EDUCATION FOR OCEAN LITERACY AND SUSTAINABILITY: LEARNING FROM ELDERS, LISTENING TO YOUTH

BY CRAIG STRANG

I was invited to represent the National Marine Educators Association (NMEA) as the opening keynote speaker at the International Pacific Marine Educators Network Conference in October 2008. Below is my written presentation about the history and future of Ocean Literacy.

I had the pleasure of speaking at the International Pacific Marine Educators Conference (IPMEC) in Honolulu in 2007, and so I was especially honored to be invited back to speak at the International Pacific Marine Educators Network (IPMEN) Conference in Townsville, Australia in 2008 about our efforts in the United States to define and improve Ocean Literacy. I want to thank the Conference Organizing Committee, especially the conference co-chairs, longtime NMEA member Harry Breidahl and his youthful Australian protégé, Andrew Vance. Thank you also to the NMEA for supporting the conference.

I would like to begin by sharing some of my reflections about the historic meeting in Honolulu in 2007 that I think will also provide a context for weaving together the main elements of IPMEN 2008. The theme of the conference in Australia was, "Learning from Elders, Listening to Youth," and the first two strands of the conference were titled, "Education for Ocean Literacy" and "Sustainability Education." Those four things: Elders, Youth, Ocean Literacy, and Sustainability, may each seem at first to be worthy in their own right, but disparate and almost unrelated. That is, unless you were at IPMEC 2007. You see, usually when I go to professional ocean sciences or education meetings, I fit right in. Most of the people I meet are, well, a lot like me. I'm a 47-year old white man born in the United States.

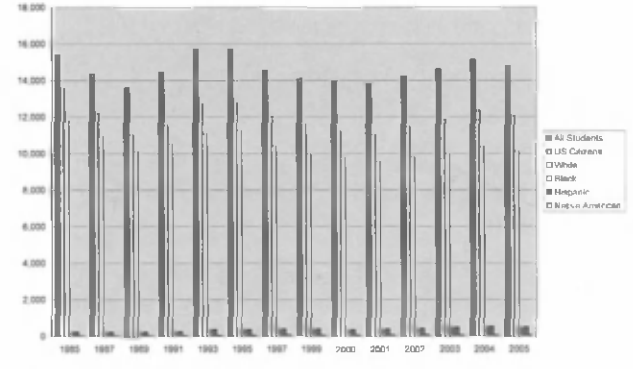
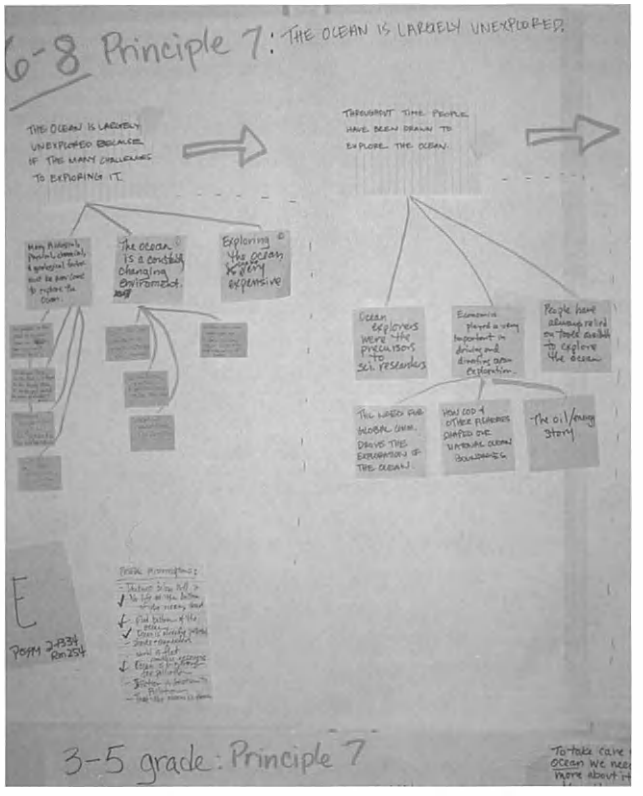


Figure 1. Graduate Enrollments in Earth, Atmospheric, and Ocean Sciences. NSF Science and Engineering Indicators 2008.



