CENTERS FOR OCEAN SCIENCES EDUCATION EXCELLENCE

Bridges to the Future

Tampa Sunshine Skyway Bridge

National COSEE Network Meeting

May 6-8, 2013

Tampa, Florida

Agenda at a Glance

Monday, May 6

Various	Participant Arrival	Marriott Waterside
3:00 p.m.	Council Meeting	Salon G
7:00 p.m.	Welcome Gathering	Waterside Grill (located at the Marriott)

Tuesday, May 7

7:30 a.m	Council Breakfast Meeting	Salon G
7:30 a.m	Breakfast (non-Council members)	Salon Foyer
8:30 a.m.	Welcome and Introductions	Salons H, I, J
8:45 a.m.	Plenary: *The Future of the National COSEE Network*	Salons H, I, J
9:45 a.m.	Breakout Sessions: *The Future of the National COSEE Network*	Salon G, Meeting Room 7
10:45 a.m.	Break	Salon Foyer
11:00 a.m.	Plenary: *COSEE Impact on Ocean Scientists*	Salons H, I, J
11:45 a.m.	Brainstorming Session: *COSEE Impact on Ocean Scientists*	Salons H, I, J
12:30 p.m.	Lunch	Salon Foyer
1:30 p.m.	Plenary: *COSEE Network Online Legacy*	Salons H, I, J
1:50 p.m.	Breakout Sessions: *COSEE Network Online Legacy*	Salon G, Meeting Room 7
2:10 p.m.	Gallery Walk: *COSEE Network Online Legacy*	Salons H, I, J
2:30 p.m.	Plenary: *Next Generation Science Standards*	Salons H, I, J
3:00 p.m.	Breakout Sessions: *Next Generation Science Standards*	Salon G, Meeting Room 7
3:45 p.m.	Break	Salon Foyer
4:00 p.m.	Report Out: *Next Generation Science Standards*	Salons H, I, J
4:30 p.m.	Plenary: *Announcements*	Salons H, I, J
6:00 p.m.	Center Showcase	Florida Aquarium
7:00 p.m.	Working Dinner and Lecture	Florida Aquarium

Wednesday, May 8

7:30 a.m.	Council Breakfast Meeting	Salon G
7:30 a.m.	Breakfast (non-Council members)	Salon Foyer
8:30 a.m.	Welcome Back & Recap	Salons H, I, J
8:45 a.m.	Plenary: *Review of September 2012 Diversity Work Session*	Salons H, I, J
9:00 a.m.	Plenary: *The C21 Ocean Scientist*	Salons H, I, J
10:15 a.m.	Break	Salon Foyer
10:30 a.m.	Panel: *Individual Pathways to an Ocean Science Career*	Salons H, I, J
11:15 a.m.	Breakout Sessions: *The C21 Ocean Scientist*	Salon G, Meeting Room 7
11:45 a.m.	Report Out: *The C21 Ocean Scientist*	Salons H, I, J
12:15 p.m.	Lunch	Salon Foyer
1:15 p.m.	Plenary: *Reports from Relevant Projects*	Salons H, I, J
1:30 p.m.	Plenary: *Update on Education Initiatives from NSF and NOAA*	Salons H, I, J
2:00 p.m.	Plenary: *Next Steps for the Network*	Salons H, I, J
3:00 pm	Adjourn	

Meeting Logistics

HOTEL/ACCOMMODATIONS

Tampa Marriott Waterside Hotel & Marina
700 South Florida Avenue
Tampa, Florida 33602
(813) 221-4900

Check-in: 4:00 p.m.
Check-out: 11:00 a.m.

GROUND TRANSPORTATION

The hotel does not provide shuttle service.

Tampa Marriott Waterside is located 9 miles from the Tampa Airport.

- SuperShuttle: $12 one-way. For reservations, call (800) 282-6817.
- Taxi: $25 one-way.

MEETING SPACE

All meeting events will take place at the Tampa Marriott Waterside. All meeting rooms are located on the second floor.

- General Session Room: Salons H, I, J
- Breakout Rooms: Salon G and Meeting Room 7
- COSEE Council Meeting Space: Salon G

Monday evening's Welcome Gathering will take place at the Waterside Grill, located at the Marriott.

MEALS

Full meeting registration fee includes the following meals:

- Monday May 6: Welcome Gathering at the Waterside Grill. A cash bar will be available.
- Tuesday, May 7: Breakfast, breaks and lunch, Tampa Marriott Waterside, Salon Foyer
- Wednesday, May 8: Breakfast, breaks and lunch, Tampa Marriott Waterside, Salon Foyer

OPTIONAL EVENT

Florida Aquarium
Tuesday, May 7, 6:00 – 9:00 p.m.
COSEE Center Showcase and Dinner with Lecture by Dr. David Hollander, University of South Florida.
Hor d'oeuvres and dinner will be served. A cash bar will be available.

OTHER

On-site contacts:
Andrea Gingras, COSEE National Network Coordinator, 401-954-0065 (cell)
Romy Pizziconi, COSEE National Network Assistant, 203-640-4264 (cell)

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Welcome

Welcome to Tampa, Florida and the the 2013 National COSEE Network Meeting!

The National COSEE Network Meeting provides us with an opportunity to come together as a community of scientists and educators to look back at some of the successful work that has been accomplished in the past year, and to look forward to a new vision of the COSEE Network as the NSF funding for COSEE Centers winds down.

The meeting's agenda reflects these two directions. We begin the meeting with a focus on the future of the National COSEE Network. This will provide us with a framework for our thoughts as we continue through the agenda of the meeting. We will return to this topic at the end of our meeting in a session focusing on next steps for the Network.

Several sessions will provide us with an opportunity to learn about what COSEE has accomplished. The COSEE Evaluators group will present their findings regarding impacts on ocean scientists from COSEE Center activities. The Web Working group will roll out their new products, and our newest Centers will showcase their activities.

The remainder of the agenda focuses on new opportunities in ocean science education. These include the recent release of the Next Generation Science Standards and a renewed emphasis on undergraduate education at NSF.

I urge you to enter into discussions with your colleagues both informally and formally, and contribute your ideas as we explore the possibilities and the challenges for the next stage of the National COSEE Network.

