, Shannon Point Laboratory, Western Washington University directs the NSF-funded Minorities in Marine Science Undergraduate Program. This program is characterized by raising students' personal comfort level; demonstrating high expectations for performance; ensuring a good chance of meeting program standards (by including remedial math and writing workshops); engaging in a wide diversity of activities flexible enough to accommodate individual needs; establishing a group dynamic early (including a faculty/mentor leader); and establishing one-on-one mentoring between students and advisors, which should be maintained throughout the program. The program has resulted in: 219 post-program awards, internships, fellowships or scholarships; 185 presentations at scientific conferences; and 39 refereed publications. Of the 119 program alumni since 1991: 91 have completed B.A./B.S. degrees, 25 are in progress, and 3 are not in school, representing 24 percent; 26 have completed M.S. degrees, and 23 in progress, representing 54 percent; 3 have completed Ph.D. degrees, and 7 are in progress, representing 11 percent; and 3 have completed professional degrees, and 7 are in progress, representing 11 percent.

Dr. Ben Cuker at Hampton University directs four diversity programs:

1. The American Society of Limnology and Oceanography Minorities Program (ASLOMP), funded by NSF: Mentoring, role modeling, community-building and networking through a scientific society; 561 students since 1990.
2. Multi-cultural Students at Sea Together (MAST): A month-long hands-on sailing adventure that includes science, policy and the heritage of African

Moderator
Dr. Matthew Gilligan,
Savannah State University

Introduction
RADM Fred Byus,
Oceanographer of the Navy

Panelists
Dr. Judith Vergun,
University of Hawaii at Manoa

Dr. Larry Robinson,
Florida A&M University

Dr. Maria Alvarez,
El Paso Community College

Americans and Native Americans on Chesapeake Bay; 82 students since 2000.

3. Hall-Bonner Program for Minority Doctoral Scholars in the Ocean Sciences, also funded by NSF: Critical mass and joint effort of minority-serving institutions (MSIs) (Hampton University) and traditional Ph.D. programs at Old Dominion University and Virginia Institute of Marine Science.
4. Multicultural Students in Aquatic Sciences: Virtual community and networking, including a newsletter with 409 recipients.

Dr. Eda Davis-Butts directs Oregon State University's Science and Math Investigative Learning Experience (SMILE) program, which promotes a strong sense of safety, inclusive community, high expectations, positive attitudes, cooperative contributions, mentoring, long-term enrichment support (up to nine years), personal connections and experiences in higher-education settings. Results include high school graduation rates: 60 percent Latino and Native American students, 79 percent all Oregon students, 84% SMILE students with two years in the program, and 95 percent SMILE students with more than four years in program.

Dr. Judith Vergun directed the University of Hawai'i at Manoa's Native Americans in Marine and Space Sciences (NAMSS) and Diversity Internship Program and currently directs the Hawai'i Kumu Ola STEM Program. These programs are characterized by finding and honoring the unique self, free-choice learning, intensive mentoring, multigenerational participation, free tutoring, role models from similar cultural backgrounds, someone who cared, networking with other programs, brokering and sponsoring educational exchanges and participation in professional conferences, a sense of place and belonging, and respect for differing views. Approximately 3,000 people have been involved in the programs over 20 years, with an average of 95 percent of undergraduates earning B.S. degrees in STEM, and 53 percent continuing in graduate school.

Dr. Ashanti Pyrtle directs the NSF-funded Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science Professional Development Program at the University of South Florida. The vision of this M.S. and Ph.D. program is to reduce gaps in the preparation, representation and full participation of minorities in Earth System Science via professional development opportunities, mentoring and community-building experiences. Students engage in both actual and virtual activities. Seventy-five total mentees and 52 mentors have participated in the program; 840 M.S. and Ph.D. candidates have participated in Virtual Community Forum Postings; and 50 M.S. and Ph.D. candidates have participated in informal and formal sessions of Web Cam Conferences.

Dr. Matt Gilligan has directed two kinds of collaborative programs at Savannah State University (SSU): a research experiences for undergraduates program between SSU and the Harbor Branch Oceanographic Institution, and an internship/graduate program between SSU and the Skidaway Institute of Oceanography. As a result of these collaborations and other funded projects, the percent of graduates from SSU's B.S. in Marine Science degree who had significant research experience increased from 25 percent before 1999 to 66 percent after, and the number of students graduating with honors increased from 30 percent before 1999 to 41 percent after.

NOAA's Educational Partnership Program

Dr. Larry Robinson presented an overview of NOAA's Educational Partnership Program (EPP), which has several components. In the Undergraduate Program, students take coursework integral to NOAA's mission and spend two internship cycles at NOAA: one summer at NOAA headquarters in Silver Spring, MD, learning about NOAA's work, and 10 weeks conducting field work at a NOAA line office. In the Graduate Scientist Program, students at the appropriate point in their matriculation in a Master's or Ph.D. program are selected competitively to work at a NOAA line office, and that work constitutes the basis of their Master's or Ph.D. dissertations. Another component is the Entrepreneurship Program, which is designed to increase the numbers of students proficient in environmental business enterprises and to facilitate linkages among the MSI community, NOAA, and the private sector.

The lion's share of the EPP budget goes to the four cooperative science centers, each receiving $2.5 million over three years. The City College of New York has a center for remote sensing, Florida A&M University has the environmental cooperative science center, Howard University has the atmospheric cooperative science center, and the University of Maryland Eastern Shore has the living marine resources center. All of these efforts are multi-institutional, and 17 of the 21 academic partners in these cooperative science centers are MSIs. A fifth cooperative science center will be designated fairly soon.

Regarding best practices, Dr. Robinson emphasized the importance of the collaborative development of the EPP program components and cooperative science centers. Much work was conducted over the years through NOAA's Expanding Opportunities Conferences, at which the MSI community and others identified needs to increase NOAA's presence at MSIs and the presence of underrepresented minorities in NOAA's workforce. Dr. Robinson stressed the research conducted today through the centers is crucial to NOAA's mission.

The EPP reports the following success stories:

- 19 of the 20 Ph.D. graduates since inception were underrepresented minorities;
- 58 of the 74 Ph.D. students currently supported by the centers are underrepresented minorities;
- between FY 2000 and 2004, 9 Ph.D.s in atmospheric sciences were awarded nationally to African Americans and Hispanics, while Howard University, the lead atmospheric cooperative science center, produced 3 Ph.D.s in May 2006, and has an additional 12 in the pipeline;
- between FY 2000 and 2004, 21 Ph.D.s in environmental sciences were awarded to African Americans and Hispanics nationally, while Jackson State University, an MSI member of the environmental center, produced at least 3 of the 21 in each one of those years; and
- in 2005 and 2006, the environmental center graduated 8 minority students with Ph.D.s.

In terms of the impacts on NOAA's workforce, NOAA's overall minority representation increased from 4.5 percent of the new hires in 2001 to 9.2 percent of the new hires in 2005. In 2001, only 2.5 percent of NOAA's science and technology new hires were underrepresented minorities; in 2005, that number rose to 7.1 percent.

El Paso Community College

At the institutional level, El Paso Community College (EPCC) has been highly successful in generating resources to involve minority and disadvantaged students in scientific research activities and in the Ph.D. pipeline. An Hispanic-Serving Institution (HSI), with five campuses in far-west Texas, EPCC is the fastest-growing community college in the Nation, with five campuses in far-west Texas and an enrollment of more than 24,000 students (http://www.epcc.edu).

