Abstract #J1.4

Lessons Learned. . . Centers for Ocean Sciences Education Excellence:Central Gulf of Gulf of Mexico (COSEE:CGOM) Nonformal and Formal Education

Sharon H. Walker, The University of Southern Mississippi, College of Science and Technology, J.L. Scott Marine Education Center & Aquarium

Shelia A. Brown, The University of Southern Mississippi, College of Science and Technology, J.L. Scott Marine Education Center & Aquarium

Susan Culipher-Ross, The University of Southern Mississippi, College of Science and Technology, J.L. Scott Marine Education Center & Aquarium

Jessica Kastler, Louisiana Universities Marine Consortium

John Dindo, Dauphin Island Sea Lab

Michael Spranger, University of Florida, Florida Sea Grant College Program

Richard Tinnin, University of Texas Marine Science Institute

R. Dan Brook, Mississippi State University

Peter Tuddenham, The College of Exploration

Tina Bishop, The College of Exploration

Jean May-Brett, Louisiana State Department of Education

Corresponding Author: Sharon H. Walker, The University of Southern Mississippi, P.O. Box 7000, Ocean Springs, MS 39566-7000, email: sharon.walker@usm.edu

ABSTRACT

Lessons Learned… COSEE:Central Gulf of Mexico Nonformal and Formal Education

Sharon H. Walker, University of Southern Mississippi and J.L. Scott Marine Education Center and Aquarium, Biloxi, MS; and M. Spranger, J. Dindo, R. Tinnin, J. Kastler, S. Brown, S. Ross, R. D. Brook, T. Bishop, and P. Tuddenham

This NSF/ONR-NOPP/NOAA-Sea Grant funded COSEE:CGOM presentation will review "best practices" and lessons learned during its first two years–based on individual and collective states' program involvement with middle school teachers, research scientists, and informal educators. Implementation strategies which will be discussed include: participant recruitment, "face to face" and online graduate courses and two-day workshops, as well as teachers-to-sea, website development, and cognitive and affective formation and summer evaluations. This session will involve several, brief presentations; and oceanographic and coastal processes resource materials will be distributed.

Lessons Learned. . . Centers for Ocean Sciences Education Excellence:Central Gulf of Gulf of Mexico (COSEE:CGOM) Nonformal and Formal Education

Sharon H. Walker, Shelia A. Brown, Susan Culipher-Ross, Jessica Kastler, John Dindo, Michael Spranger, Richard Tinnin, Dan Brook, Peter Tuddenham, Tina Bishop, and Jean May-Brett

1. Project goal

The primary goal of this COSEE:CGOM effort is to strengthen ocean sciences education through the interpretation of research results for interested public, precollege teachers and their students, informal educators, and university and community college faculty and their students concerning the relevance of the oceans to our everyday lives. The COSEE:CGOM is physically located within The University of Southern Mississippi (USM)-College of Science and Technology's (CoST) J.L. Scott Marine Education Center and Aquarium (MEC&A) in Biloxi with satellite centers located within existing facilities in Alabama, Florida, Louisiana, and Texas. This project links educators, researchers, and interested public regionally and thematically, focusing on America's Sea, the Gulf of Mexico, as the vehicle to teach ocean sciences education.

2. Background and need

Over the last decade rich opportunities have been missed by the ocean sciences community in not having a proactive, nationally coordinated educational program for the benefit of our country (Consortium of Oceanographic Research and Education (CORE), 1996, Danzig and Daley, 1999; *COSEE Current* (NMEA, 2001); McManus, et al., 2000; Nowell, 2000; Walker, et al., 2000; and Walker, et al., 1992). It was also reported by Watkins (2000), "the exciting thing about the ocean is that its science is virtually *all* relevant to societal needs–quality of life, economic development, national security, education..." Based on repeated acknowledgment of these missed opportunities, in May 2000, the National Science Foundation (NSF) provided fiscal support for a

three-day COSEE Workshop–implemented by USM-CoST in Long Beach, Mississippi–involving 73 attendees representing 21states and the District of Columbia. These participants included scientific researchers, K-16 teachers, information technology personnel, underrepresented groups, informal educators, and undergraduate students. The overarching goal of the May 2000 Workshop was "to create a document that recommends strategies for the NSF and other Federal agencies to use in a nationally coordinated effort to improve and promote Ocean Sciences education in response to the opportunities by this workshop." As a result of the findings and subsequent recommendations of this COSEE Workshop, the Ocean Sciences (OCE) Division of the NSF developed an "Announcement of Opportunity." This COSEE:CGOM represents one of seven regional sites within this country.

As stated in the 2002 COSEE:CGOM proposal, this effort is a unique, thematic collaborative which is designed to deliver technology-enriched, ocean sciences education–based on "sound" science–to cadres of middle-school teachers, undergraduate students, university and community college faculty, informal educators, underrepresented groups, and interested public. The rationale used to develop this effort resides in the fact the Gulf of Mexico is the drainage basin for the largest (Mississippi River) and the fourth largest (Mobile-Tensaw) river systems in North America. This basin drains two-thirds of the land mass of the continental United States. As reported in 1990 by the Environmental Protection Agency (EPA), the Gulf of Mexico is a national treasure deserving of our time, attention, and best stewardship efforts due to the following resources it provides:

- more finfish, shrimp, and shellfish than the South and Mid-Atlantic, Chesapeake, and New England Regions combined annually;
- a shrimp fishery which is among the most valuable U.S. fisheries;

- critical habitat for 75% of the migratory waterfowl traveling the U.S.;
- half of the national coastal wetlands' total;
- one-sixth of the U.S. population lives in the Gulf Coast states; and
- 90% of the U.S. offshore oil and gas production.