It has been a pleasure to serve as the COSEE Council chair, and I wish to thank the National COSEE Office for providing unparalleled support and leadership for COSEE, the members of the COSEE meeting planning committee for working hard to put this meeting together, and to all the session facilitators, participants, and scribes for volunteering to help run the meeting

Jan Hodder
COSEE Pacific Partnerships
National COSEE Council Chair

Day 1: Tuesday, May 7, Detailed Agenda

7:30 a.m. Salon G	Council Breakfast Meeting
7:30 a.m. Salon Foyer	Breakfast (non-Council members)
8:30 a.m. Salons H, I, J	Welcome and Introductions Gail Scowcroft, National COSEE Network Executive Director Jan Hodder, COSEE Council Chair and COSEE Pacific Partnerships
8:45 a.m. Salons H, I, J	Plenary: *The Future of the National COSEE Network* Presenters: Gail Scowcroft and Billy Spitzer, National COSEE Office *Status of the Network and Strategic Planning Update* Presenter: Jean Egmon, Kellogg School of Management, Northwestern University, COSEE NAC Facilitators: Gail Scowcroft, National Network Executive Director; Billy Spitzer, National COSEE Office Scribe: Romy Pizziconi, National COSEE Office Objective: To review the status of the Network and identify strategies for sustaining and moving the Network forward Outcome: Conditions of the future Network membership and operating policies
9:45 a.m. Salon G Meeting Room 7	Breakout Sessions: *The Future of the National COSEE Network* Facilitators: Each group will have a Council member Scribes: Each group will designate a scribe
10:45 a.m. Salon Foyer	Break
11:00 a.m. Salons H, I, J	Plenary: *COSEE Impact on Ocean Scientists* Presenters: Patricia Kwon, COSEE West; Andrea Anderson, COSEE Alaska, COSEE Ocean Learning Communities Scribe: Coral Gehrke, COSEE Pacific Partnerships Objective: Explore the results of the Scientist Study survey recently completed by the COSEE Evaluators. Outcome: Identify future research questions about impacts on scientists and possible funding opportunities to support that research.
11:45 a.m. Salons H, I, J	Brainstorming Session: *COSEE Impact on Ocean Scientists* Facilitator: Linda Duguay, COSEE West Guiding Question: Based on the results of the COSEE Scientist Study, are there other questions about impacts on scientists that might warrant further investigation? Guiding Question: If so, how might those studies be funded?
12:30 p.m. Salon Foyer	Lunch
1:30 p.m. Salons H, I, J	Plenary: *COSEE Network Online Legacy* Presenters: Carla Companion, COSEE Ocean Systems; Greg Baerg, Raytheon Web Systems Facilitators: Carla Companion, COSEE Ocean Systems; Lisa Taylor, COSEE Ocean Systems Scribe: Meghan Buckley, COSEE Florida Objective: The Web Working Group has endeavored to create new webpage types on COSEE.net designed to showcase high-level COSEE accomplishments. Outcome: To generate a list of Center and Network activities, models, events and resources that can be featured in the new pages on COSEE.net.
1:50 p.m. Salon G Meeting Room 7	Breakout Sessions: *COSEE Network Online Legacy* Scribes: Each group will designate a scribe Guiding Question: What are the COSEE impacts and what should be archived/continue to be available?
2:10 p.m.	Gallery Walk: *COSEE Network Online Legacy*

Day 1: Tuesday, May 7, Detailed Agenda

2:30 p.m. Salons H, I, J	Plenary: *Next Generation Science Standards* Presenter: Peter McLaren, Science and Technology Specialist, Rhode Island Department of Education Facilitators: Judy Lemus, COSEE Island Earth; Liesl Hotaling, National COSEE Office and COSEE NOW Scribe: Andrea Gingras, National COSEE Office
3:00 p.m. Salon G Meeting Room 7	Breakout Session: *Next Generation Science Standards* Facilitators: Judy Lemus, COSEE Island Earth; Liesl Hotaling, National COSEE Office, COSEE Networked Ocean World; Linda Duguay, COSEE West; Sue Cook, COSEE Florida; Phil Bell, COSEE Learning Communities; Shawn Rowe, COSEE Pacific Partnerships Scribe: Each group will designate a scribe Objective: Pathways in which COSEE can support the inclusion and implementation of ocean content in the next Generation Science Standards. Outcome: Establishment of working groups and outlines to develop a product or publication in the following areas: 1) Effective teacher preparation through direct training and exemplary lessons of ocean sciences; 2) Aligning NHSS and OLPFC and developing NGS learning progressions with the oceans; 3) Creating a COSEE "Practices of Ocean Science" Guide for teachers to address NGSS Practices Dimension.
3:45 p.m. Salon Foyer	Break
4:00 p.m. Salons H, I, J	Report Out: Next Generation Science Standards Scribe: Romy Pizziconi, National COSEE Office
4:30 p.m. Salons H, I, J	Announcements Gail Scowcroft, COSEE National Network Executive Director
6:00 p.m. Florida Aquarium	Center Showcase COSEE OCEAN, COSEE Florida, COSEE Island Earth and COSEE TEK will share and showcase events, projects, and news from their respective Centers. Members of the Network are encouraged to collaborate on future projects and partnerships.
7:00 p.m. Florida Aquarium	Working Dinner and Lecture Presenter: Dr. David Hollander, Associate Professor, University of South Florida

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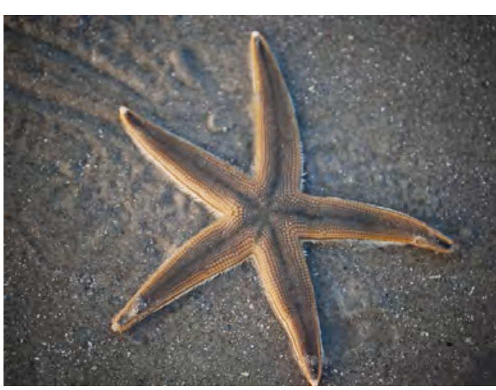

The Future of the National COSEE Network

PLENARY SESSION PRESENTER

Jean Egmon, Kellogg School of Management, Northwestern University

Jean Egmon is the director of the Ford Center Network. She is also the president of Third Angle, Inc. Jean's work focuses on spotting & leveraging interdependencies across value networks. This means synthesizing information and ideas from diverse sources, working with companies to spot the "third angle," i.e., a higher order concept of simple elegance that enables companies to meet multiple needs of multiple stakeholders at once. From there, she works with companies to design strategies and environments to innovate and make decisions that create a pull for participation across the networks.

Applications of this expertise include: uncovering and exploring new market niches; engaging cross-boundary collaboration for invention and innovation; designing new things to be more easily adopted & viral across customers and employees; employing a design method where interdisciplinary teams approach a variety of business questions with a design mindset and iterate with end users; and designing work to be done by networks.

Jean relies heavily on her interdisciplinary background, and that of her team, in cognition, management, and complexity sciences, marketing and literature to develop frameworks, approaches and tools that help business leaders and scientists see the world with a more connective lens and actively build their own capabilities and applications in these areas.

Organizations with which Jean has worked include: Abbott, Accenture, Bank of America, Boeing, Equity Office Properties, Exelon Corporation, ExxonMobil, General Electric, Kraft, Merck, Proctor & Gamble, Raytheon, Unilever, United Airlines & US Intelligence.

Jean's Ed.D. and M.A. are from the University of Illinois in management and cognition. Jean's B.A from Monmouth College is in business administration and English.