EPCC was the first community college to be funded by many federal programs that traditionally fund four-year, research-intensive institutions. After participating in a workshop by the Quality Education for Minorities Network, EPCC received two grants from NSF: an Academic Research Infrastructure Grant and a Multi-user Biological Equipment Grant. This funding generated the infrastructure needed to provide meaningful research opportunities for EPCC students. After participating in the Extramural Associates Program at the National Institutes of Health (NIH), EPCC was the first community college to receive a grant from the Minority Biomedical Research Support-Research Initiative for Scientific Enhancement (MBRS-RISE) Program, to provide students with the tools needed to succeed in college, transfer to a university and pursue a biomedical research career (www.epcc.edu/programpages/rise).

Many of these students are already in graduate school and have received awards for their research presentations at national meetings. The MBRS-RISE Program is only one program from the Minority Opportunities in Research (MORE) Division at the NIH National Institute of General Medical Sciences. The MORE Division (http://www.nigms.nih.gov/Minority) has a variety of other programs that target minority and disadvantaged students, including the Bridges Program, which links community colleges with baccalaureate-granting institutions; the MARC program, which supports students at the junior and senior levels; the Bridge Program, which transitions students from Master's-granting institutions to Ph.D.-granting institutions; and the MBRS-RISE Program, which provides support throughout the entire spectrum.

In summary, Dr. Vergun noted the following four main themes, known and recommended for many years, and detailed and summarized in Dr. Ben Cuker's paper "Programmatic Approaches to Building Diversity in the Ocean Sciences": building community, role modeling, intensive mentoring, and authentic experiences.

What Are the Obstacles?

Asking the wrong questions. Colleagues have been presenting best practices and tangible results of successful programs for more than 20 years. It is time to ask: (1) Why are institutions and organizations not following best practices, and (2) Why are we not asking that question? We are experiencing institutional and bureaucratic failure, not programmatic failure, or lack of information or models of successful programs.

Lack of mentoring and isolation. A recent report by the American Council on Education, which performed a six-year longitudinal study of underrepresented minority students in colleges and universities in STEM fields increasing the success of minority students in science and technology, concluded that obstacles and not lack of interest account for the shortage of minority students in STEM fields. Lack of mentoring and isolation by minority students at majority-serving institutions—especially in certain majors, laboratories and research groups—are often cited as obstacles.

Persistent myths. The myth that underrepresented groups aren't interested in science and technology is accompanied by others, such as high-performing science students don't exist in underrepresented groups; they have no science or technology role models; they're unable to get through weed-out courses in STEM disciplines; and, in general, academic excellence and minority access are mutually exclusive.

All of these myths were debunked recently in a May 25, 2006, article in The New York Times describing the NSF-funded Meyerhoff Scholars Program at the University of Maryland, Baltimore County. The program was cited as a model illustrating that a vibrant, well-structured science program can produce large numbers of underrepresented minority students who excel and remain in STEM fields.

Competition from other fields. Mark Loveland, Education Programs Coordinator at the National Academy of Sciences' Koshland Science Museum, remarked that surveys demonstrate that professional careers other than basic science or ocean sciences—such as law, medicine and business—do a better job recruiting and promoting minorities and women into their careers, and offer more compelling economic and other tangible benefits. Mr. Loveland asked Dr. Vergun what might attract a bright, eager, competent minority or female student to pursue a career in academic research or sciences, especially in the ocean sciences, versus more lucrative fields. Dr. Vergun responded by saying what makes the difference is someone who cares and an exciting, engaging experience that opens opportunities in a world about which students have no idea. Our students rarely hear anything about the marine sciences until college, and most colleges and universities don't have marine science undergraduate degree programs.

Recommendations

Ask the right questions. Dr. Frank Hall (NAS) reminded us that what's missing in best practices is: asking the right questions, understanding that gender diversity is different from ethnic diversity, and ensuring that decision-making positions are filled with people who have the wisdom and experience to make informed decisions. Asking the right questions will lead to reasonable solutions that facilitate continuing or establishing programs that build an innovative workforce through diversity.

Link marine laboratories and MSIs. Research experiences at the undergraduate level are the best preparation for and best predictor of graduate study. Education and research at marine laboratories and field stations, in particular, can be life changing. Linking marine laboratories and MSIs offers a huge potential for higher representation by underrepresented minorities in ocean sciences.

Include community colleges. In developing programs to improve ocean literacy and to generate an innovative workforce with diversity in mind, it is critical to include community colleges. The United States has more than 1,000 regionally accredited community or two-year colleges enrolling more than 10 million students. According to the American Association of Community Colleges, 46 percent of all U.S. undergraduates, 45 percent of first-time freshmen, 56 percent of Hispanic, 57 percent of Native American, 46 percent of African American, 48 percent of Pacific Islander and 58% of female undergraduates enroll at these institutions (http://www.aacc.nche.edu). This is a talented student population with great potential to enter the Ph.D. pipeline. Community colleges are responding to the needs of the workforce, developing science curriculum and providing educational opportunities at all levels. Providing training to faculty and administrators at these schools is extremely important.

Develop an Excellence in Science award. As one of the conference's outcomes, Dr. Paul Sandifer (NOAA) proposed forming a special committee that would develop a plan for creating a significant Excellence in Science award to be named for Dr. Ernest Everett Just, an outstanding African American scientist and role model. Born in Charleston, SC, in 1883, Dr. Just graduated magna cum laude from Dartmouth College and earned a Ph.D., again magna cum laude, in experimental embryology from the University of Chicago. He was a distinguished teacher at Howard University and from 1909 to 1930 became part of the critical mass of scholars working at the Marine Biological Laboratory at Woods Hole. Dr. Just pioneered work using marine organisms as models to understand basic cellular processes and became an internationally acclaimed scholar.

Include the disabled in the workforce. Denise Monte, a teacher at the American School for the Deaf, suggested that people with disabilities, who for a variety of reasons will never enter college, can support scientists and other advanced-level positions. Agencies like NSF and NOAA have funded programs for students with disabilities, including the Ocean Exploration Program's teacher of the deaf workshops. Ms. Monte asked that these groups be considered when developing programs and activities for improving ocean literacy.

Regional Approaches to Ocean Literacy

Dr. Sharon Walker.

The panelists focused on how regional efforts are achieving the mission and goals of the *U.S. Ocean Action Plan* (2004), the U.S. Commission on Ocean Policy Report *An Ocean Blueprint for the 21st Century* (2004), NOAA's *Strategic Education Plan* (2004), the National Oceanographic Partnership Program-Ocean Research Advisory Program *Strategic Education Plan* (2002), the COSEE Workshop Final Report (McManus et al., 2000), the COSEE Strategic Plan, Revised (2005) and many other similar ocean sciences education "benchmark" reports within the last several years. Simply defined, ocean literacy is an understanding of and the ability to discuss the role of the world's ocean, coasts and watersheds in serving as the cornerstone of life as we know it on this planet, and the effects of humans on them. These presenters discussed how their respective regional approaches are contributing to ocean literacy, along with the opportunities for and the challenges to achieving ocean literacy. They presented the specific recommendations of OOS, OHHI, CELC, COSEE, and the Gulf of Mexico Alliance (GOMA), which were affirmed by the CoOL participants' questions and answers.

How Are Regional Approaches Contributing to Ocean Literacy?