The three, broad themes concerning the Gulf of Mexico on which the regional COSEE has been focusing encompass: habitats and organisms, oceanography and coastal processes, and marine technologies. These themes will provide proposed audiences an augmented appreciation and understanding of the relevance of the oceans to our everyday lives and the interconnectedness of all species on this watery planet.

This COSEE:CGOM effort includes the following, primary partners: USM-CoST-MEC&A and the Mississippi-Alabama Sea Grant Consortium (MASGC); the University of Texas' (UT) Marine Science Institute (MSI) in Port Aransas; the Dauphin Island Sea Lab (DISL) Research Consortium on Dauphin Island; the University of Florida (UF)/Florida Sea Grant College Program, the UF-Seahorse Key Marine Laboratory, the FL Department of Fish and Wildlife Conservation in Cedar Key, and the FL Museum of Natural History located on the UF campus in Gainesville; and the Louisiana Universities Marine Consortium (LUMCON) in Cocodrie. Each of these facilities is affiliated with an Institution of Higher Learning and an informal science education center and each has a documented and successful history of working with the various audiences previously discussed. Other key partners include the U.S. Navy, specifically, the Naval Meteorology and Oceanography Command (NAVMETOCCOM) and the Naval Oceanographic Office (NAVOCEANO); the National Marine Educators Association (NMEA); the National Science Teachers Association (NSTA); the Center for Educational and Training Technology, the Digital Research and Imaging Laboratory of the School of

Architecture and the NSF Engineering Research Center (NSF ERC) at Mississippi State University (MSU) in Starkville; and the College of Exploration in Potomac Falls, Virginia.

This regional COSEE will enhance the ocean literacy of the citizenry within the five Gulf of Mexico states by "bridging the gap" between ocean sciences researchers' results and the interpretation and relevance of those data for all audiences represented by the general public. Further, this proposed effort will be a continued call to action in response to a litany of dismal status reports documenting lower-than-acceptable levels of U.S. student achievement and teacher preparation in technology and science—as reported in *A Nation at Risk* (1983), *Benchmarks* (1993), the *National Science Education Standards* [*NSES*], (1996); and *The Third International Mathematics and Science Study* [*TIMSS*] (NSTA, 1996 and 2000).

The understanding of and appreciation for technology and science, specifically the oceans, is critical for this nation's citizenry. The *Pew Oceans Commission Report* (2003), indicates the U.S. coasts are "more densely populated than the rest of the country with half the U.S. population living in the one-fifth of our land area along the coasts; by 2025, demographers anticipate three quarters of the U.S. population will reside in coastal regions." The National Sea Grant College Program (Walker, et al. 1992) reported that:

> "Never before have scientific and global environmental issues influenced the actions of governments and individuals as they do today. Too few citizens, however, have an understanding of scientific principles and developing technologies—an understanding essential to help them make responsible decisions that affect their immediate environment and that influence governmental policies having global implications."

In October 2000, the Report of the President's Panel on Ocean Exploration, entitled *Discovering Earth's Final Frontier: A U.S. Strategy For Ocean Exploration,* was released

Among other characteristics of this strategic ocean science program recommended by the *Report*, "The Ocean Exploration Program should include an educational component that encompasses both formal and informal educational institutions as well as the general public. These efforts should incorporate existing programs and organizations that support marine and ocean sciences education" (p. 9).

The need for enhanced ocean sciences education is clearly recognized by the oceanographic community scientists, including classroom and informal education experts alike. A 1996 NSF-sponsored workshop–hosted by CORE–on ocean sciences and K-12 education found that

> "Oceanographic processes and features are ideally suited for constructing and demonstrating knowledge and science-based skills in the fundamental principles of science across the disciplines, including the social sciences, and over a wide range of levels of sophistication."

In the *1998 Year of the Ocean Discussion Papers*, an overview of the status of marine education stated that "nationally, preservice teaching and teacher credential programs rarely provide any special instruction in oceanography. Teaching methods courses frequently provide information about water, but rarely about the ocean specifically." Ocean and coastal studies offer abundant opportunities for relevant, exciting, and integrative technology and science education. In response to meeting the *NSES*, ocean and coastal science education are also largely untapped resources. Admiral (retired) James Watkins, former President of CORE, recognized that even though ocean sciences comprise "one perfect implementation mechanism to meet national standards," explicit references to the oceans are missing from the *NSES* (NOAA, 1998).

The *National Science Education Standards for Professional Development* (National

Research Council, 1996) concluded that effective inservice education must include: the learning of science content through inquiry; the integration of science, learning pedagogy (teaching strategies), and demonstrating science relevance to students when teaching; and the building of science understanding and abilities for lifelong learning which are coherent and integrated.