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The Future of the National COSEE Network

PLENARY SESSION PRESENTER

Billy Spitzer, National COSEE Office

William Spitzer is a member of the NCO team, and a co-PI of COSEE OS. At the New England Aquarium, he is Vice President for Programs, Exhibits, and Planning, and is responsible for oversight of exhibit design, animal care, volunteer, and education programs as well as institutional strategic planning.

Previously, he served as Director of Education, leading the development, delivery and evaluation of institutional education programs and exhibits that reach more than one million Aquarium visitors, and thousands through outreach to schools, youth and community organizations.

He is PI of the National Network for Ocean and Climate Change Interpretation, a 5 year NSF CCEP project, and has served as PI for many informal science education projects funded by NSF, NOAA IMLS, and foundations.

Prior to coming to the Aquarium, Dr. Spitzer worked at TERC, an educational research and development firm in Cambridge, MA. At TERC, he focused on creating professional development opportunities for teachers and learning opportunities outside schools in museums and science centers, supported by effective applications of technology.

Dr. Spitzer has a background in physics, chemistry and oceanography.

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Consortium for Ocean Science Exploration and Engagement (COSEE)

Earth is experiencing a period of unprecedented change due to the activity of humans, and the ocean at the forefront of these changes. Sea level rise, more intense storms, the warming and acidification of the ocean, serious impacts to many marine species, and an increase in ocean dead zones and marine disease are all part of our future.

COSEE, an organization of forward looking ocean scientists and educators, has a proven record of bringing the scientific knowledge and skills needed to understand and solve these problems to a diversity of audiences. Over the past 10 years, COSEE has built a national network that is able to foster the integration of ocean research into high quality educational materials and programs, build strategic partnerships, disseminate effective practices, advocate for ocean science education, and assist scientists in realizing the broader impacts of their research.

COSEE is now poised to further the change in culture needed to make ocean science accessible, relevant, and meaningful to all citizens. Through the engagement of ocean scientists and their cutting edge research, COSEE uses state-of-the-art technology and evidence-based solutions to provide high impact programs and resources that can **transform the learning and doing of ocean science.**

By building bridges between the ocean science and education communities, COSEE is:

1. **Redefining what it means to be an ocean scientist** by integrating outreach, communication, and education skills into the development of the scientific workforce

2. **Building coherence in K-16 ocean science education** by providing a unified voice that represents both ocean scientists and educators

3. **Realizing the broader impacts of ocean research programs** through coordinated, effective outreach and education initiatives

Over the next three years, COSEE will strengthen its consortium by building:

1. a diverse portfolio of funded projects and programs

2. an expanded cadre of members, partners, and leaders

3. a strategic set of tested, high impact programs

Consortium for Ocean Science Exploration and Engagement (COSEE) Strategic Framework-November 2012

Mission – Our Core Purpose

To transform the learning and doing of ocean science

Values – What We Stand For

Visionary Leadership

- *We are strategic, forward-looking leaders and catalysts for positive change*
- *We are trusted experts and innovators*
- *We seek innovative approaches to drive advances in ocean science*

Collaboration

- *We embrace diversity as core to our mission*
- *We build strong partnerships across a broad, diverse set of stakeholders*
- *We are committed to building a sustainable model of collaboration*

Positive Impact

- *We are passionate about delivering relevant, high quality programs and resources*
- *We use research and data to drive excellence*
- *We hold ourselves accountable for achieving positive and enduring outcomes*

Vision- Our Picture of the Ideal Future

COSEE is sustainable and enduring …

- *COSEE provides vital and effective leadership, governance and infrastructure*
- *Stable funding from varied sources support design and delivery of exemplary programs*
- *Diverse, vibrant partnerships leverage programs and resources across the Nation and the world*
- *State-of-the-art technology enhances delivery and extends reach of programs world-wide*
- *Data-driven decisions ensure effective practices and programs*
- *Strong leaders and new members provide continuity and ensure long-term viability*

- *Professional development programs equip current and future generations of scientists*
- *Dynamic ocean science is integrated into learning environments across the Nation*
- *Diverse people are learning about the ocean and pursuing STEM-related careers*
- *COSEE is a model for collaboration that can extend across disciplines and around the world*

… advancing ocean science literacy and discovery!

Strategic Goals – Our Focus for the Next 3 Years

- Goal #1: Achieve strong, stable funding of $10M per year from diverse sources
- Goal #2: Build a diverse, vibrant and sustainable Consortium
- Goal #3: Deliver high impact programs

Goal #1: Achieve strong, stable funding from diverse sources

Desired Results:

- $10M per year for next 3 years to get through "start-up" period
- Grow funding over time to extend reach
- Diversified portfolio – public and private sources at Federal / national, state and local levels

Key Strategies:

- Develop a prospect list (D of Education, NOAA, DOD, DOE, NSF, NASA, ONR, Foundations, individuals, energy sector, etc.)
- Refine the message – What are we selling? What is the value proposition? What is the impact? What is the evidence?
- Create a robust business plan / prospectus
- Enlist professional fundraiser
- Establish a fundraising Board

Goal #2: Build a diverse, vibrant and sustainable Consortium

Desired Results:

- Governance structure that supports variety of members and partnerships
- Advisory Council / Board providing strategic direction and fundraising support
- Pipeline of emerging leaders and members to ensure long-term sustainability
- Clearly articulated value proposition to attract / retain members and funders

Key Strategies:

- Define and document governance structure
- Develop membership criteria and categories
- Define value proposition
- Define the right mix of people / skill sets for Board / Advisory Council, Council Members
- Revamp / maintain working groups (e.g., evaluation)

Goal #3: Deliver high impact programs

Desired Results:

- Successful delivery of high-priority programs to demonstrate value of COSEE
    - Professional development for emerging and professional scientists
    - Strategic access to / dissemination of COSEE resources
    - Create new pathways / eliminate barriers to broaden participation

Key Strategies:

- Catalogue and assess existing programs to determine which ones to stop / continue as Consortium activities
- Identify where Consortium can have greatest value / impact for existing / new programs
- Package / "sell" activities in terms of expected outcomes that resonate with funders
- Utilize technology to extend impact / reach

The Future of the National COSEE Network

COSEE Funding Timeline

Center	Initial End Date
COSEE Florida: Water as a Habitat	9/30/2015
COSEE Island Earth	8/31/2014
COSEE California	9/30/2013
COSEE OCEAN	9/30/2013
COSEE Ocean Systems	9/30/2013
COSEE SouthEast	9/30/2013
COSEE West	9/30/2013
National COSEE Office	9/30/2013
COSEE Networked Ocean World	8/31/2013
COSEE Pacific Partnerships	8/31/2013
COSEE TEK	8/31/2013
COSEE Alaska	7/31/2013
COSEE Central Gulf of Mexico	2/29/2012
COSEE Great Lakes	11/30/2011
COSEE Coastal Trends	8/31/2011
COSEE Ocean Learning Communities	8/31/2011
COSEE New England	1/31/2010