Based on the PowerPoint presentations made by each panelist (located at www.nmsfocean.org), regional efforts are collectively achieving success in the following areas:

- Providing education and professional development programs for pre-college teachers. (This interaction of scientists and formal and informal educators is resulting in an extremely positive paradigm shift of mutual respect between these two professions).
- Incorporating high-quality ocean sciences content within existing curricula and informal learning materials, using sound science that is aligned with State Standards, the National Science Education Standards, and the *Essential Principles and Fundamental Concepts of Ocean Literacy*.
- Leveraging technology to enhance ocean sciences literacy (as stated by Barstow in 2002), and enable humans to be placed physically or virtually in diverse oceanic environments. This marine technological revolution has been driving the need to teach science as inquiry, to teach about the Earth as a system, and to increase the accessibility of the Internet and visualization technologies.
- Improving partnerships within the ocean sciences and education communities.
- Promoting the development of a sustained and diverse ocean sciences-related workforce through internships, fellowships, and mentoring.
- Increasing coordination and collaboration among academia, nonprofit organizations, state and government agencies, and aquariums, museums, and science centers.

What Are the Major Challenges?

The Regional Approach panelists identified the following major challenges to strengthening ocean literacy:

Acquiring increased and sustained funding for ocean sciences education, to include the development and implementation of a successful public awareness campaign.

- Encouraging the passage of the NOAA Organic Act, which will enhance all areas of NOAA's funding, but specifically education and outreach.
- Improving communications strategies among scientists, educators, decision makers, and the general public relative to the importance of their research data to every individual's life.
- Maintaining a common ocean sciences education focus among ocean, coast, and watershed (to include the Great Lakes) groups with similar research missions—i.e., academia, government agencies, organizations, nonprofit organizations, professional societies, business and industry, and aquariums, museums and science centers; and the varied audiences who need to be aware of and understand these findings—i.e., decision makers, the media, teachers, students, and the general public.
- Evaluating and assessing enhanced ocean literacy among local, regional, and national audiences.
- Determining the best mechanism to use so all stakeholders understand and support a regional approach to ecosystem management.

Moderator
Dr. Sharon H. Walker, *Administrator/Education Director, University of Southern Mississippi, J.L. Scott Aquarium*

Scott Marine, *Education Center and Aquarium and MS-AL Sea Grant Consortium*

Introduction
David Sampson, *Deputy Secretary, U.S. Department of Commerce*

Panelists
Dr. Dana Sitzler, *Alaska SeaLife Center-Ocean Observing Systems (OOS)*

Dr. Paul Sandifer, *NOAA Oceans and Human Health Initiative (OHHI)*

Mr. Jerry Enzler, *National Mississippi River Museum & Aquarium and Coastal Ecosystem Learning Center*

Mr. Craig Strang, *University of California-Berkeley and Centers for Ocean Sciences Education Excellence (COSEE)*

Opportunities

The Regional Approach panelists identified the following major opportunities for enhancing ocean literacy:

- Serving as liaisons and facilitators at the local, state, regional and national levels—on behalf of all audiences' needs from the cradle to the grave—to better understand the role of the world's ocean, coasts and watersheds (to include the Great Lakes) in serving as the cornerstone of life as we know it on this planet.
- Engaging additional scientific disciplines in professional development programs for formal and informal educators, as well as traineeships for undergraduate and graduate students.
- Recognizing and promoting the economic importance of the ocean sciences, technology, and education within the United States and the need to identify gaps and develop programs to maintain a competitive and ethnically diverse, healthy workforce.
- Understanding and better predicting how the condition of the oceans, coasts, and watersheds affects human health, and providing this information to resource and public health managers, decision makers and the general public to maximize health benefits and reduce or eliminate health risks.
- Continuing the ocean sciences education proactive involvement with the two subcommittees of the Interagency Committee on Ocean Science and Resource Management Integration—i.e., the Joint Subcommittee on Science and Technology and the Subcommittee on Integrated Management of Ocean Resources.

Recommendations

Strengthen regional networks.

- Leverage and engage audiences involved in regional programs (e.g., IOOS, OHHI, COSEE, and GOMA) to focus on regional issues, from nutrient loading and hypoxia, to water quality, habitats, wetlands loss, and natural hazards (such as hurricanes, tornadoes, erosion, and flooding).
- Continue to increase and promote ocean, coast and watershed (to include the Great Lakes) coordination and collaboration among the public and private sectors, states, regions, scientists, formal and informal educators, and federal agencies.

Develop coordinated messages.

- Develop and implement a coordinated public awareness campaign, focusing on the relevance of the world's ocean, its coasts, and watersheds (to include the Great Lakes) through various approaches—i.e., the media (print, radio, and television), web sites, and electronic clearing houses.
- Evaluate and develop and/or revise curricular materials, based on sound science, and align these resources with the *Essential Principles and Fundamental Concepts of Ocean Literacy*, state standards, and the National Science Education Standards.

The Regional Approach to Ocean Literacy Panel recommended the continuation and strengthening of the opportunities outlined above and remained steadfast in its respective commitments to turning the cited challenges into achievable actions. The recommendations, offered by the CoOL attendees in their Conference Evaluations, were visionary and ambitious. And, as paraphrased in the manuscript by Walker and Chavis (2005-2006), it is only through persistent, proactive, aggressive, and dedicated leadership that ocean sciences literacy has finally been elevated to the national agenda. The CoOL participants must continue to move this action item forward, as individuals, organizations and agencies collectively working together to achieve the vision of an ocean-literate public. It is also important to be ever cognizant of the fact that education and outreach in the ocean sciences are ongoing processes, since both the ocean and the technologies used to explore and study it and, thus, our knowledge of it are continually changing.

In closing, quoting Walker and Chavis (2005-2006): "There are no singular, simplistic solutions for enhancing ocean sciences literacy in this country. Only carefully considered, multiple proactive education and outreach strategies with sustained funding will lead to substantive improvement in our world's ocean. Clearly, the security of our Nation is directly tied to what we know, and what we do not know, about the ocean. The ocean acts as a connection among nations and provides the medium to start a dialogue to increase an international awareness and understanding among all people as our common global heritage and the critical role it plays in our everyday lives. A part of the solution to enhancing ocean science literacy should be fairly simple...that all of us, working in partnership, lie at the heart of these very vital connections and communications."

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Behind the Lens: A Media Perspective on Ocean Literacy

Moderator
Dr. Ellen Prager,
President,
Earth2Ocean, Inc.

Lucheon Panel
Mr. Bill Blakemore,
ABC News

Ms. Cheryl Lyn Dybas,
NSF and Freelance Journalist

Mr. Mark Bauman,
National Geographic Society

Today, more than ever, an increasing diversity of media outlets offer a powerful tool to improve the public's ocean literacy and awareness of the importance of the ocean and its relevance to everyday life. The panel of distinguished speakers for this session was asked to provide the conference participants with their perspectives on the challenges and opportunities that media outlets offer with regard to ocean literacy. As the panel represented years of exceptional service covering science and environmental issues in radio, television, and print and now online, the presenters were also asked to provide specific advice based on their experiences. The entire session was replete with excellent suggestions and enlightening commentary.

Panelists

Dr. Prager opened the session with a brief look at where the public gets its science and technology information, citing a 2004 NSF survey that found that most people look to television, then newspapers and magazines. However, if a topic is of interest, people will now principally go the Internet for further information. Dr. Prager offered that one of our challenges, as well as opportunities, is to make ocean science relevant to everyday life. She also suggested that while many journalists are interested in covering ocean topics, it is often their editors or producers who make the final decision; thus, the community must engage them as well. Dr. Prager wrapped up her presentation by stressing that most people watch their local news for the weather. Thus, a group with whom she interacts, StormCenter Communications, is working with local meteorologists, as well as The Weather Channel, to incorporate environmental topics into their programming.