Unfortunately, many elementary and middle school teachers are inadequately prepared to teach science in grades 5-9. As a result, many teachers choose not to attempt to teach science in their classrooms, ultimately resulting in less science being taught at this level nationally. A report funded by NSF (Horizon Research, Inc., 2002) found only 25% of elementary teachers perceived themselves as qualified to teach science. Further, less than 25% of these teachers spent more than four days in science-related professional development in the three years prior to this study. Finally, only one-third of the teachers participating in professional development "indicated that they changed their teaching practice as a result" (p. 2). These concerns have all been addressed more recently in Part 3, Chapter 8 in the *U.S. Commission on Ocean Policy Report* (2004).

To address this serious concern, this regional COSEE-CGOM study is providing a sequential set of professional development opportunities to both enhance and expand the content and pedagogical competence of middle school teachers, to include involving scientists. The primary rationale in involving scientists and teachers is twofold, i.e., to provide enhanced ocean sciences content for teachers and to provide an opportunity for scientists to understand and better appreciate the precollege teaching profession and the needs of middle school teachers. Further, this effort will provide enhanced ocean sciences content knowledge for nonformal educators and the interested public in the Mississippi COSEE and the satellite COSEE facilities in each of the other Gulf of Mexico states.

Additionally, the *COSEE Workshop Final Report* (McManus, et al., 2000) and the *COSEE Implementation Steering Committee Report* (2001) both documented that improving diversity within the ocean sciences and creating a more scientifically literate citizenry requires that all educators, both formal and nonformal, be active participants. To best accomplish these goals most efficiently, outreach must occur in regions with higher proportions of underrepresented and underserved persons in science. Further, low economic status and traditionally undervalued educational systems have resulted in a population that generally does not have the capacity to understand the human impacts on the local environment. The U.S. Gulf Coast region contains significant proportions of populations considered to be underrepresented in ocean sciences and generally underserved by society. The U.S. Census Bureau (2002) data reveal the Gulf Coast states' minority populations consist primarily of two groups: Hispanics (outer portion: Texas and Florida) and African Americans (inner portion: Louisiana, Mississippi, and Alabama). As African Americans comprise the largest numbers of persons underrepresented in ocean sciences within this region, the following data are provided: these population groups are of relatively high densities along the coastal counties; importantly, a significant proportion of these demographic groups (> 30%) is under the age of 18; this result is consistent with U.S. Census Bureau projections that by the year 2020, the majority of high school-aged students will be comprised of persons from minority groups.

Impacting our population is the fact that the Gulf of Mexico states are among the most economically impoverished regions of the United States with poverty rates above the national average (U.S. Census, 2002). In particular, the state of Louisiana has the highest per capita rate of children born into poverty. The poverty in this region consists of two distinct populations: the rural and urban poor. In the states of Louisiana and Mississippi, both populations live in

proximity to the Mississippi Delta where poverty cuts across both ethnic and racial boundaries. Cities, such as New Orleans, have high concentrations of poverty as shown by the fact that >65% of Orleans Parish school children are on free or reduced lunch (Louisiana Department of Education, 2000) and 40% of the children are born into poverty (U.S. Census, 2002).

Concerns by the U.S. Department of Commerce (2000) suggest a technological underclass is developing in this country. Equally important, issues of environmental justice and racism are prevalent in the five Gulf of Mexico states. Unless proactive measures are taken to educate the underrepresented and underserved groups about their local environment, this lack of access to and use of technology will increase the numbers of underserved American citizens who will not have access to information necessary for a concerned citizenry. The partners of this effort believe if this situation continues, the population of U.S. citizens who will live their lives in poverty, with no hope for themselves and future generations will only increase.

The partners implementing this effort cannot, nor do they seek to, solve all the social problems of the Gulf of Mexico region. However, the COSEE:CGOM is positively impacting these populations. The combined efforts of these partners impact approximately 400,000 interested public annually; of this number approximately 100,000 participants are represented by precollege students. Not all of these students will become ocean scientists as adults: this is not the goal of this study. However, in a region with such low income, this regional COSEE:CGOM demonstrates to these students a future of possibilities. All of the partners in this study currently teach and will continue to teach all students about their environment with the integrated types of hands-on learning that cannot be easily accomplished in the traditional classroom.

Finally, each site also provides added value to both students and the general public since these aquariums and natural history museums provide an important, and non-intimidating

platform from which to engage the public in learning about ocean exploration, as well as demonstrating the influence the ocean has on each person's quality of life (Schubel, 2001). Through ongoing educational programs and exhibits, the Mississippi COSEE and satellite COSEE facilities are promoting a better understanding of the ocean, to include the special characteristics of the Gulf of Mexico. This increased understanding should lead to better stewardship of the ocean, the Gulf of Mexico, and ocean resources by those who visit the facilities and participate in their programs. Thomashow (1995) suggests that people are motivated to be environmental stewards not because of technical analyses regarding environmental degradation, but because they become aware of the place in which they live and the profound connection they have to this "place."

3. Objectives

This COSEE:CGOM is physically located within USM-CoST-MEC&A in Biloxi, MS with state satellite centers within existing facilities in Florida, Alabama, Louisiana and Texas. Public exhibition and research laboratory space are provided at each outreach facility, thereby allowing each satellite COSEE:CGOM to serve as a "window to the Gulf of Mexico" and to the oceans in general, so all guests can observe and interact with the science educators concerning the oceans and near-shore environments. Specific objectives related to the stated goal of this COSEE include:

- Expanding linkages between teachers, scientists, and partner organizations conducting ocean sciences research, education, and outreach.
- Creating professional development opportunities for "up to" 60 middle school teachers (grades 5-9) and "up to" 60 scientists through 15-day annual Institutes.
- Disseminating ocean sciences research results and complementary education materials and

expand the linkages among informal educators, researchers, and interested public.