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COSEE Impact on Ocean Scientists

PLENARY SESSION PRESENTERS

Patricia Kwon, COSEE West

Patricia Kwon, Viewpoint Consulting, COSEE EWG Chair and evaluator for COSEE West. Patricia has evaluated education and outreach programs in the ocean sciences serving as (1) Center evaluator for COSEE West since 2002, (2) member of the COSEE National Network Evaluation Advisory Committee during the first cycle of NSF COSEE funding, (3) member of the EWG during the second cycle of NSF COSEE funding, (4) EWG Chair since 2011, (5) researcher on cross-COSEE efforts such as the COSEE Scientist Study and concept mapping collaborative workshops, and (6) evaluator on other projects with Aquarium of the Pacific, NOAA MSRP, Heal the Bay, and Santa Monica Bay Ocean Observing Systems. She has a B.A. in behavioral biology from Johns Hopkins University and M.A. in sociology from UCLA. Patricia managed overall project activities, compiled project findings, and acted as liaison to the COSEE Council and NSF.

Andrea Anderson, COSEE Alaska and COSEE Ocean Learning Communities

Andrea Anderson, Principal, SoundView Evaluation & Research, is the evaluator for COSEE Alaska and COSEE Ocean Learning Communities. Andrea has evaluated education and outreach programs for 15 years serving as (1) Center evaluator for COSEE Alaska and COSEE Ocean Learning Communities, (2) member of the EWG during the second cycle of NSF COSEE funding, (3) researcher on cross-COSEE efforts such as the COSEE Scientist Study, and (4) evaluator on other projects, such as the NOAA-funded BOAT project with Monterey Bay Aquarium, Alaska SeaLife Center, and Florida Aquarium. Andrea created the coding scheme and interview protocol for the COSEE Scientist Study and conducted scientist interviews, which informed development of the scientist survey of professional activities. Andrea has a Ph.D. in Curriculum and Instruction-Science Education from the University of Washington at Seattle.

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COSEE's Influence on Scientists' Professional Practices:

Findings from the COSEE Scientist Study

Andrea Anderson
SoundView Evaluation & Research
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COSEE OLC & COSEE Alaska

Rena Dorph
The Lawrence Hall of Science
The University of California, Berkeley
❖❖❖
COSEE California

Patricia Kwon
Patricia Kwon & Associates
❖❖❖
COSEE West

With the support of

Joo Chung
Matthew Cannady
The Research Group • The Lawrence Hall of Science
The University of California, Berkeley

David Plude
SoundView Evaluation & Research

and the

COSEE Evaluation Working Group

September 2012

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Executive Summary

Background

The *2010 COSEE Scientist Engagement Survey Key Findings* reported that 28% of scientists who participated in COSEE in 2010 agreed or strongly agreed that COSEE had a positive impact on their scientific research. This finding sparked interest in better understanding the impact COSEE had on scientists' professional practices. In response to this interest, the National Science Foundation commissioned COSEE evaluation researchers to design and implement the study described herein.

Study data collection began with interviews of 14 scientists selected from among the 28% of scientists referenced above. These interviews were designed to support the development of a scientist survey that served as the main data collection method for this study. The final scientist survey was sent to 1,841 COSEE-involved scientists. With a response rate of 41%, we analyzed 767 completed surveys. Scientists answered 48 Likert-style items examining the impact of COSEE on scientific research, involvement in education and outreach (E&O), and university/college level teaching. There was also opportunity for free response to open-ended questions and scientists at all career stages, equally from men and women, provided further elaboration of the survey responses through their comments.

Three main sources of evidence for impact are: 1) factor analysis scores— determining a statistical measure of the scientists' perceived impact of COSEE in their scientific endeavors, including instruction, research, and E&O; 2) descriptive or secondary indicators of professional responsibilities; and 3) comments made to the free-response questions.

Results

The study resulted in several findings regarding survey respondents' perceptions of COSEE's impact on various aspects of their professional practice, most notably the impact of COSEE on respondents' professional responsibilities.

1. **Survey respondents are accomplished professionals and increasingly involved with Center and Network activities and partnerships.** The majority (78%) work in academic institutions, and reflect the full range of career stages. During 2011 75% of respondents participated, while 70% have done so for three years or less.

2. **Respondents indicated that COSEE had a positive impact on their professional responsibilities, including education & outreach, college-level teaching, and research.** More specifically, 81% of scientists responding to the survey said that COSEE had a positive impact on their E&O and 45% of respondents said that COSEE had a positive impact on their scientific research and on their college-level teaching.

3. **Scientists' thinking about research, teaching and E&O is evolving—in part due to involvement with COSEE.** Survey results showed that more than one-third of the scientists (37%) agreed or strongly agreed that COSEE involvement changed the way they *think* about research questions, with 34% indicating a *shift in focus* toward more societally relevant questions.

4. **The quality and quantity of education and outreach increased because of COSEE, according to respondents.** Nearly three-quarters of the scientists taking the survey said COSEE helped improve the quality of their work and gave them opportunities to plug into existing education and outreach (73% and 72%, respectively).

5. **Respondents report that their college-level teaching improved.** Nearly three-quarters of the respondents (70%) said their science teaching improved, while 78% asserted that COSEE expanded their network of colleagues (i.e., educators and other scientists) to support their teaching.

A. Anderson, R. Dorph, P. Kwon

6. **Length and type of affiliation with COSEE influenced the degree to which COSEE impacted respondents' professional activities.** Statistical analysis showed positive correlation between *number of years* with COSEE and impact on factors: research, education and outreach, teaching and institutional support, while there were significant differences on those factors based on the *type* of involvement.

7. **COSEE activities (e.g., professional development and proposal support) targeted at scientists had an impact on respondents' professional practices.** There were significant differences with those who involved COSEE in proposal development and/or participated in professional development for three of four factors, compared with those who did not participate.

8. **Respondents' perspective on the impact of COSEE on their teaching is related to their personal and professional characteristics.** There were significant and positive relationship for females and those not tenured on the "teaching" factor, but a significant negative correlation between academic degree and the "teaching" factor.

9. **Respondents note other personal and institutional benefits from COSEE.** Three-fourths of the responding scientists (75%) agreed or strongly agreed that COSEE had a positive impact on their understanding of science education practices and science learning research.

10. **Respondents are reaching out to underrepresented audiences, but institutions are still finding it challenging to recruit them into the sciences.** The survey results revealed that 52% of respondents agreed or strongly agreed that COSEE had a positive impact on reaching out to underrepresented audiences, yet only 24% similarly agreed that COSEE had a positive impact on their institution's success at recruiting underrepresented students into the sciences.