Speaking next, Mr. Blakemore began by explaining that it is not the job of a professional journalist to be a propagandist—even if the cause is to save the world or to save the ocean. If people are destroying the world's ocean, it is his job to report that, no less than to report efforts and ideas there may be for saving it. The professional journalist aims neither to "give people what they want to hear" nor to "give people what the journalist thinks they ought to hear." The first is not news, and the second is just propaganda. Rather, the journalist's job is to try at every deadline to give people what they agree, once they learned it, was good for them to learn. He noted that complaints that TV journalists "just deal in soundbites" are silly: in print media they are called quotes. Concise communication is the goal in journalism, no less than in good conversation. Thinking in headlines and compelling phrases has always served a vital role. It's the journalist's job to get scientists to speak clearly, free of jargon, so the public can understand the information being communicated.


Dr. Ellen Prager and Bill Blakemore.

Mr. Blakemore reported that though large important stories sometimes take a while to "catch on," there really comes a moment of "critical mass" of public interest when the story finally catches fire, as seems to be happening now with global warming. He said both journalists and scientists need to work more diligently at assessing, and then reporting, when findings are and are not controversial. He noted that "all criticism must always be listened to, but it must also be judged," and that lately journalists have failed to bother to check the often groundless criticism of global warming skeptics. He also said that many scientists are fascinating, passionate people. As in any profession, the great ones shine through, especially when they present confirmable, refutable but still unrefuted findings. Mr. Blakemore noted that people who are passionate about and concerned with the story itself, and the journalists who are really serious about being good professional journalists, usually find each other.

Ms. Dybas was the next panelist to speak. She observed that to get news coverage, it is essential to relate science to what is familiar to people. Readers may be asking, "How can research help me personally?" She noted that when working on ocean stories, it may be useful to continually ask: Who is my audience? Ms. Dybas suggested that the best hope of capturing the mass public's attention is with news related to health, consumer products or other developments that impact our daily lives. And, when constructing a story, it is useful to remember that journalists turn the structure of a scientific paper or presentation essentially upside down. In a news story, the conclusions always come first. She also noted the importance of publication in a peer-reviewed journal, because then the research has been vetted. If the information is published elsewhere, journalists will often go on to other sources. In conclusion, Ms. Dybas made a strong plea that public science stories need to be direct and short and should contain minimal jargon.

Studies show a clear relationship between a story's length and the number of reads or hits it gets. Mr. Bauman began by noting that in communicating science, wonder is at the base of everything he and National Geographic do or try to do. He suggested looking for teachable moments and "bringing people into the tent." Such popular movies as "March of the Penguins" can be used to bring people into the tent to create moments to teach about the ocean, climate, or other related events. Mr. Bauman noted that a variety of media forms can be used to reach different audiences and age groups. For instance, on television (PBS), he may reach an older audience, but related pieces that go on broadband online can get a million and a half hits on a single story. Online stories also have a long shelf life and are often viewed long after they were first posted. He also suggested the importance of creating an empathic connection with the audience (e.g., Critter Cams). Mr. Bauman wrapped up by revealing that National Geographic and other media organizations often have the broad science or the editorial content for a story, but lack images. If science teams are in the field or have access to images associated with stories, such as climate change or fisheries issues, these organizations need them and will use them.

A few more words of advice came from the question-and-answer session. Panelists told participants not to shy away from controversy, doom and gloom, or bad guys. If it's real, say it and get it out there fast. They also suggested that just talking about the problems is not effective: we must provide solutions as well. It was noted that a key to successful media relations is for scientists to form relationships with journalists, particularly journalists whom they learn to trust and with whom they work well. Regarding politics, it was suggested that scientists best serve policy debates if they stick to the science, and that this does not preclude speaking out forcefully when scientists think nonscientists are failing to perceive critical findings. In conclusion, the panel stressed that with so many media outlets for news and information today, more content is needed; relevant, meaningful ocean stories can provide some of that content and help improve ocean literacy.

Recommendations

Make it relevant to people's lives. Specify the relevance of ocean science and issues to everyday life when pitching related stories to the media. Specifically identify your target audience and make a connection to their interests and concerns. Some examples are health, weather, consumer products or the economy. Popular movies and subjects can also be used to obtain the public's attention and create teachable moments.

Speak their language. When working with journalism professionals, think in terms of soundbites, headlines or compelling phrases. Ocean science stories for the public should begin with the conclusions and be direct, short, and jargon-free. Show your passion for research or a topic in interviews.

Provide imagery. Media outlets are often looking for imagery that field teams or researchers may have. Contact representatives directly and offer images or inquire regarding what types of products they are seeking.

Stick to the science. Scientists can best serve policy debates by sticking to the science and explaining if results or research has been misrepresented. Don't shy away from controversy, doom and gloom, or the bad guys if they truly exist. Assess when controversy exists or doesn't exist, and make this clear in comments. Along with reporting problems, be sure to suggest solutions.

Invest in messaging. A growing diversity of media outlets offers great potential to improve ocean literacy; however, additional effort and resources are needed to take full advantage of the opportunities. Look to use a variety of outlets to reach different audiences over different time spans. Engage producers and editors as well as journalists or reporters, for they may decide what stories or topics will be covered.

Section III.
Regional Workshop Executive Summaries

Regional workshops were held at five sites in California, Mississippi, Maryland, Iowa and Illinois. Following are the executive summaries of these efforts. Full reports can be found at www.NMSFocean.org.

Aquarium of the Pacific *Long Beach, CA*

As part of the national CoOL, the Aquarium of the Pacific hosted a simultaneous event in Long Beach, California. The California conference brought together 119 participants representing academia, aquariums, museums, science centers, media, federal and state government officials and staff, industry, nonprofit organizations, foundations and other stakeholders with an interest in environmental literacy. Attendees discussed the *Essential Principles and Fundamental Concepts of Ocean Literacy*; suggested strategies for achieving ocean literacy; and outlined the current challenges and opportunities facing the Nation and California for educating schoolchildren and the general public to make informed and responsible decisions about the ocean and its resources.

"The ocean literacy movement is evolving and needs many partnerships and political influence to achieve tangible results."

After watching satellite broadcasts of the national conference, the participants convened in smaller groups for panel discussions and "brainstorming." The conference added a regional perspective to the topics of the national conference, focusing on raising Californians' awareness and understanding of how the ocean affects them and how they affect the ocean no matter where they live.

Many challenges and opportunities are involved in achieving the goal of an ocean-literate citizenry. Insufficient funding, lack of direct public interaction with the ocean, overtasked teachers and underdeveloped ocean science curricula are just a few of the examples of challenges for the ocean literacy movement. Conference participants worked together to transform these challenges into opportunities by developing practical recommendations on how to expand ocean awareness for the general public, K-12 students, and teachers. Participants suggested immediate and ongoing recommendations:

- *Form strategic partnerships and collaborations with important and relevant organizations.* Work with groups, such as the California Ocean Communicators Alliance, Southern California Wetlands Recovery Project, NMEA, Southwest Marine and Aquatic Educators Association, COSEE, California Ocean Protection Council, and nonprofit organizations with a commitment to free-choice learning. Strengthen partnerships between formal and informal education entities.
- *Convey consistent messages about the ocean.* Use a common list of ocean literacy resources to develop and deliver unified messages about the ocean to link nonprofit organizations, elected officials and the voting population.
- *Influence the Education and Environment Initiative (EEI) program.* Become informed about and work with the State of California's EEI program to ensure ocean literacy is highlighted in that effort.
- *Increase interest in science, technology, engineering and math (STEM).* Use environmental literacy to inspire students to improve their educational performance in STEM fields and lead them to pursue related careers.
- *Become a storyteller.* Make the ocean more personal and create a sense of excitement by telling stories about marine animals, biodiversity, shifting baselines and climate change, so as to create a better understanding of each person's role in nature.
- *Inform the public about the economic benefits the ocean provides to the State of California.* Californians love their beaches. Use beach stories as a starting point, with the final chapter stressing that California has the largest ocean economy of any state in the Nation. In the year 2000, industries along the California coast generated $43 billion and provided 408,000 jobs.
- *Rate the performance of state and local governments.* Conference participants should unite once a year to create a report card to rate the state and local governments' ecosystem management performance as a protector of the ocean's vast ecosystem and as a funder for its protection and restoration of watersheds.