- Providing “Teachers-To-Sea” opportunities for “up to” 42 middle school teachers annually aboard U.S. Navy Oceanographic Survey Ships (14 teachers on each of three different voyages).
- Enhancing the numbers of minority students in ocean sciences research and education by providing annual Summer Internships.
- Assisting school districts within the Gulf of Mexico region to align enhanced ocean sciences with district, state, and national standards.
- Creating, coordinating, and maintaining an appropriate regional website which will be linked to all of the collaborators, as well as the COSEE:Central Coordinating Office (CCO).
- Implementing program evaluation to provide assessment data and analyses to evaluate the effectiveness of the COSEE:CGOM to the COSEE:CCO.

4. Methodology

The methodology being implemented to achieve these goals involves the following:

- Engaging scientists and educators (up to 24 per state, i.e. 12 scientists and 12 teachers) by providing them the opportunity to work and learn side-by-side with mutual professional respect as teams of two (a scientist and an educator) in a 15-day Institute (five actual “person to person” days in the field and a minimum of 80 hours virtually via distance learning, “spread over” six weeks during the summer).
- Providing increased ocean and coastal sciences contact through annual Nonformal Workshops.
- Continuing to place up to 42 teachers/year aboard the U.S Navy’s oceanographic survey ships (14 teachers per semester with each voyage encompassing approximately seven to 10

days) to work with U.S. Navy surveyors (modeling the 1997-2002 National Oceanographic Partnership Program (NOPP)-funded COAST and COAST:PILOT nationally recognized programs).

- Recruiting and providing research and education projects for summer underserved, undergraduate students.
- Assisting school districts within the Gulf of Mexico region in aligning enhanced ocean sciences content with district, state, and national standards.
- Creating, coordinating, and maintaining an appropriate regional website, linking all of the collaborators, as well as the COSEE:CCO.
- Implementing a program evaluation model to provide assessment data and analyses to evaluate the effectiveness of the proposed COSEE:CGOM to the COSEE:CCO, the NSF, the NOPP/Office of Naval Research (ONR), and NOAA-OAR Sea Grant.

5. Rationale

As previously mentioned, the primary goal of this proposed regional COSEE:CGOM effort is to strengthen ocean and coastal sciences education through the interpretation of research and education results for the interested public, precollege teachers and their students, nonformal educators, and university and community college faculty and their students concerning the relevance of the oceans to our everyday lives. These research and education results are leveraging former awards from the U.S. Navy/NOPP, NSF, and the NOAA-National Sea Grant College Program. This project links educators, researchers, and interested public both regionally and thematically (oceanography and coastal processes, habitats and organisms, and marine technology) focusing on America's Sea, the Gulf of Mexico, as the vehicle to teach ocean and coastal sciences.

6. 2003 Project results

a. Summer Institutes

The COSEE-CGOM implemented five Summer Institutes in June 2003 in the states of Alabama, Florida, Louisiana, Mississippi, and Texas. These Institutes provided professional development opportunities for middle school teachers and scientists. The Institutes involved teacher/scientist teams in an inquiry-based, field activities (five days "face to face") and 10 days of online virtual conferences ("spread over" six weeks during the summer) for three-semester hour credits or Continuing Education Units (CEUs) for the participating teachers.

In 2003, a total of 53 teachers and 38 scientists participated in the institutes, which consisted of:

Alabama – 13 teachers - 7 scientists; Louisiana–10 teachers - 5 scientists;

Florida – 10 teachers - 11 scientists; Mississippi–11 teachers - 11 scientists; and

Texas – 9 teachers - 4 scientists

The ethnicity of the participating teachers was 88% Caucasian, 8% African American, and 4% Hispanic. Gender breakdown for participants was 85% females and 15% males.

Each Institute issued pre- and posttests to the teachers to evaluate cognitive achievement for the "face-to-face" component of the Institute. All teachers from all states were given 25 questions (1-25) that were the same of all states and 25 questions (26-50) that were developed and suited for the respective state. Two tailed, paired t-tests were utilized for data analyses. The data indicated that the results for the first 25 questions that were common to all states were statistically significant at the 0.01 level for Florida and Mississippi and significant at the 0.05 level for Alabama, Louisiana and Texas. For questions 1-50, the data indicated that the results were statistically significant at the 0.01 level for Alabama, Florida, Louisiana, and Texas and

significant at 0.05 level for Mississippi.

Likert-scale evaluations were issued to teachers of all states and the scientists of Alabama and Mississippi to determine attitudinal achievement and perceived value of activities, field trips and speakers of the Summer Institutes. The data indicated that 98% of the Alabama and Mississippi teachers; 99% of the Florida and Louisiana teachers and 100% of the Texas teachers rated the activities of average to very valuable. Seventy-five percent of Alabama, 68% of Florida, 82% of Louisiana, 93% of Texas, and 68% of Mississippi activities were rated very valuable. The scientists for Alabama and Mississippi rated the activities as 100% and 99% average to very valuable, respectively with 73% of the Alabama and 40% of the Mississippi activities as being very valuable.