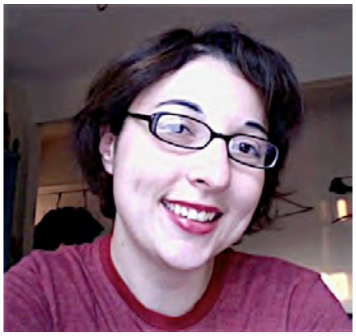
Conclusions

The study described herein contributes to understanding the benefits of COSEE to scientists and the scientific enterprise and provides evidence and support for NSF's investments in education and outreach. This contribution is three-fold. First, researchers used factor analysis to develop and evaluate a survey instrument, which may be useful in future studies. Second, the scientists who participated in this study provided us with key insights about the ways in which COSEE impacted their professional practices. Third, the study raised questions that are worthy of future investigation.

Finally, this study shows there is an intensity and duration of engagement needed in order to witness the types of transformative outcomes we observed among these respondents. It suggests that substantial investment is required to meet NSF's goals for Broader Impacts and to transform relationships between scientists and educators.

PLENARY SESSION PRESENTERS

Carla Companion, COSEE Ocean Systems



Carla Companion is a research associate for the Center for Ocean Science Education Excellence (COSEE) Ocean Systems. Carla serves as the co-chair of the Excellence in Networking Tools sub-group (ENTs) and is a member of the Web Working Group (WWG). In addition to supporting COSEE-OS workshops, webinars and projects, Carla is a User Interface Requirements Developer and Tester for the NSF-funded Ocean Observatories Initiative. Prior to joining COSEE-OS, she earned her MS in Environmental Studies/Environmental Education from Antioch University New England and her B.S. in Marine and Freshwater Biology from the University of New Hampshire.

Greg Baerg, Raytheon Web Systems

Greg Baerg is a project lead for Raytheon Web Systems at the Jet Propulsion Laboratory in Pasadena, CA. Greg interacts with the COSEE Web Working Group to design and implement COSEE Center websites and content management system, including COSEE.net and individual center sites.

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PLENARY SESSION PRESENTER

Peter McLaren, Science and Technology Specialist, Rhode Island Department of Education

Peter McLaren is Past President of the Council of State Science Supervisors (CSSS), serving as President from July, 2010 until April, 2013. McLaren has served on the CSSS Executive Board since 2007. He is a member of the National Academies' Committee for Developing Assessments of Science Proficiency in K-12 Education and is a member of the Board of Directors for the Triangle Coalition for Science and Technology Education. Mr. McLaren has also served as a member of the national writing committee for the Next Generation Science Standards (NGSS)

Under his leadership, CSSS has implemented Building Capacity in State Science Education (BCSSE), a national project designed to empower foundational knowledge, motivation, partnerships, and collaborations at the state level necessary to ensure that a new vision for science learning and teaching, with fidelity to the National Research Council's report (2012) A Framework for K-12 Science Education is present in classrooms throughout the United States. Since 2011 CSSS has conducted three national BCSSE conferences for state science supervisors and their State Implementation Teams. The fourth BCSSE conference will take place in Pittsburgh, Pennsylvania on June 7th and 8th, 2013.

Mr. McLaren is currently the Science and Technology Specialist for the Rhode Island Department of Education (RIDE) where he is responsible for policy issues pertaining to K-12 science curriculum, instruction, and assessment as well as technology education. Before joining RIDE in 2005, McLaren was a teacher of science for 13 years at both the high school and middle levels. An award winning educator Peter was recognized with the Milken Family Foundation National Educator Award (2001) and as the Rhode Island Science Teacher of the Year (1995) by the MIT sponsored, Network of Educators of Science and Technology.

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NEXT GENERATION SCIENCE STANDARDS For States, By States

The Next Generation Science Standards

Executive Summary

There is no doubt that science—and, therefore, science education—is central to the lives of all Americans. Never before has our world been so complex and science knowledge so critical to making sense of it all. When comprehending current events, choosing and using technology, or making informed decisions about one's healthcare, science understanding is key. Science is also at the heart of the United States' ability to continue to innovate, lead, and create the jobs of the future. All students—whether they become technicians in a hospital, workers in a high tech manufacturing facility, or Ph.D. researchers—must have a solid K–12 science education.

Through a collaborative, state-led process, new K–12 science standards have been developed that are rich in content and practice and arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked science education. The Next Generation Science Standards are based on the *Framework for K–12 Science Education* developed by the National Research Council.[1]

Advances in the Next Generation Science Standards

- Every NGSS standard has three dimensions: disciplinary core ideas (content), scientific and engineering practices, and cross-cutting concepts. Currently, most state and district standards express these dimensions as separate entities, leading to their separation in both instruction and assessment. The integration of rigorous content and application reflects how science and engineering is practiced in the real world.
- Scientific and Engineering Practices and Crosscutting Concepts are designed to be taught in context – not in a vacuum. The NGSS encourage integration with multiple core concepts throughout each year.
- Science concepts build coherently across K-12. The emphasis of the NGSS is a focused and coherent progression of knowledge from grade band to grade band, allowing for a dynamic process of building knowledge throughout a student's entire K-12 scientific education.
- The NGSS focus on a smaller set of Disciplinary Core Ideas (DCI) that students should know by the time they graduate from high school, focusing on deeper understanding and application of content.
- Science and engineering are integrated into science education by raising engineering design to the same level as scientific inquiry in science classroom instruction at all levels, and by emphasizing the core ideas of engineering design and technology applications.

[1] The performance expectations were developed using elements from the NRC document and should be cited as, *A Framework for K-12 Science Education,* © 2012, National Academy of Sciences." Moreover, the portion of the standards entitled "Disciplinary Core Ideas" is reproduced verbatim from *A Framework for K-12 Science Education: Practices, Cross-Cutting Concepts, and Core Ideas*. They are integrated and reprinted with permission from the National Academy of Sciences. © 2012, National Academy of Sciences

- The NGSS content is focused on preparing students for college and careers. The NGSS are aligned, by grade level and cognitive demand with the English Language Arts and Mathematics Common Core State Standards. This allows an opportunity both for science to be a part of a child's comprehensive education as well as ensuring an aligned sequence of learning in all content areas. The three sets of standards overlap and are reinforcing in meaningful and substantive ways.

NGSS Design Considerations

In putting the vision of the *Framework* into practice, the NGSS have been written as performance expectations that depict what the student must do to show proficiency in science. Science and Engineering Practices were coupled with various components of the Disciplinary Core Ideas and Crosscutting Concepts to make up the performance expectations. The NGSS architecture was designed to provide information to teachers and curriculum and assessment developers beyond the traditional one line standard. The performance expectations are the policy equivalent of what most states have used as their standards. In order to show alignment and coherence to the *Framework*, the NGSS include the appropriate learning goals in the Foundation Boxes in the order in which they appeared in the *Framework*. They were included to ensure curriculum and assessment developers should not be required to guess the intent of the performance expectations.