An early draft of a conceptual flow diagram in the Ocean Literacy Scope & Sequence.

Ocean sciences and ocean sciences education are the least diverse of all science disciplines. Blacks, Latinos, and Native Peoples make up only a tiny fraction of those working or studying in this field. Figure 1 shows graduate enrollments in Earth, Atmospheric, and Ocean Sciences in the U.S. from 1985-2008. Blacks, Latinos, and Native Americans are represented by the barely perceptible pimples along the base of the chart.

At IPMEC 2007, however, I was immediately struck by how many people were either a lot older or younger than I am, and by how many people had a different color skin from mine. Delegates to that meeting came from: American Samoa, Australia, Canada, Chile, Cook Islands, Fiji, Hawaii, Japan, Marshall Islands, Mexico, Micronesia, Papua New Guinea, New Zealand, Northern Mariana Islands, Samoa, United Kingdom, and the United States mainland. Accompanying the demographic diversity in the room at the Conference were also a range of perspectives, experiences, and world views that I found enriching, troubling, beautiful,

and inspiring. IPMEC 2007 inspired and profoundly embodied the theme that was chosen to carry forward to IPMEN 2008: Learning from Elders and Listening to Youth. Although I had known it before intellectually, I came to know at IPMEC in a very direct and personal way, that the work we have done in the U.S. to define and promote Ocean Literacy, represents the perspectives of a narrow band of society. It is conspicuously missing at least two things: Traditional Knowledge of the ocean; and the fast paced, lively discourse of those indigenous to the placeless age of social networking. And so, our work in Ocean Literacy is incomplete and inadequate.

Unfortunately, I think this inadequacy is more than a philosophical issue. It goes beyond our American failure to be politically correct and inclusive. I worry in fact it is our Achilles heel that ultimately could prevent Ocean Literacy from achieving our goal: to become the underpinning of a system of education that leads to sustainability. Session 1 of IPMEN 2008 addressed Ocean Literacy and Session 2 addressed Sustainability Education. The two are closely linked and one should lead to the other, but only if we get it right. I would like to suggest getting it right means that Ocean Literacy, that is, the body of knowledge representing what we think every person should know about the ocean, must represent a new synthesis of Western scientific knowledge, Traditional Knowledge, and youthful perspectives. I'll return to this point toward the end of this article, but first, I will back up a little, and review what we mean by Ocean Literacy in the first place.

The story of Ocean Literacy in the U.S. is an extraordinary one about a process that many NMEA members and hundreds of other American scientists and educators have been engaged in over the last four years to come to agreement about what we think all people in the United States should understand about the ocean by the end of high school. The process has in many ways galvanized and reinvigorated ocean sciences education in the U.S. We have reminded ourselves that the ocean is unique, inspirational, and important like no other subject. We call our work together The Ocean Literacy Campaign.

THE CONTEXT

The ocean defines and dominates everything about our planet. It is obvious to us in the field why understanding and protecting the ocean is so critical to the future health of our planet. Climate change, ocean acidification, extinction, hurricanes, tsunamis dominate the news. And, even by putting environmental concerns aside, the ocean provides over $43 billion per year to the economy in California alone. So, sometimes it is difficult for us to understand how we got to where we currently are today.

When the National Science Education Standards were published in 1996, Ocean scientists and ocean educators were dismayed that the National Standards contain almost no mention of ocean topics. As a result, none of the 50 states, which each have their own standards, include much about the ocean,

Delegates from three continents at IPMEN discuss Ocean Literacy.

coasts, or watersheds. Consequently, understanding about these ocean topics was ignored in most K-12 classrooms. There were exceptions of course, but without a coherent framework of concepts and messages, the ocean educators and ocean scientists began to realize that these topics would remain on the margins of teaching and learning about science. As marine educators, we frequently found ourselves complaining about the absence of ocean concepts in the curriculum, and we were just as frequently asked in return, "Well, what about the ocean *is* missing and what *should* be taught about the ocean." And of course, we had no consensus about what the answer should be. The absence of ocean sciences in schools resulted in a generation of Americans largely ignorant of the importance of the ocean, which in turn, has made it even more difficult to convince the adults in our school systems to insert ocean concepts into future standards.