The 2003 Online Component of the Summer Institutes consisted of 11 days of instruction presented by 11 scientists. Topics of instruction included: 1) Coral Reef Ecology, 2) Hypoxia, 3) Northern Gulf of Mexico Harmful Algae, 4) Ocean Floor, 5) Ocean Currents, 6) Fisheries, 7) Invasive Species, 8) Sharks, 9) Stewardship and Sense of Place in the Gulf of Mexico, 10) the Abyss and Other Deep Ocean Habitats, and 11) Oysters. The Likert-scale evaluation resulted in 100% of the lectures being rated as of average value to very valuable, with 57% of the lectures rated as very valuable.

b. Sea Scholars

The Sea Scholars Program provided by the U.S. Navy's NAVMETOCCOM and the NAVOCEANO involved two, eight- to nine-day cruises aboard a T-AGS 60 oceanographic survey ship, the *USNS Mary Sears*. A total of 27 teachers from nine states participated in the Sea Scholars Voyages to the Dry Tortugas in the Gulf of Mexico. Voyages occurred June 7-14, 2003 with 11 participants and July 2-11, 2003 with 16 participants. Goals of the Sea Scholars

Voyages were to enhance public perception of the U.S. Navy as a steward of the oceans; provide K-12 teachers a view of the U.S. Navy of which too few people are aware; remove the myth that the U.S. Navy is not concerned about the environment; and increase and improve the content knowledge, attitudes, and instructional strategies of the Sea Scholars relative to coastal processes and ocean sciences. These goals were accomplished as teachers worked side by side with Navy and civilian surveyors while studying the topics of chemical, biological, geological, and physical oceanography to include bathymetry, acoustics, plankton, bioluminescence, meteorology, geodesy and mapping, conductivity, temperature, depth, geologic cores, and naval application of these data.

c. Underrepresented Internships

In 2003 one, African American female student, from the Jefferson Davis Campus of Mississippi Gulf Coast Community College was the recipient of the Summer Internship. This student worked with the Mississippi, COSEE Scientist and Educator for 10 hours a week for 10 weeks from June through August, 2003. Her duties were performed at the Scott Aquarium and included basic research for Project Marine Discovery-Sea Camp activities and implementation of the activities, as well as researching and gathering information on selected plants of the Grand Bay National Estuarine Research Reserve in Moss Point, Mississippi. It should be noted that due to the recruiting problems encountered during the January-May and summer semesters and a hiring freeze within the U.S. Navy at it Stennis Space Center facilities, there were no undergraduate scholarships provided during the 2003 academic year.

d. Web site

Dr. Dan Brook at Mississippi State University developed a COSEE:CGOM website <www.cosee-central-gom.org>. This website contains COSEE:CGOM information relative to

professional development opportunities for formal and nonformal educators; various applications for teachers, nonformal educators, and underrepresented internships, evaluative data; digital images from the various course components; and links to pertinent resource materials.

e. Evaluation

The program evaluation model funded by NOAA-OAR-Sea Grant was developed and implemented by an internal evaluator and two external evaluators. Additional activities performed by COSEE:GOM personnel in 2003 included (with the 2002 excerption noted):

- Evaluation data and interpretations
- Presentations at 16 meetings
- Co-PI Meetings/Expanded COSEE-CGOM meetings
    - December 11-13, 2002
    - July (NMEA) 2003
    - September 4-5, 2003
    - Conference Calls every two months

7. Challenges

a. Online Component

The 10-day Online Institute involved a six-week time frame with 11 scientists/educators (nine scientists and two educators) making keynote presentations with one keynote speaker presenting every three days which also involved homework being completed by 8:00 a.m. every fourth morning. "Feedback" via evaluations and e-mails from participating teachers indicated these assignments were too time-consuming for a three-hour graduate course or 7.6 CEUs. Therefore, the COSEE-CGOM Management Team, at its September 4-5, 2003 Meeting, made the decision to have six keynote presenters for the 2004, Summer Online Institute.

The Online COSEE:CGOM external evaluators, provided the following summarized results from a survey of scientist instructors who provided Online Instruction to the teacher

participants in the 2003 Summer Institutes. An email survey was sent in September 2003 to the eleven Scientist Instructors for the Online Institute. The survey consisted of seven open-ended questions. Four scientists responded to the survey, with one respondent expressing the caveat of only marginal involvement.

The first question addressed expectations about the instructor's participation in the Online Institute and whether these expectations were met. One respondent did not know what to expect and one person had no expectations prior to the Online Component. The other respondents said they had expected their presentations would be followed by interactive discussion among the participants and questions and answers from the participants. They believed the presentation of material would generate dialogue about the content but this did not happen. One instructor said this left a sense of dissatisfaction with instructional efforts. The development of an educational community that could have occurred did not happen. One person's expectation was to give a lecture and be available for questions but not to give study guides and develop activities. One person expressed that a stipend would be nice, given the amount of work in a short time period (note: all Online Instructors [except Federal employees] were provided a modest stipend for their presentations). In discussing the amount of time they spent online with the teachers, they all reiterated that they spent little time online with teachers. These Online Instructors also indicated they did not interact significantly with the other Instructors.