Coupling Practice with Content

State standards have traditionally represented Practices and Core Ideas as two separate entities. Observations from science education researchers have indicated that these two dimensions are, at best, taught separately or the Practices are not taught at all. This is neither useful nor practical, especially given that in the real world science and engineering is always a combination of content and practice.

It is important to note that the Scientific and Engineering Practices are not teaching strategies -- they are indicators of achievement as well as important learning goals in their own right. As such, the *Framework* and NGSS ensure the Practices are not treated as afterthoughts. Coupling practice with content gives the learning context, whereas practices alone are activities and content alone is memorization. It is through integration that science begins to make sense and allows student to apply the material. This integration will also allow students from different states and districts to be compared in a meaningful way.

The NGSS are Standards, not Curriculum

The NGSS are standards, or goals, that reflect what a student should know and be able to do—they do not dictate the manner or methods by which the standards are taught. The performance expectations are written in a way that expresses the concept and skills to be performed but still leaves curricular and instructional decisions to states, districts, school and teachers. The performance expectations do not dictate curriculum; rather, they are coherently developed to allow flexibility in the instruction of the standards. While the NGSS have a fuller architecture than traditional standards—at the request of states so they do not need to begin implementation by "unpacking" the standards—the NGSS do not dictate nor limit curriculum and instructional choices.

<u>*Instructional Flexibility*</u>

Students should be evaluated based on understanding a full Disciplinary Core Idea. Multiple Scientific and Engineering Practices are represented across the performance expectations for a given Disciplinary Core Idea. Curriculum and assessment must be developed in a way that builds students' knowledge and ability toward the performance expectations. As the NGSS are performances meant to be accomplished at the conclusion of instruction, quality instruction will have students engage in several practices throughout instruction.

Because of the coherence of the NGSS, teachers have the flexibility to arrange the performance expectations in any order within a grade level to suit the needs of states or local districts. The use of various applications of science, such as medicine, forensics, agriculture, or engineering, would nicely facilitate student interest and demonstrate how scientific principles outlined in the *Framework* and NGSS are applied in real world situations.

Next Steps

With the final release of the NGSS in April 2013, states will begin their individual processes to consider adoption. The lead states are under no obligation to adopt, only to seriously consider adoption. There is no set timeline for adoption or implementation. As with all K-12 educational standards, the decision to adopt by any given state is voluntary.

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Day 2: Wednesday, May 8, Detailed Agenda

7:30 a.m. Salon G	Council Breakfast Meeting
7:30 a.m. Salon Foyer	Breakfast (non-Council members)
8:30 a.m. Salons H, I, J	Welcome Back and Recap Gail Scowcroft, National COSEE Network Executive Director Jan Hodder, COSEE Council Chair and COSEE Pacific Partnerships
8:45 a.m. Salons H, I, J	Plenary: *Review of September 2012 Diversity Work Session* Presenter: Sue Cook, COSEE Florida
9:00 a.m. Salons H, I, J	Plenary: *The C21 Ocean Scientist* Facilitators: Cheryl Peach, COSEE California; Jan Hodder, COSEE Pacific Partnerships Scribe: Romy Pizziconi, National COSEE Office Objective: Explore the skills and habits of mind that will help undergraduate and graduate students successfully navigate the pathways into the ocean science careers of the 21st century. Outcome: What can COSEE continue to do to support undergraduate and graduate students interested in or planning an ocean science or ocean science related career? Presenter: Jeff Ryan, University of South Florida *Constructing The Pathways to an Earth and Ocean Systems Career* Presenter: Brian Bingham, Western Washington University *Increasing Our Diversity - Engagement in the Pathway*
10:15 a.m. Salon Foyer	Break
10:30 a.m. Salons H, I, J	Panel: *Individual Pathways to an Ocean Science Career* Preservice Teacher: Elizabeth Hoogkamp, Indian River State College Undergraduate Students: Norris Comer, Eckerd College; Lexi Duscher, Eckerd College Graduate Students: Marcy Cockrell, University of South Florida; Sarah Grasty, University of South Florida Teacher: Christopher Tolliver, Dan McCarty Middle School Post Doc: Erin Muller, Mote Marine Laboratory
11:15 a.m. Salon G Meeting Room 7	Breakout Sessions: *Ideas for Providing the Support Needed for the C21 Ocean Scientist* • High School • Community College • Undergraduate Students • Preservice Teachers • Graduate Students • Teachers Guiding Question: What can COSEE do and where do we have the support? Scribes: Each group will designate a scribe
11:45 a.m. Salons H, I, J	**Report Out**: *Ideas for Providing the Support Needed for the C21 Ocean Scientist* Scribe: Liesl Hotaling, National COSEE Office and COSEE NOW
12:15 p.m. Salon Foyer	Lunch
1:15 p.m. Salons H, I, J	Plenary: *Reports from Relevant Projects* • Earth Cube, Cheryl Peach • Ocean Observing Initiative, Sage Lichtenwalner • InTeGrate, Anne Egger Scribe: Meghan Buckley, COSEE Florida

Day 2: Wednesday, May 8, Detailed Agenda

1:30 p.m. Salons H, I, J	Plenary: *Update on Education Initiatives from NSF and NOAA* Presenter: Sarah Schoedinger, NOAA Presenters: Lisa Rom and Jeff Ryan, NSF Scribe: Andrea Gingras, National COSEE Office
2:00 p.m. Salons H, I, J	Plenary: *Next Steps for the Network* Gail Scowcroft and Billy Spitzer, National COSEE Office Scribe: Romy Pizziconi, National COSEE Office
3:00 p.m.	Adjourn

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PLENARY SESSION PRESENTERS

Jeff Ryan, University of South Florida

Dr. Jeff Ryan is Professor and Chair of the Geology Department as the University of South Florida, in Tampa, FL. He is both an active research petrologist/geochemist, studying volcanic island arcs and metamorphic phenomena in modern subduction zone settings; and a scholar and leader in geoscience education, investigating strategies that help undergraduate students transition from novice to expert in the geosciences, and the educational potential of the burgeoning field of geoinformatics. He served as a Program Officer in the NSF Division of Undergraduate Education from 2003-2005, and is currently the Principal Investigator of the NSF-funded Coastal Areas Climate Change Education Partnership (CACCE), and the Resources to Transform Undergraduate Geoscience Education (RTUGeoEd) project, an NSF Transforming Undergraduate Education in STEM (TUES) Program project aimed at building capacity in the geosciences for fundable educational innovations at the college level.