A SORRY STATE OF AFFAIRS

How could it be that in states like California, Florida, and Hawaii, the ocean is not systematically incorporated into the curriculum? Marine education had become marginalized. When it was taught, it was often presented in a very local context: if you live in a "coastal community," then of course you might teach a little about your local area; but this resulted in an idiosyncratic presentation of ocean concepts. So, there grew a perception that marine educators were neither on the cutting edge of scientific discovery, nor on the cutting edge of innovation in pedagogy. The science education reform movement in the U.S. left marine education behind.

THE RESPONSE

Several organizations came together to address this challenge: The National COSEE (Centers for Ocean Sciences Education Excellence) Network, National Marine Educators Association (NMEA), National Geographic Society, National Oceanic and Atmospheric Administration (NOAA), College of Exploration, and Lawrence Hall of Science. We quickly developed some strategies and operating principles. In order to build the consensus we

The NMEA Past-President Lynn Whitley and Sylvia George of the Cook Islands at IPMEN 2008.

sought, we needed to be totally inclusive, democratic, and transparent. We did most of our work online. At first this was an issue of expediency because we lacked the funds to travel to meetings, but we quickly learned that the online context supported the inclusivity, democracy, and transparency of our work. And it allowed busy scientists and educators to participate asynchronously at odd hours. Most importantly, we knew there could be no institutional ownership for the product. We could not have the appearance that the content of ocean literacy had been defined to support an agenda or the mission of any agency or institution. At the same time, we knew the weight of our institutional reputations was essential to make the effort a success. So our institutions lent their names, but did not require ownership of the intellectual property. Our goal was credibility not credit.

We held a two-week online conference in 2004 on the virtual campus of the College of Exploration, attended by about 100 scientists, educators, and policy makers. The conference was followed by several more face-to-face and online meetings, resulting in hundreds of pages of text about what it is that we thought was essential to teach about the ocean. We finally summarized this into a short document and then called for a special scientific review by scientists that had not previously been involved in the process. That special review was followed by an online public review. By this time, there was nearly universal agreement about the big ideas that were included.

We came to agreement about a simple definition of "Ocean Literacy." We developed a short list of Essential Principles. Each Principle is supported by several Fundamental Concepts. The definition is: Ocean literacy is an understanding of the ocean's influence on you and your influence on the ocean. An Ocean literate person: Understands the Essential Principles and Fundamental Concepts about 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. This last element of the definition is the link between education for Ocean Literacy and education for sustainability.

The NMEA members are familiar with the Seven Essential Principles of Ocean Literacy so there is no need to repeat them here. It is notable, however, that we consciously decided that the word "ocean" will always be used in the singular form, never plural. This is to use the power of our every day language to emphasize and reinforce the scientific, environmental, cultural, and social importance of the first Principle. There is only one ocean, one interconnected body of water that all people, all living things share and depend on.

THE OCEAN LITERACY SCOPE AND SEQUENCE

Since the Essential Principles and Fundamental Concepts are ideas that students should understand by the end of high school, it is difficult for a teacher, curriculum writer, or standards writing committee to know what to include about a particular ocean concept at a particular grade span that will help to build a complete understanding for that student by the end of grade 12. So, we developed another more detailed tool, an Ocean Literacy Scope & Sequence for grades K-12 that represents a logical, coherent approach to building complex ideas. The Scope and Sequence is based upon learning theory and cognitive science and attempts to proactively address misconceptions.

For each of the seven Principles, we have described what should be taught at each grade span, K-2, 3-5, 6-8, and 9-12. If, for example, you are a second grade teacher and want guidance about what to teach about Principle 1, you would look at the Principle 1 Conceptual Flow Diagram for grades K-2. A conceptual flow diagram is a particular, specialized form of a concept map. Bigger, more important concepts are at the top, and smaller supporting or nested ideas and facts are lower down. The concepts build developmentally in an instructional sequence the way a teacher might teach them. This flow of concepts progresses from top to bottom and from left to right. At the very bottom are boxes representing connections from one principle to another. There are 28 of these conceptual flow diagrams, one for each of four grade bands within each of the seven Principles. They took over two years to create and in November 2008, underwent a large-scale online public review hosted by the College of Exploration.