A question was posed about the ease or difficulty of developing their materials for online presentation. In general, the instructors stated that it was not difficult to develop materials. For one presenter, the process was simple but time-consuming, as the web made it slightly more complicated. One person said it took a good deal of time to reformat.

The Online Presenters voiced several concerns and suggestions:

- There may be limitations for teachers downloading with dial-up modems.
- *Guidelines* should to be developed for Instructors concerning what will work in this instructional medium (it should be noted *Guidelines* were developed for implementation of the 2004 Online Institutes).
- Instructors need a good way to receive feedback concerning whether the participants got the content information "with or without misconceptions." The homework being sent to individual COSEE educators precluded appropriate feedback for the Instructors.
- There wasn't enough time to put together a quality online presentation.

When asked about difficulties encountered, three instructors stated they had no difficulties. One person would have liked more advance information about the logistics of participation (in 2004 there has been sufficient time for preparation by the Online Instructors). Technical difficulties in 2003 included: 1) the web site was not friendly to non-Microsoft browsers and 2) not all MS Explorers have Flash Player installed. However on the positive side, one person said that "the page does look nice with the proper computer setup."

Benefits derived from Scientist Instructors' participation included:

- A good chance "to look at my program from a different perspective."
- "New experience in working in distance learning area."
- An opportunity for "transferring the information in our many years of science to understandable and usable information for educators and the public" (same as with any education and outreach group).

On the downside, one person derived no personal or professional benefits and

emphasized the desire for closer interaction with participants.

Survey respondents were asked to provide impressions of how the experience enhanced scientist-educator connections. By and large they responded that expected interactions among scientists and educators did not occur. Cross-state connections among scientists and educators on the topic areas did not happen. Reasons may have been technology issues or short, time frame. One person expressed the view that the online format was very limiting for interactions and found the “face to face” more conducive. However, one person said that the Institute was a good way to inform the educators about his research program, to help build more knowledgeable students and public. Respondents acknowledged benefits for the educators and encouraged future Online Programs.

The following thoughts and suggestions were provided by the Online Instructors (most of these suggestions have been implemented in 2004):

- Make the web site viewable by any web browser for both text and multimedia files. The web site should be compliant with common html standards or other cross platform format.
- Rethink how to get scientist instructors involved; more clearly define and market reasons why scientists would want to be involved.
- Seek ways to require communication between educators and instructors, e.g., short questions by instructors to the educators.
- Provide basic ocean science concepts to teacher participants ahead of time.
- Increase the “face to face” time.
- Allow the Online Instructors to help develop the pre- and posttest questions. (This has been implemented in 2004).

b. Other Challenges

- Recruitment of students for Internships was more difficult than anticipated. The reasons included funding, travel and housing considerations, and potential students were concerned about being away from their families.
- Recruitment of scientists was difficult; perhaps due to the fact too many scientists were committed for the 2003 summer prior to the PI/Co-PIs invitation to participate in the "face to face" Institute and the paradigm shift between scientists and educators had/has not yet successfully occurred. It should be noted the recruitment of scientists for 2004 was not as difficult as was the case in 2003.

8. Accomplishments

a. Students supported

One African American student, representing the Jefferson Davis Campus of Mississippi Gulf Coast Community College was the recipient of the Summer Internship. This student worked with the COSEE Scientist and Educator for 10 hours a week for 10 weeks from June through August, 2003. Her duties were performed at the Scott Aquarium and included basic research for Project Marine Discovery-Sea Camp activities and implementation of the activities, as well as researching and compiling information on selected plants of the Grand Bay National Estuarine Research Reserve in Moss Point, MS.

b. Publications and/or presentations

- Brown, Shelia. 2003. Sea Scholars, National Marine Educators Association, July 21, Wilmington, NC.

- Brown, Shelia, Cindy Moon, and Christine Wilson. 2003. Plankton and Other COSEE Staff Development Activities, Mississippi Science Teachers Association Annual Conference, October 27, Jackson, MS.
- Kastler, Jessica, C. Chavin, J. Cain, L. Pulling, J. Simpson, V. Stewart, C. Banks-Jones, K. Barbay, T. Miguez, C. Bihm, and S. Bordelon. Center for Ocean Science Education Excellence (COSEE) at LUMCON (I), Louisiana Science Teachers Association Annual Conference, December 5, Chauvin, LA.
- Kastler, Jessica, C. Chavin, J. Cain, L. Pulling, J. Simpson, V. Stewart, C. Banks-Jones, K. Barbay, T. Miguez, C. Bihm, and S. Bordelon. Center for Ocean Science Education Excellence (COSEE) at LUMCON (I), Louisiana Science Teachers Association Annual Conference, December 5, Chauvin, LA.
- Spranger, Mike. 2003. COSEE, Florida Marine Science Educator Association Annual Meeting, May 2, Marathon, FL.
- Spranger, Mike. 2003. COSEE: Partnerships at Work, Southeast Atlantic Ocean Observation System Project Biannual Meeting, May 28, Jacksonville, FL.
- Spranger, Mike. 2003. COSEE: Goals, Objectives, Expectations, Formal Educator's COSEE Institute, June 23, Cedar Key, FL.
- Spranger, Mike. 2003. COSEE, Annual Florida Sea Grant Faculty Meeting, October 7, Gainesville, FL.
- Spranger, Mike. 2003. Bridging the Gap: Changing the Science/Education Paradigm, NonFormal COSEE Education Workshop, December 10, Gainesville, FL.
- Walker, Sharon H. 2003. Central Gulf of Mexico Center for Ocean Sciences Education Excellence, Mississippi Academy of Sciences, February 14, Hattiesburg, MS.