Brian Bingham, Western Washington University

Brian Bingham is a Professor in the Department of Environmental Sciences at Western Washington University (Bellingham, WA). His research activities center on symbiotic relationships like those that exist in reef-building corals. He teaches courses in marine science, experimental design and statistics and co-directs the Marine and Estuarine Science Graduate Program at Western Washington University. Since 1991, Brian has administered the Multicultural Initiative in the Marine Sciences Undergraduate Program (MIMSUP). The goal of this National Science Foundation-funded program is to increase the participation of individuals from underrepresented groups in the marine sciences. Webpage: http://faculty.wwu.edu/bingham/

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NEWS**FOCUS**

A Sea Change for U.S. Oceanography

Marine scientists are confronting declining budgets and a shrinking research fleet as torrents of data from new technologies remake their field

SINCE 1996, OCEANOGRAPHER KIPP Shearman has relied on a duo known around the lab as Bob and Jane to measure chlorophyll and other environmental parameters in the ocean off the Oregon coast. Roaming the sea for 3 to 5 weeks at a time, the pair never complains and comes up for air just every 6 hours. They're 2-meter-long automated submersibles called gliders, and the reams of data they've collected have allowed Shearman's team at Oregon State University, Corvallis, to make novel insights into changing marine ecosystems.

The gliders are cheaper than sending scientists out in ships to make measurements, Shearman says, and they can remain at sea nearly indefinitely. He named the machines after some senior colleagues, and, "We kid them that we're replacing them with robots."

There's a glimmer of truth to that notion. Two cultural shifts are simultaneously shaking the foundations of oceanography in the United States—and fueling a debate about the future direction of a fast-changing field. Fewer scientists are going to sea as a result of a shrinking science fleet, flat budgets, and skyrocketing costs. At the same time, oceanographers are using a growing array of high-tech devices—such as satellites, gliders, and vast networks of sensors tethered to the sea floor—to remotely collect more data than ever before without getting wet.

The trends are helping to transform oceanography "from small science to big science," says technologist James Bellingham of Monterey Bay Aquarium Research Institute (MBARI) in Moss Landing, California. That shift, in turn, is affecting how researchers study an increasingly urgent set of problems, including overfishing, ocean warming, and acidifying seas. It is also altering the culture of oceanography, including how scientists share data and how young oceanographers are trained.

Online
sciencemag.org
Podcast interview with author Eli Kintisch (http://scim.ag/pod_6124).

The churning is prompting contradictory emotions, however. The decline of the U.S. science fleet is "a catastrophe that's happening in slow motion," warns Bruce Appelgate, who heads ship and marine operations at the Scripps Institution of Oceanography in San Diego, California. But "we've entered a new era in oceanography, and it's for the best," declares oceanographer Sydney Levitus of the U.S. National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Maryland.

A waning fleet

A symbol of the changes remaking marine science floats alongside the dock at the Woods Hole Oceanographic Institution (WHOI) in Massachusetts. In its glory days, the research vessel *Atlantis* boasted adventures that kept it at sea for 10 months a year. Last year, it was out of port for only 8 months. Idle, the 84-meter-long vessel has the vacant feel of an abandoned steel office building, albeit a floating one. Labs and workshops sit empty; just a few crew members and students were busy during a recent visit. "We've had our thumb out looking for work," says Captain A. D. Colburn. He was "grateful" that Canadian scientists hired the ship for a monthlong mapping mission this past summer. But fewer U.S. researchers are using *Atlantis* as a result of funding issues and because its equipment is undergoing recertification tests to deploy its celebrated partner craft, the piloted submersible *Alvin*. So Colburn is confronting "a lot of face time with my computer," he says glumly, echoing a common refrain these days among oceanographers.

The dormancy is a product of decades-long policy shifts. During the Cold War, the U.S. Navy was the main benefactor of the nation's marine scientists, whose studies on ocean mixing and sound scattering served

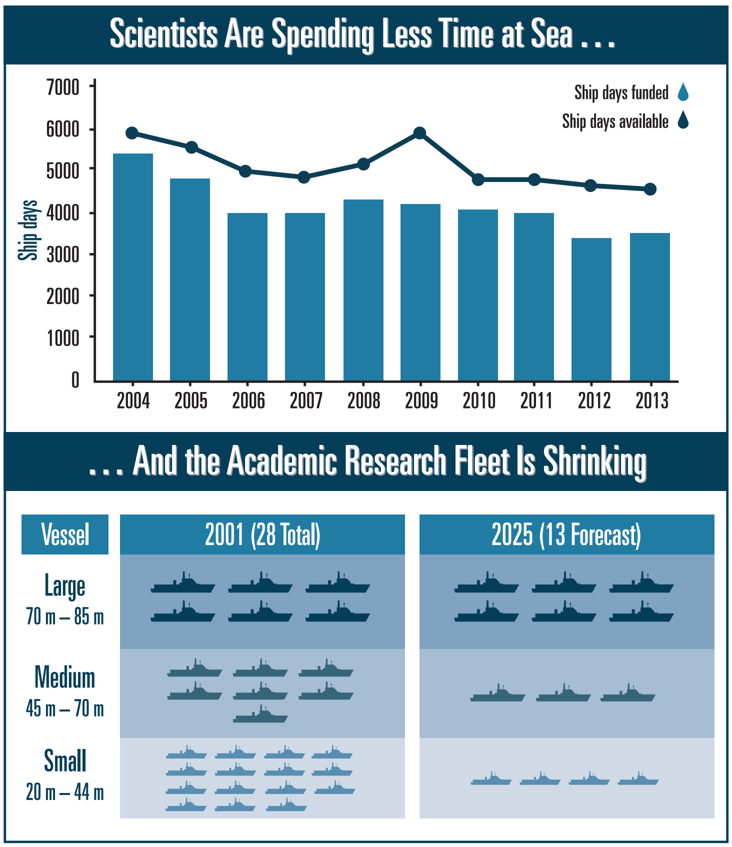
CREDIT: TRISTAN PEERY, OREGON STATE UNIVERSITY

Published by AAAS

Robot overboard. Gliders offer scientists like Kipp Shearman a nearly permanent presence at sea.

military needs such as for undersea warfare. As the Navy has steadily reduced its support for academic oceanography, researchers have pieced together support from up to nine federal agencies; NOAA, the National Science Foundation (NSF), and the Navy are now the main funders. The fraction of federal research funding devoted to ocean sciences plummeted as the Cold War wound down, from roughly 7% in the 1970s to 3.5% in the 2000s, analysts estimate.

While budgets have stagnated, the U.S. science fleet has shrunk and the price tag for expeditions has skyrocketed. Academic oceanographers rely largely on government-built vessels operated by the University-National Oceanographic Laboratory System (UNOLS), a consortium of 62 universities and government laboratories. In 2001, UNOLs boasted 28 ships; now there are 19, and fleet officials project that there will be 13 in 2025, barring new federal commitments. Meanwhile, operating costs for the five largest UNOLS ships, which can support dozens of scientists for months at a time, have doubled in the last decade to roughly $36,000 per day. Daily costs for smaller ships have increased by 50%, to about $8000 per day. Such increases—along with hefty investments in new technologies—are reshuffling marine science budgets: This year, for the first time, NSF's Division of Ocean Sciences, a major UNOLS funder, expects to spend more of its $352 million budget on ships and infrastructure than on support for research grants.