ACTIVITIES AND IMPACT

The NMEA can claim credit for many of the accomplishments and outcomes of the Ocean Literacy Campaign. Many of those involved have been invited as speakers to dozens of national, state, and local conferences. Interestingly, we have been invited to nearly as many scientific meetings as education meetings. Scientists are very interested in theoretical guidance to their own education and outreach and Broader Impact work. Many major ocean science conferences now have, for the first time, education strands and speakers. This truly represents a sea change in ocean sciences education!

In addition, there have been eight special conferences in four countries entirely dedicated to discussing Ocean Literacy: Public

Ocean Literacy: What residents of Southern California should know, Long Beach, California 2005; The Conference on Ocean Literacy, Washington, DC 2006; The International Pacific Marine Educators Conference, Honolulu, Hawaii 2007; New England Ocean Sciences Education Consortium Conference on Ocean Literacy 2007 and 2008; The Japan Ocean Literacy Symposium, Tokyo 2008; Primera Feria Educativa del Océano, Chile 2008; and The International Pacific Marine Educators Network Conference, Townsville, Australia 2008. In addition, Ocean Literacy has become a common rallying point permeating throughout all the recent conferences and publications of the NMEA, as well as programs and products developed by members of the NMEA. The Ocean Literacy Campaign has become an Ocean Literacy Movement!

NOAA and the National Science Foundation have created whole grant programs (Environmental Literacy Grants and COSEE respectively) that require applicants to address the Essential Principles of Ocean Literacy. New instructional materials designed specifically to systematically teach Ocean Literacy are beginning to hit the market. The new edition of *Life On An Ocean Planet* from Current Publishing, and the Ocean Sciences Curriculum Sequence for grades 3-5 funded by NOAA, developed by Lawrence Hall of Science/COSEE California and distributed by Carolina Biological are notable examples. At the college level, COSEE California and Lawrence Hall of Science have developed a high impact, award-winning college course built around Ocean Literacy that is now being taught in over 25 colleges, universities, and informal science education institutions. The course, *Communicating Ocean Science*, is available nationally along with professional development and technical assistance from COSEE.

Several states are using the Ocean Literacy Principles and Concepts to increase ocean sciences in their K-12 standards and instructional materials (e.g., South Carolina, Georgia, Maryland, Michigan, Florida, and California).

The real impact, however, can be observed in areas that are harder to measure. The process we have been through has activated the ocean sciences and education communities in a way that I have not previously experienced in my career. In ongoing national discussions about mainstream science education related to revising standards, developing assessments, and writing new curriculum and texts, ocean sciences now has a small corner at the table. We are now included in these conversations. We still have much left to do, but at least we now have a (sea)horse in the race.

Most importantly, we have changed the way we think about the role of ocean sciences in science education. For decades, marine education was assumed to be an enrichment topic, taught by a handful of teachers with a special passion and learned only by students who were either being remediated or who had already completed the standard curriculum. The new way of thinking is that you cannot be science literate or culturally fluent unless you understand systematically how the ocean works. Ocean Literacy is comprised of ideas so essential, that if you did not understand them, you could not consider yourself to be science literate. Ocean sciences is *not* enrichment, it is, in fact, essential. You would be doing your students, even the youngest ones a disservice by not teaching them about the ocean. This thinking brings ocean sciences into the mainstream—for every child in every school.

Now I would like to return to my initial comments about the relationship between Ocean Literacy, Traditional Knowledge of the ocean, and youthful perspectives. Currently, Ocean Literacy has been unintentionally (perhaps even accidentally) defined as a Western scientific understanding of ocean systems. It is further characterized by the American value placed on a culture of exploration, so easy to confuse with colonialism, and by the Judeo/Christian ethic of stewardship; that distinctly Western approach to protecting natural resources for human consumption described in Genesis. It does not include the wisdom of Traditional Knowledge, nor is it reflective of the high speed, mixed race, metro culture of our young people. I have an increasing concern that the approach to Ocean Literacy described here will not lead us to sustainability education.