- Walker, Sharon H., John Dindo, Jessica Kastler, Michael Spranger, Richard Tinnin, Shelia Brown, and Dan Brook. 2003. COSEE:CGOM, National Marine Educators Association Share-A-Thon at the National Science Teachers Association National Conference, March 27, Philadelphia, PA.
- Walker, Sharon H., John Dindo, Jessica Kastler, Michael Spranger, Richard Tinnin, Shelia Brown, and Dan Brook. 2003. COSEE:CGOM, COSEE PI Meeting, March 3-4, Washington DC. Invited special presentation (oral), national meeting, published abstract.
- Walker, Sharon H. and Michael Spranger. 2003. COSEE:CGOM Update, Sea Grant Week, April 24-28, Galveston, TX.
- Walker, Sharon H., John Dindo, Jessica Kastler, Michael Spranger, Richard Tinnin, Shelia Brown, and Dan Brook. 2003. COSEE:CGOM, The Oceanography Society-Oceanology International Americas Ocean Conference, June, New Orleans, LA. Poster presentation, international meeting, published abstract.
- Walker, Sharon H., John Dindo, Jessica Kastler, Michael Spranger, Richard Tinnin, Shelia Brown, and Dan Brook. 2003. Central Gulf of Mexico (CGOM):Center for Ocean Sciences Education Excellence (COSEE), July, Wilmington, NC. Oral presentation, national meeting (with international attendance), published abstract.
- Walker, Sharon H., John Dindo, Jessica Kastler, Michael Spranger, Richard Tinnin, Shelia Brown, and Dan Brook. 2003. Center for Ocean Sciences Education Excellence:Central Gulf of Mexico (COSEE:CGOM)—The First Year, Marine Technology Society, September 22-26, San Diego, CA. Oral presentation, international conference, published paper (proceedings).

9. Benefits - 2003

The benefits for agencies, scientists, teachers and their students are significant and include the following:

- This effort was a “win-win” partnership involving sponsors from academia, state and federal governments, businesses and industries, and the private sector;
- Participation included 80 precollege teachers (27 sea scholars and 53 COSEE:CGOM teachers) and 46 scientists (32 “face to face” institute, six Sea Scholars, and eight Online Instructors not included prior);
- Potentially, the 1,620 “second tier” teachers potentially can be positively affected through the staff development programs implemented by the Institutes and Sea Scholar participants;
- Potentially, the 218,050 precollege students potentially can be impacted by these 1,620 teachers over a five-year teaching career;
- Partnering of scientists and teachers resulted in an enhanced understanding and mutual respect between the disciplines of science and education;
- The *Oceanography and Coastal Processes Resource Guide* developed by teachers for teachers was aligned with *NSES* in 1999 (hard copy, CD-ROM, web site http://www.coast-nopp.org/toc.html);
- The Coast web site continued to be effective in the dissemination of the *Resource Guide* by receiving an average of 518,000 hits and 106,000 pages requests of information on a monthly basis since year 2000;

- Over 700 URLs, seven glossaries, career exploration data, and visualization tools for teachers were added to the *Resource Guide* web site in 1999 and were used consistently throughout the 2000-2003 timeframe;
- The Online Component of the COSEE:CGOM Institute integrated real-time data streams and archived data to promote "hands-on" learning experiences delivered directly to users via high speed internet;
- Evaluation and assessment analyses for pre- and posttest cognitive achievement scores by all "face to face" participants were analyzed and proven to be statistically significant;
- Evaluation and assessment analyses for pre-and posttest cognitive achievement scores by Alabama and Florida for the Online Institute were significant at the 0.05 level. In Texas, only the teachers pretest scores were significant at the 0.05 level and the posttests were significant at the 0.01 level. In Mississippi and Louisiana, neither the pre- or posttest scores were significant.
- Likert-Scale attitudinal achievement for all participants were also analyzed and revealed a high perceived value of content, presenters, activities and/or field trips;
- One underrepresented student was positively impacted for potential career pathway;
- And, during 2003, sixteen presentations at local, regional, or national meetings/conferences were made.

10. Other Collaborations

- The U.S. Navy—NAVMETOCCOM's and NAVOCEANO's involvement included two, eight to nine day cruises aboard a T-AGS 60 oceanographic survey ship, the *USNS Mary Sears*. A total of 27 teachers from nine states participated in the Sea

Scholars Voyages. Voyages occurred June 7-14, 2003 with 11 participants and July 2-11, 2003 with 16 participants.

- The National Marine Educators Association; the National Science Teachers Association; the FL, AL, MS. LA, and TX State Science Teachers Associations; the Marine Technology Society; the Sea Grant Network; the Consortium for Oceanographic Research and Education (CORE); the American Association for Limnology and Oceanography; and the American Geophysical Union assisted this project in recruitment of program participants, in the dissemination of the results through their newsletters and websites, or through professional presentations at these conferences.
- The State Departments of Education in each of the five, Gulf of Mexico states and the LA Public Broadcasting station were involved in the recruitment of participants and the dissemination of project results. The Mississippi Gulf Coast Community College, Jefferson Davis and Jackson County Campuses participated in the recruitment of underserved, undergraduate students, as well as the University of New Orleans.