- *Engage the media.* Increase coverage of environmental literacy and its messages by tailoring the stories to fit media requirements. The media is not a public relations agent of any movement, but is always looking for relevant and exciting stories.
- *Incorporate overfishing into ocean literacy programs.* Fish are one of our most important marine resources, and overfishing is one of ocean management's greatest challenges.
- *Connect inland communities to the ocean.* Develop explicit messages for inland communities to instill a sense of relationship to and interdependence on the ocean.
- *Give children and adults hands-on experiences.* Take them to affected sites as part of formal and informal education programs. These experiences will give them opportunities to see the deterioration as well as the positive aspects of their environment. Encourage all to learn how to live in harmony with nature.

It has been pointed out nationally and in many sectors that California is playing a leadership role in ocean governance and management. Governor Arnold Schwarzenegger's response to the U.S. Commission on Ocean Policy was among the most creative and assertive in the Nation. The legislature's education and environmental initiatives have become an important model for the Nation, and California's universities are leading the effort to support such initiatives throughout the state. The formation of California's Ocean Policy Council, with appropriation of necessary funding and the recent designation of a series of marine-protected areas along the central coast, are other examples of leadership.

The ocean literacy movement is evolving and needs many partnerships and political influence to achieve tangible results. This was very evident as this conference progressed. Implementing the above recommendations is a key component toward cementing California's leadership in the environmental literacy movement. Conference participants and others can create opportunities to increase the public's (from preschoolers to grays) knowledge about and understanding of the state of the ocean and its needs. As a result of concentrated, collaborative, well-funded efforts people will become connected to the ocean as never before and will steward this resource for the generations to come.

J.L. Scott Marine Education Center and Aquarium *Ocean Springs, MS*

THE UNIVERSITY OF SOUTHERN MISSISSIPPI
J.L. SCOTT MARINE EDUCATION CENTER

The J.L. Scott Marine Education Center and Aquarium (MEC&A), formerly located in Biloxi, Mississippi, was devastated by *Hurricane Katrina* on August 29, 2005. The Interim MEC&A is located in Ocean Springs at the Gulf Coast Research is administered by the University of Southern Mississippi. The 35 attendees of the Gulf of Mexico regional CoOL represented Gulf State scientists, educators, media, academia, marine laboratories, and federal and state government agencies.

The regional CoOL agenda is located on pages 15-18 of the detailed Regional Report, which can be found at http://www.nmsfocean.org. The Agenda incorporated sessions via satellite downlinks from the national CoOL event in Washington, DC. To better meet the needs of the citizenry within the Gulf of Mexico, the Downlink Regional CoOL Agenda scheduled well-known regional facilitators to lead the discussions following seven, live sessions, as delineated in the agenda (page 17). The Gulf of Mexico participants were so favorably impressed with messages from the panelists with national perspectives, that only the Informal Education: Creating an Ocean-Literate Society was facilitated by Dr. LaDon Swann, Director of the MS-AL Sea Grant Consortium, following the national, Informal Panel presentations. However, all Scott Aquarium Downlink participants actively participated in the discussions concerning Opportunities, Challenges, and Next Steps/Recommended Actions for each Panel. Several Downlink participants also sent questions to various panelists at the national CoOL event.

Regional Opportunities

The participants in the Gulf of Mexico CoOL identified the following regional opportunities for enhancing ocean literacy:

- Creating a national/regional campaign, utilizing weather reports for ocean messages.
- Maintaining the momentum.
- Strengthening ocean literacy lessons and activities within the Gulf of Mexico Alliance. Hurricanes have given the Gulf of Mexico the most "teachable moment" to emphasize and teach many aspects of hydrology, geology and biology. Natural disasters provide a unifying theme for all the Gulf States.
- Promoting increased visits to aquariums, museums, and science centers for experiential learning through living and static exhibitry.
- Seeking methods for incorporating ocean curricula into K-12 education.
- Providing additional, experiential learning through internships and mentoring.
- Developing and implementing college-level and graduate, interdisciplinary "Certification in Ocean Studies," to include science, economics, history, law, policy, creative writing, math and geography.

Regional Challenges

The participants also noted the following regional challenges to expanding ocean literacy:

- Increasing and sustaining ocean sciences education funding at the local, state, regional and national levels.
- Reaching the general public, students and teachers located inland. It is difficult enough to reach coastal audiences.
- Providing and disseminating a coordinated message to teachers, students and the general public.
- Embracing the relevance of the ocean, its coasts and watersheds in K-12 students for career choices.
- Keeping an ocean focus.
- Striving to be more efficient with limited resources.
- Making web sites more current and user friendly.
- Ensuring educational resources are effective and based on sound science.
- Augmenting teacher participation in planning activities.
- Evaluating and assessing education and outreach initiatives.
- Encouraging the passage of the NOAA Organic Act.

Next Steps/Actions

The Gulf of Mexico Regional Downlink participants at the Scott Aquarium agreed that the next steps are turning the challenges into actions by being more proactive, aggressive and tenacious, individually and within each participant's organization and/or agency.

Evaluations

The Attitudinal Achievement Evaluations were administered to each participant, using a Likert-scale evaluation, with rankings of each panel as being Very Valuable, Valuable, Average Value, Limited Value, and Very Little Value. The interpretation of these data analyses revealed the following perceived values by the Scott Aquarium Downlink participants:

- **Creating an Ocean-Literate Society: A National Perspective**
  77% Very Valuable and 23% Valuable
- **Ocean Literacy: The Link to Economic Vitality**
  82% Very Valuable and 18% Valuable
- **The Keynote Luncheon - The Power of the Ocean**
  90% Very Valuable and 10% Valuable
- **Ocean Literacy: What You Need to Know**
  78% Very Valuable and 22% Valuable
- **Formal Education: Creating an Ocean-Literate Society**
  80% Valuable and 20% Average Value
- **End of the Day (June 7) Wrap-up**
  56% Very Valuable, 22% Valuable, and 22% Average Value
- **Live from the Mediterranean: A Conversation with Bob Ballard**
  62% Very Valuable and 38% Valuable
- **Informal Education: Creating An Ocean-Literate Society**
  77% Very Valuable and 23% Valuable
- **Behind the Lens: A Media Perspective on Ocean Literacy**
  70% Very Valuable, 15% Valuable, and 15% Average Value
- **Ocean Literacy and Education: Building an Innovative Workforce through Diversity**
  47% Very Valuable, 38% Valuable, and 15% Average Valuable
- **Regional Approaches to Ocean Literacy**
  92% Very Valuable and 8% Valuable
- **Informal Education: Creating an Ocean-Literate Society - Scott Aquarium**
  71% Very Valuable and 29% Valuable
- **Summary and Wrap-up**
  50% Very Valuable, 30% Very Valuable, 10% Average Value, and 10% Limited Value

Conclusions

This Regional Downlink is helping to achieve the tasks of the *U.S. Ocean Action Plan* as delineated by Rom et al. (2005-2006) by:

- increasing coordination and promoting collaboration;
- ensuring a coordinated education and outreach message;
- ensuring that data collected through ocean and Earth observations are translated into usable forms for teachers, students and the general public; and
- assessing the current and future ocean workforce.