On October 13, 2008, the day I left San Francisco for Townsville to attend IPMEN, the front page, above-the-fold headline that appeared in the *San Francisco Chronicle* read: "Economy could cool fight on global warming: fear grows that curbing emissions will lose priority." Our Western scientific understanding of the *Inconvenient Truth* of climate change caught our attention for a year or two. Green became our national color in the U.S.: green energy, green technology, a whole new green economy. But then in a matter of weeks, a financial crisis threatens to make us suddenly forget our convictions. The most inconvenient truth of all, it turns out, is one that Bill Clinton, not Al Gore taught us, "It's the Economy, Stupid." This Western obsession that values standard of living over quality of life is the result of knowledge without wisdom. We need to learn from our elders who understand the importance of learning from the past, and

Joeli Veitayaki (right) from the University of the South Pacific will host IPMEN 2010 in Fiji.

we need to listen to the urgency of young people who care less about the Dow Jones today and more about the health of the planet they will inherit.

A NEW SYNTHESIS?

I am coming to think that Ocean Literacy needs to be redefined to include Traditional Knowledge and youthful perspectives about the ocean. By Traditional Knowledge here, I want to be clear that I do not mean the secret and private knowledge that indigenous people may not want to share with outsiders, but rather I mean the universal and transcendent knowledge that indigenous people wish that all people could understand—the essential things critical to sustaining the ocean and us.

PRINCIPLES OF TRADITIONAL KNOWLEDGE?

What might be some Principles of Traditional Knowledge about the ocean that would be comparable to the seven Principles of Ocean Literacy? Truthfully, I have no idea and it is certainly not my place to suggest what they might be, but I have done my best to listen closely in my few opportunities to learn from elders and indigenous peoples. I had a wise, old professor in college who used to tell me regularly, "Dare to be naïve!" So, at risk of sounding foolish, I will dare to be naïve. I am naively putting forward some ideas here not because I think they are correct, but rather to stimulate discussion about the topic. I hope these ideas receive strong reactions and considerable discussion. Here are some things I have heard, or thought I heard, related to Traditional Knowledge of the ocean:

- All living things are interconnected;
- The health of natural ecosystems depends on the interactions of people with those ecosystems;
- Natural cyclic events on land predict natural events in marine ecosystems; and
- The same species may behave and reproduce differently in different nearby locations—and so needs to be managed differently in different locations.

PERSPECTIVES OF YOUTH?

The perspectives of young people do not, it seems to me, have much to do with the content of Ocean Literacy, but rather with the process by which we approach education that leads to sustainability. Here are some things I think I hear young people telling me. They all have to do with thinking outside the box. In fact, they have to do with not even perceiving that the box ever existed:

- Race and nationality don't matter;
- Social networking and common values do matter;
- Rules and hierarchy don't matter; and
- Communications and action do matter.

These are just some examples of things I have been thinking about recently that I hope will stimulate discussion in the community of those promoting Ocean Literacy. As the success of our work extends beyond the few "true believers," I look forward to including a larger and wider and more diverse audience in that discussion. As we consider new perspectives and world views, I am confident that there is one bit of knowledge that we all hold in common. That is, of course, Principle 1: There is only one ocean. We will never get another one. I hope we will learn together to honor and care for it.

CRAIG STRANG is Director of COSEE California, Associate Director of the Lawrence Hall of Science at the University of California, Berkeley, and sits on the NMEA Board of Directors. He has been working with others on the Ocean Literacy Campaign since 2003 and is schooled daily on the perspectives of young people by his 15-year-old son.

PHOTO CREDITS

All Photos: Courtesy of Craig Strang

Figure 1: Courtesy of Science and Engineering Indicators 2008 document (NSB 08-01), accessed at http://www.nsf.gov/statistics/seind08/

RELATED BRIDGE RESOURCE PAGES:

Ocean Literacy Network (College of Exploration):
http://www.coexploration.org/oceanliteracy/

BlueFrontier: Sustainable Seas Expeditions (National Geographic):
http://www.nationalgeographic.com/seas/