11. Acknowledgements

The authors of this manuscript wish to express appreciation to the following organizations: the National Science Foundation (Geosciences Directorate-Ocean Sciences Division and the Education and Human Resources Directorate-Division of Undergraduate Education); the National Oceanographic Partnership Program; the U.S. Navy (NAVMETOCCOM, NAVOCEANO, the Naval Research Laboratory, the Office of the Oceanographer of the Navy, and the Office of Naval Research); the National Oceanic and Atmospheric Administration-Office of Atmospheric Research-National Sea Grant College

Program and the Sea Grant College Programs of Florida and Mississippi-Alabama; the National Marine Educators Association; the National Science Teachers Association; the Consortium for Oceanographic Research and Education; the Center for Educational and Training Technology and the Electronic Visualization Lab in the School of Architecture at Mississippi State University; The University of Southern Mississippi-Gulf Coast Research Laboratory-J.L. Scott Marine Education Center and Aquarium; the Dauphin Island Sea Lab-Estuarium; The University of Florida-Gainesville and its Seahorse Key Marine Laboratory; the Florida Museum of Natural History; the Florida Department of Fish and Wildlife Conservation in Cedar Key; The University of Texas-Marine Science Institute; the Louisiana Universities Marine Consortium; the College of Exploration; and the State Departments of Education in Mississippi, Louisiana, Texas, Florida, and Alabama.

REFERENCES

American Association for the Advancement of Science, 1993: *Benchmarks for Science Literacy*, Oxford University Press: New York.

Consortium for Oceanographic Research and Education (CORE), 1996: *Oceans 2000: Bridging the Millennia—Partnerships for Stakeholders in the Oceans*. A Report on the Interagency Partnership Initiative.

Centers for Ocean Science Educational Excellence (COSEE), 2001: *Report of the COSEE Implementation Steering Committee*. National Science Foundation.

Danzig, R. and W.M. Daley, 1999: *Turning to the Sea: America's Ocean Future*. National Oceanic and Atmospheric Administration, Washington, D.C.

Environmental Protection Agency/Gulf of Mexico Program, 1990: *Our National Gulf Treasure*. GMP-FS-001 (09/90).

Horizon Research, Inc. 2002, <http://2000survey.horizon-research.com>.

McMannus, Dean A., Sharon H. Walker, Benjamin Cuker, Patricia Goodnight, Susan Humphris, Paula Keener-Chavis, Donald Reed, Veronique Robigou, Jerry Schubel, 2000: *Center for Ocean Science Education Excellence—The Report of a Workshop Sponsored by the National Science Foundation*, 1-69 pp.

National Marine Educators Association (NMEA), 2001: *Current: The Journal of Marine Education*, **17,** (2).

National Oceanic and Atmospheric Administration, 1998. *Year of the Ocean Discussion Papers*. Prepared by the U.S. Federal Agencies with Ocean Related Programs. "Marine Education U.S.A.: Overview," Section k-1, 1-24 pp.

National Research Council (NRC), 1996: *National Science Education Standards*. Washington, D.C.: National Academy Press.

National Science Teachers Association, 1996: *NSTA Reports-Third International Mathematics and Science Study.*

Nowell, A, 2000: Education in Oceanography: History, Purpose, and Prognosis. In: *50 Years of Ocean Discovery: National Science Foundation 1950-2000*. National Academy Press, Washington D.C., 195-200 pp.

Oceanography and Coastal Processes Resource Guide. 1999. <www.coast-nopp.org/toc.html>.

Pew Oceans Commission, 2003: <www.pewoceans.org/mission.asp>.

Schubel, Jerry R., 2001: "The Roles of Informal Science Education in the Constellation of Science Education Programs in Promoting COSEE," *Current: The Journal of Marine Education*, **17** (2).

Thomashow, Mitchell, 1995: *Ecological Identity: Becoming a Reflective Environmentalist*, Cambridge, MA: MIT Press.

U.S. Census Bureau, 2002: *2000 Census Data.* <http://factfinder.census.gov/servlet/BasicFactsServlet>.

U.S. Commission on Ocean Policy Report, 2004: <http://www.oceancommission.gov/documents/welcome.html>

U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, 2000: *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration. The Report of the President's Panel on Ocean Exploration*. NOAA no. NA87GPO105.

U.S. National Commission of Excellence, 1983: *Nation at Risk: The Imperative Education Reform*. Washington, D.C.: U.S. Government Printing Office.

Walker, Sharon H., James I. Jones, Robert J. Shephard, Michael J. Pelzcar, Vicki Osis, and Linda Skupien, 1992: *Shaping the Future—Sea Grant, Science and Society: The Role of Marine Education*. Printed by NOAA—The Mississippi-Alabama Sea Grant Consortium, MASGP-92-0112. 21 pp.

Walker, Sharon H., Paula Coble, and Frances Lee Larken, 2000: "Ocean Sciences Education for the 21st Century." *Oceanography: The Official Magazine of the Oceanography Society*. **13** (2), 32-39 pp.

Watkins, ADM James D, 2000: The Importance of Ocean Sciences to Society. In: 5*0 Years of Ocean Discovery: National Science Foundation 1950-2000*. National Academy Press, Washington D.C.