John G. Shedd Aquarium *Chicago, IL*

Conference Overview

The John G. Shedd Aquarium in Chicago, Illinois, hosted the Great Lakes Regional Conference on Ocean Literacy on Thursday, June 8, 2006. Approximately 60 Great Lakes professionals participated in the one-day conference. Participants came from Illinois, Indiana, Wisconsin, Ohio, Michigan, and Canada. Conference attendees represented numerous organizations and agencies, including Sea Grant, NOAA, Brookfield Zoo, Chicago Botanic Garden, the U.S. Environmental Protection Agency-Great Lakes National Program Office, Illinois Department of Natural Resources, DuPage County Forest Preserve and The Field Museum.

The meeting agenda incorporated sessions via satellite downlinks from the Washington, DC., conference, including "Creating an Ocean-Literate Society: A National Perspective," "Understanding Ocean Literacy," "Informal Education" and "Regional Approaches to Ocean Literacy." In addition, two on-site panels focused on two Great Lakes topics: "Great Lakes Informal Education" and "Great Lakes Network and Community Building."

"Many participants expressed the need for more teacher training and development opportunities related to marine and freshwater science."

On-Site Panels

The "Great Lakes Informal Education" panel featured six speakers: Stephanie Smith, Alliance for the Great Lakes, Education Programs Manager; Daryl Rizzo, Shedd Aquarium, Assistant Director of Education; Betty Kay Swanson, Shedd Aquarium, Public Programs Manager; Kim Swift, Indiana Dunes National Lakeshore, Education Programs Manager; and Jim Lubner, Wisconsin Sea Grant and COSEE Great Lakes, Education Coordinator and Water Safety Specialist. Informal Education panelists were asked to respond to three questions or discussion points:

1. How is your organization or agency currently contributing to Great Lakes/Ocean Literacy?
2. What are the greatest opportunities you see for advancing Great Lakes/Ocean Literacy?
3. What is your "Big Hairy Audacious Goal" for Great Lakes/Ocean Literacy?

The "Great Lakes Network and Community Building" panel featured five speakers: Jill Ryan, Great Lakes Aquatic Habitat Network and Fund, Director; Derek Stack, Great Lakes United, Executive Director; Cathy Green, Thunder Bay National Marine Sanctuary, Education Coordinator; Chris Grubb, National Wildlife Federation, Great Lakes Water Resources Coordinator; and Joyce Coffee, Chicago Department for the Environment, Program Director for Natural Resources and Water Quality. Panelists were invited to provide a brief overview of their organizations and contributions to Great Lakes advocacy and stewardship. They were also asked to respond to two questions:

1. How do you make the Great Lakes relevant to your constituents?
2. What is the one thing that you would tell your constituents to do to help protect the Great Lakes?

Small Group Discussions

Time was set aside to discuss and share ideas specifically about the *Essential Principles of Ocean Literacy,* because of their significance to the ocean literacy movement and the valuable feedback this group can provide. Great Lakes educators, experts and stakeholders encounter issues and challenges that are unique to the region. This conference presented a unique opportunity for Great Lakes professionals to influence priorities and decision making at the national level.

Great Lakes conference participants were divided into four facilitated subgroups. Guiding questions were provided to the group facilitator. A member of each group was asked to take notes and record comments during the discussion. These notes were collected, collated and are presented in the full report.

Major Recommendations

Several recommendations emerged during the small group and panel discussions, as well as on the evaluations that were distributed to and collected from conference participants. Following are the most common insights and recommendations:

- Many participants expressed the need for more teacher training and development opportunities related to marine and freshwater science. Teachers need access to more programs, as well as the financial support to attend these training sessions. They also need a stronger commitment from school administrators, allowing them the time and resources needed to participate in professional development and curriculum enhancement programs.
- Great Lakes educators and communications professionals need to provide consistent Great Lakes messages and content and, therefore, should work cooperatively to develop and share effective delivery techniques and communications strategies. A Great Lakes edition of the *Essential Principles of Ocean Literacy* would be especially beneficial to educators in the Great Lakes region.
- Several participants suggested that a "Great Lakes experience" should be required for students prior to high school graduation. Inclusion of Great Lakes content in local, state and/or national science standards and curricula would necessitate a freshwater or lake experience, whether real or virtual.
- Great Lakes advocates, educators and communications professionals should foster relationships with the media and other "nontraditional" partners, such as commercial and recreational fishermen, recreational boaters, land developers and legislators, to raise awareness, garner support, and build consensus among various stakeholder groups.

National Aquarium in Baltimore *Baltimore, MD*

On June 7, 2006, the National Aquarium in Baltimore (NAIB), in partnership with Maryland Sea Grant (MDSG), served as a regional CoOL workshop site. Representatives from the mid-Atlantic region who gathered to listen to panelists presenting at the national CoOL in Washington, DC, discussed the latest research findings on motivating behavior change on behalf of "a cause," and became part of the testing and formative evaluation of Watershed Moments, a new staff-led, interactive auditorium program focused on citizen actions to preserve the Chesapeake Bay Watershed.

"An ocean-literate person understands: the essential principles and fundamental concepts, can communicate about the ocean in a meaningful way, and is able to make informed and responsible decisions regarding the ocean and its resources."

The planners of the Baltimore workshop approached the ocean literacy challenge from a regional watershed perspective. As defined by the Ocean Literacy Campaign, *"an ocean-literate person understands: the essential principles and fundamental concepts, can communicate about the ocean in a meaningful way, and is able to make informed and responsible decisions regarding the ocean and its resources."* Principle #6, "The ocean and humans are inextricably interconnected," speaks to the general public in ways that touch their everyday lives.

For this regional workshop, colleagues from the region with a shared interest in education and behavior change were invited to become part of a local and focused effort to test long-term measurement of behavior change. Evaluation experts from the Institute of Learning Innovation (ILI) provided a workshop on the field of human behavior change and methodology to measure "intent" to change. This workshop should be of great interest to all our colleagues as they look toward the major principles of ocean literacy, particularly our role in communicating principle #6. Participants in the workshop committed to continued work as a team, and plans are underway for a follow-up workshop in 2007.

Group Recommendations and Follow-up Action Items

Recommendations:

- Engagement and coordination of a broad community of information providers are essential.
  - Effective partnerships grow capacity and reach.
  - Effective partnerships are based on mutual respect and shared goals.
  - Success will require that partners build synergistic capacity.
- A successful approach must consider the communities we want to reach. By definition these must be engaged productively and at the right time.
  - We should think broadly about the communities of interest and challenge ourselves to think of the key social and cultural networks that might be engaged.
  - Effective engagement should also include business and economic interests, particularly those who can benefit from a greater stewardship ethos
  - Engagement should seek to create individual leaders who can catalyze interest and action within their communities. Leadership extends from local to broader scales.
  - We should seek effective ways to empower leaders with the tools that will help them develop viable partnerships and networks.
- Success will require a portfolio of effective actions that are customized for specific audiences.
  - To be effective, scientifically credible actions must be developed in a manner that resonates within the cultural, social and economic context of the individual and community of interest.
  - To be effective, actions must find support at both the individual and the community levels.
  - Effective actions leading to behavior change must be linked with short- to long-term assessment tools based on well-defined metrics.

Follow-up Actions

- The "Chesapeake Literacy" Working Group: The principal participants in the workshop (NAIB, MDSG, ILI, and EarthEcho) agree to form a partnership and work together to catalyze a new network of information providers. Each participant brings a unique capacity to the partnership, and each is tied to a series of important communities of interest. Follow-up meetings of the working group will occur in the last quarter of 2006 and will focus on identification of other key partners as well as items noted below.
- Defining "Communities of Interest": The Working Group will develop a detailed list of communities of interest. These will include those with a traditional "watershed interest" but also those that extend to the urban, suburban and agricultural areas so important to Chesapeake Bay. In addition, we will seek participation from social and economic net works and communities of faith with interest and a willingness to engage.
- Defining Potential Behaviors to Target: The Working Group will develop a series of actions that individuals and their communities can take to build watershed stewardship. To be effective, these actions must be coupled with assessment mechanisms that provide clear metrics of success and affect the problems facing the watershed.

Planning a Broader Meeting: The Working Group will plan and implement a larger meeting to build networks, define actions and target communities on a regional scale. A primary goal of this effort will be to develop a pilot program with appropriate assessment mechanisms that the partners can implement on a variety of scales.

National Mississippi River Museum & Aquarium *Dubuque, IA*

The National Mississippi River Museum & Aquarium is a Coastal America Learning Center dedicated to the inland waters as well as the Gulf. In that capacity, it was able to play a key role in focusing attention on the inland waters as a means to increase ocean literacy. The CoOL downlink in Dubuque was refocused to be a "Conference on Rivers and Ocean Literacy" (CORAL). The intent was to draw attention to the interplay between rivers and the ocean, and in particular the Mississippi watershed of 31 states and the Gulf of Mexico.

The Dubuque sessions were attended by more than 70 people who listened to the national speakers from Washington, DC, and participated in discussion groups to develop a strategy for the Mississippi and the Gulf. Conferees included museum educators and administrators from 24 museums along the Mississippi River, as well as scholars, K-12 educators, city and county elected officials, religious organizations and environmental advocates.

"The rivers and the ocean are interconnected, and the activities in the Mississippi River watershed have enormous import for the future of the Gulf."

Connection of Rivers to the Ocean

The rivers and the ocean are interconnected, and the activities in the Mississippi River watershed have enormous import for the future of the Gulf. Each day the Mississippi pours millions of cubic feet of water into the Gulf. This water contains alarmingly large amounts of nutrients, which run off from agricultural, municipal and private homeowner activities in the watershed. Heavy rains push pesticides and chemical fertilizers into streams that flow into the Mississippi's main stem and ultimately into the ocean. This nonpoint-source pollution feeds the algae in the Gulf of Mexico, causing algal blooms. The ensuing decomposition of the algae depletes the water of much needed oxygen, resulting in a hypoxic zone. Larger animals swim away, and smaller invertebrates die. The Gulf of Mexico dead zone is caused, in large part, by how people in 31 states use and abuse their rivers and the adjacent land.

There are other important issues beyond excess nutrients. Coastal erosion has made the coastal cities much more prone to hurricane damage. The sediment plume of the Mississippi is evident in the Atlantic Ocean all the way to the coast of Georgia. Chemicals such as mercury that run from rivers to the ocean affect the health of fish and the people dependent upon those fish for sustenance. Habitat loss, including the loss of wetlands and saltwater marshes, affects the fish, animals, and people who live along the coasts.

Some of the biggest challenges are conflicts of use. Which user group has precedent? Fishermen? Boat enthusiasts? Transportation companies? Wildlife?

Challenges and Barriers to Ocean Literacy

- *Lack of awareness.* People are unaware of the issues and their solutions. A National Geographic Poll on rivers (Penn, Schoen & Berland Associates, 2001) shows that while more than 90 percent of adult Americans want to get involved in clean water efforts, 60 percent don't know where to go to obtain more information about river protection and conservation, and 35 percent express the sentiment "I don't know how I can help."
- *Lack of funding.* Insufficient resources are affecting both the informal educators, such as museums and nature centers, as well as the schools with limited funds for field trips and enrichment activities. An experience directly with nature or in a museum setting with an effective exhibit or education program can be life changing. Without financial resources, children and families will not have exposure to the natural world, nor hands-on or immersive learning and life-changing activities.
- *Competition for time and interest.* A majority of Americans (53 percent) say that the first or second most important reason they are not involved is that they simply do not have enough time (Penn et al). The popularity of electronic entertainment is at an all-time high. People are tuned in to their Internet, their iPod, and their television, with little desire to learn about the hydrological cycle or to learn "one more thing" about how to live their lives. But these

barriers can be overcome, both by exposure to real experiences in museums and aquariums, and by utilizing the electronic media as an ally in the dis semination of ocean messages.

- *Conflicting or inconsistent messaging.* Action is needed locally, but needs to be repeated many times throughout the Nation. Concise, consistent messages need to be developed to maximize the communication and educational efforts.

Next Steps for the Region: Ocean Literacy through Informal and Formal Education

- *Use the network of 58 museums to reach 10 million people with a life-changing exhibit.* The conferees were surveyed to determine next steps. The top priority cited by the group was to use the network to develop a life-changing exhibit about the Mississippi River and the ocean. This Rivers to the Sea exhibit can address ocean literacy on a regional or even national scale, and can travel to major museums as well as smaller sites.
- *Use the network of environmental organizations to reach millions of people.* Thirty-five environmental organizations on the Mississippi are working on a multi-year effort to establish restoration targets for land, water and people and to communicate the message of the Mississippi and the Gulf to a wide national audience. This effort can greatly increase ocean literacy
- *Use an emerging network of community foundations to promote action locally.* More than 20 community foundations on the Mississippi are coordinating their efforts to address issues of the Mississippi River. These foundations, from St. Paul to New Orleans, are looking to fund programs within their communities that affect the health of the Mississippi and the Gulf.
- *Continue to provide rich life-changing experiences.* The museums and other groups are already reaching a large audience with life-changing experiences. These can be coordinated so that the experiences collectively build upon one another and reinforce the consistent messaging
- *Develop innovative outreach activities to families.* This can include storm drain stenciling, river cleanups, awareness festivals, special tours and other community activities that engage families directly with the environment.
- *Foster the efforts to teach river and ocean literacy informal education settings.* The conferees support state and national efforts to teach river and ocean literacy in school.

Appendix I. Steering Committee and Working Committee

Steering Committee

Dr. Sue Cook
Consortium for Oceanographic Research and Education

Dr. Matthew Gilligan
Savannah State University

Dr. Gerhard Kuska
Council on Environmental Quality

Ginger Potter
U.S. Environmental Protection Agency
Office of Environmental Education

Dr. Ellen Prager
Ocean Research and Resources Advisory Panel

Dr. Jerry Schubel
Aquarium of the Pacific

Robert Sullivan
Smithsonian National Museum of Natural History

Adm. Dick West
Consortium for Oceanographic Research and Education

Dr. Gerald Wheeler
National Science Teachers Association

Working Committee

Dr. Sharon Walker, Chair
The University of Southern Mississippi–Scott Aquarium

Lori Arguelles
National Marine Sanctuary Foundation

Dr. James Elder
Campaign for Environmental Literacy

Dr. Marlene Kaplan
National Marine Sanctuary Foundation

Paula Kenner-Chavis
NOAA Office of Ocean Exploration

Louisa Koch
NOAA Director of Education

Sarah Schoedinger
National Marine Educators Association

Appendix II. Conference Agenda

Conference on Ocean Literacy

June 7 - 8, 2006
Ronald Reagan Building
Washington, DC

June 7

9:00 – 10:30 Creating an Ocean-Literate Society: A National Perspective
High-level speakers, including members of the Administration and Congress, will address the importance of ocean literacy to our Nation.

James L. Connaughton, *Chairman, Council on Environmental Quality*
The Honorable Thad Cochran, *U.S. Senate*
Mr. Jean-Michel Cousteau, *President, Ocean Futures Society*
Mr. Tom Luce, *Assistant Secretary, U.S. Department of Education*

10:30 – 10:45 Break

10:45 – 12:00 Ocean Literacy: The Link to Economic Vitality
Government, academia and industry representatives will underscore the value of ocean literacy to the Nation's economy.

The Honorable Gene Taylor, U.S. House of Representatives
The Honorable Lynn Scarlett, Acting Secretary, U.S. Department of the Interior
Mr. Benjamin H. Grumbles, Assistant Administrator, U.S. Environmental Protection Agency
Dr. Rita Colwell, Professor Emeritus, University of Maryland
Mr. Ray Ban, Executive Vice President, The Weather Channel

12:15 – 1:45 Luncheon Keynote: The Power of the Ocean
Introduction: Dr. James Elder, Director, Campaign for Environmental Literacy

Mr. Richard Louv, Futurist, Journalist and Author

2:00 – 2:30 Ocean Literacy: What You Need to Know
Panelists will discuss the Essential Principles and Fundamental Concepts of Ocean Literacy.

Ms. Sarah Schoedinger, National Marine Educators Association
VADM Conrad T. Lautenbacher, Jr., Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator
RADM Richard West, Consortium for Oceanographic Research and Education

2:30 – 2:45 Break

2:45 – 4:45 Formal Education: Creating Ocean-Literate Students
Panelists will discuss the challenges and opportunities in formal education relative to getting ocean literacy into the classroom and textbooks.

Moderator: Mr. Dan Barstow, TERC
Dr. Sylvia Earle, National Geographic Society
Mr. Richard Steinke, Maryland Department of Education
Dr. Gerald Wheeler, National Science Teachers Association
Mr. Larry Snowhite, Houghton-Mifflin
Mr. Gerald A. Lieberman, State Education and Environment Roundtable

4:45 – 5:00 End of day wrap-up

Ms. Paula Keener-Chavis, NOAA Office of Ocean Exploration

June 8

9:00 – 9:45 Live from the Aegean: A Conversation with Bob Ballard
Telepresence technology will connect Dr. Bob Ballard with participants from his expedition in the Mediterranean Sea.

The Honorable Frank Wolf, U.S. House of Representatives
Ms. Kris Ludwig, University of Washington
Dr. Bob Ballard, President, Mystic Aquarium and Institute for Exploration
Dr. Steve Coan, Chief Operating Officer, Mystic Aquarium and Institute for Exploration

9:45 – 10:00 Break

Appendix II. Conference Agenda

Conference on Ocean Literacy

June 7 - 8, 2006
Ronald Reagan Building
Washington, DC

10:00 – 11:45 Informal Education: Creating an Ocean-Literate Society
Panelists will discuss opportunities to engage the public in ocean literacy through such venues as aquariums, museums and science centers.

Moderator: Mr. A. Ted Beattie, John G. Shedd Aquarium
Dr. Jerry Schubel, Aquarium of the Pacific
Dr. Paula Coble, University of South Florida
Dr. Jackie Ogden, Disney's Animal Kingdom
Ms. Julie Scardina, Sea World

12:00 – 1:30 Behind the Lens: A Media Perspective on Ocean Literacy
A keynote speaker or panel will share perspectives on using the media to create greater ocean awareness in the public at large.

Moderator: Ellen J. Prager, Ocean Research and Resources Advisory Panel
Mr. Bill Blakemore, ABC News
Cheryl Lyn Dybas, National Science Foundation and Freelance Journalist
Mr. Mark Bauman, National Geographic Society

1:45 – 3:00 Ocean Literacy and Education: Building an Innovative Workforce through Diversity
Panelists will discuss strategies to reach out to underrepresented groups, creating a more ocean-literate population, and investing in the marine sciences workforce of the future.

Moderator: Dr. Matt Gilligan, Savannah State University
RADM Fred Byus, Oceanographer of the Navy
Dr. Judith Vergun, University of Hawaii
Dr. Larry Robinson, Florida A&M University
Dr. Maria Alvarez, Professor, El Paso Community College

3:00 – 3:15 Break

3:15 – 4:45 Regional Approaches to Ocean Literacy
Panelists will discuss best practices in regional approaches to ocean literacy.

Moderator: Dr. Sharon Walker, The University of Mississippi and J.L. Scott Aquarium
David A. Sampson, Deputy Secretary, U.S. Department of Commerce
Ms. Dana Sitzler, Alaska SeaLife Center
Dr. Paul Sandifer, NOAA Oceans and Human Health
Mr. Jerry Enzler, National Mississippi River Museum and Aquarium
Mr. Craig Strang, COSEE California
Dr. Sharon Walker, Gulf of Mexico Alliance

4:45 – 5:30 Summary and wrap-up
Recommendations from the panels are presented for discussion.

Ms. Louisa Koch, NOAA Director of Education

6:00 Reception at the Ronald Reagan Building

Regional Workshops
Concurrent regional workshops on June 7 and 8 will bring the CoOL beyond Washington, DC. Five sites will view portions of the conference via satellite or web connections and will also ask participants to discuss regional coordination of ocean literacy efforts.

Aquarium of the Pacific, CA
J.L. Scott Aquarium, MS
John G. Shedd Aquarium, IL
National Aquarium in Baltimore, MD
National Mississippi River Museum and Aquarium, IA

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

CHAIRMAN

June 7, 2006

Dear Conference Participants:

It is my pleasure to welcome you to the Conference on Ocean Literacy! Through the President's Ocean Action Plan, we are taking responsible actions to make our oceans, coasts, and Great Lakes cleaner, healthier and more productive. A key part of this effort is to advance our understanding of our oceans, coasts, and Great Lakes, including promoting lifelong education. In addition to the important role of formal education from kindergarten through university in advancing our understanding of our environment, successful ocean stewardship also depends on informed policymakers and an informed public. We must work together to develop an ocean literate society.

This two-day forum presents an opportunity to discuss the essential principles of ocean literacy as well as the current challenges and opportunities in both formal and more informal, or experienced-based, education efforts. Our speakers include Members of Congress, Federal and state government officials, and representatives from aquariums, museums, science centers, media, industry, academia, non-profit organizations and foundations, and others with an interest in ocean literacy. To expand our reach, the Conference on Ocean Literacy will be viewed around the country via web cast. We have additional attendees participating via live-feed at regional sites in Baltimore, Maryland; Ocean Springs, Mississippi; Dubuque, Iowa; Chicago, Illinois; and Long Beach, California. We are putting our newest educational technologies to good use!

While this is the first gathering of its kind, this conference is just the first step in improving ocean literacy. The federal agencies that are part of this conference, together with their partners at the regional, state and local levels, play a critical ongoing role as members of the Committee on Ocean Policy in the implementation of the U.S. Ocean Action Plan and in our efforts to strengthen ocean education coordination. We encourage open and frank discussions that move us toward achieving meaningful results by facilitating a stronger foundation from which policymakers and the public can make informed, responsible decisions about the ocean and its resources.

Finally, this conference is made possible by the hard work of many people. I applaud the members of the Steering and Working Groups who dedicated their time, energy and talents to make this conference a reality. I thank you for your interest and participation in this conference. I encourage everyone to enjoy the exhibitors, speakers, and opportunities to exchange ideas as we, collectively, carry forward the ideas generated by this conference and forge a path toward enhancing ocean literacy in our country.

Yours Sincerely,

James L. Connaughton, Chairman
Council on Environmental Quality
and Cabinet Committee on Ocean Policy

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