Landlocked? Fewer ships and less money mean getting to sea is increasingly challenging for university researchers.

One result is that, in a bid to pinch pennies, funding agencies have been urging scientists to use smaller, less expensive ships for their work when possible. That can create problems, researchers say. As part of a 2005 geological study of Hawaiian volcanoes, for instance, geologists deployed 35 seafloor seismometers using one of the larger UNOLS vessels, the 85-meter-long *Melville* operated by Scripps. When they returned the following year to retrieve them, NSF stipulated that the researchers use the smaller and less-costly *Ka'imikai-o-Kanaloa*, operated by the University of Hawaii, which lacks the *Melville*'s heft and ability to maneuver laterally. The downsizing contributed to two mishaps in rough seas, says Scripps geophysicist Gabi Laske, the cruise leader. In one, a 200-kg seismometer smashed against the side of the vessel as the crew tried to haul it on deck, causing minor damage to a sensor. "It's extremely unlikely this would have happened with a larger ship," Laske says. "It's these little things that make science in the ocean more dangerous and more difficult."

The combination of fewer ships, increasing costs, and stagnating budgets is also creating a worrying feedback loop. Researchers interested in going to sea say they are having a harder time getting their proposals funded—and NSF has in the past suggested that requests that don't include costly ship time might have a better chance of winning approval. Discouraged, some researchers have simply stopped trying to do science aboard ships. "The last thing we want to do is spend a lot of time working on a proposal that is not going to be successful," says biological oceanographer Dennis McGillicuddy of WHOI.

In 2011, a UNOLS survey of 355 oceanographers found that 62% had at some point been "reluctant" to ask for at-sea funding, citing a "perception of low award rate for proposals with ship time." Ironically, that reluctance could further hasten the decline of the fleet, because it reduces demand and funding for the vessels. Indeed, officials say the demand for ship time is declining.

Many UNOLS vessels, some of which are 40 years old, are also showing their age or suffering from underfunded maintenance programs. Last year, three of the fleet's four large vessels operating from Pacific ports had serious technical problems. The 84-meter-long *Thomas G. Thompson*, for instance, was sidelined for half a year with a busted main thruster, a calamity that was "very disruptive" for several major cruises, says official Douglas Russell of the University of Washington (UW), Seattle, which manages the ship. (Some blame availability of parts, not the maintenance schedule, for the problem.) And in early 2012, the U.S. Coast Guard had to rescue the *Kilo Moana*, a 57-meter-long vessel operated by the University of Hawaii, after corrosion punched a 6-centimeter hole in its hull. "Not only are we losing ships, but the condition of the ships is such that they're breaking down," says Peter Wiebe, an oceanographer at WHOI and former UNOLS chair.

The prospects for major improvements are relatively bleak. A 2001 UNOLS plan called for building 10 new ships by 2020 for a fleet size of 16. The proposed additions included seven large ones, to "maintain fleet capacity" (*Science*, 21 January 2005, p. 338). So far, however, replacements have come more slowly than envisioned and just three new

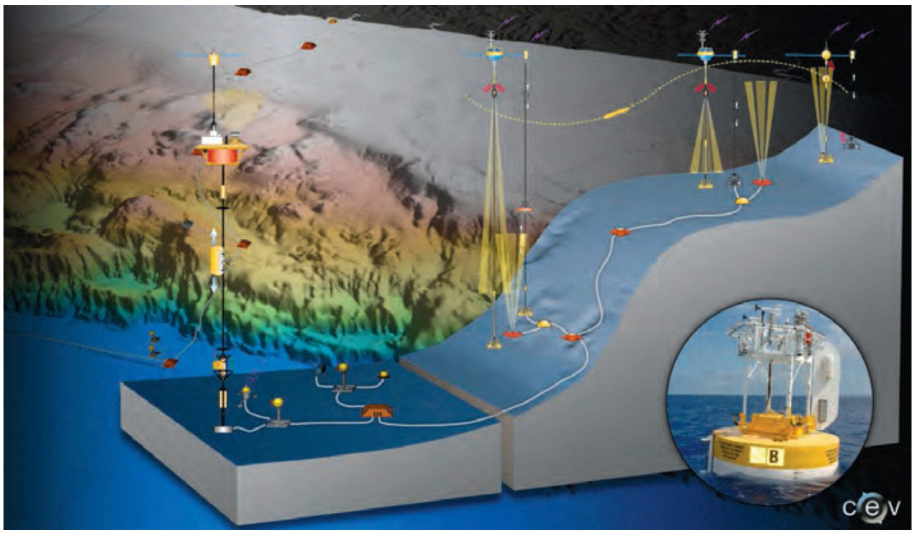
CREDITS: UNOLS

ones have appeared, including two large ships with less range than the vessels they replaced. Three are getting tested or are under construction, and three others are on the drawing board but unfunded. If those three fail to materialize, vessel retirements would shrink the fleet to 13 vessels in 2025. A smaller fleet will be "increasingly unable to meet science user demands," concluded a 2009 UNOLS report. "[M]ulti-ship operations" would be more difficult to schedule, it warns, as would "expeditions in remote areas."

Even stabilizing the fleet at 13 vessels could become a stretch given current U.S. budget problems. This past June, NSF and Navy officials recommended that UNOLS retire some smaller ships sooner than planned in order to create savings that "would be used to bolster the schedules of the remaining vessels." That framework troubles researchers who primarily work in coastal and nearshore waters, where the smaller ships are an advantage. The plan will create "a big gap" in the fleet, McGillicuddy says.

The downsizing doesn't necessarily mean disaster, says Rodey Batiza, an official with NSF's ocean research branch. Modern ships feature more capable laboratory spaces than their predecessors and can deploy robotic payloads that can roam widely, enabling vessels to collect "1000 times more data in a day than they did a decade ago," Batiza says. But many oceanographers are not persuaded. "The ocean is undersampled now, and it was undersampled when we had 28 ships," McGillicuddy says. "The new tools don't obviate the need for research vessels."

The bottom line, believes former UNOLS Chair Bruce Corliss, dean of the Graduate School of Oceanography at the University of Rhode Island (URI), Narragansett Bay, is that "we have a significant crisis for the UNOLS fleet."



Wired sea floor. A panoply of sensors and robots will provide fully powered, real-time data through the Ocean Observatories Initiative.

The marine tech revolution

The fleet's woes are all the more striking in contrast to the dazzling new data-gathering tools that oceanographers now deploy. Walk the deck of a research vessel built in the 1970s, and you'll find shiny new submersibles, buoys, and other devices sporting the latest in batteries, communications, and cameras, often built by graduate students half as old as the ships. These are the tools of a technological revolution in oceanography that began some 3 decades ago, with the 1978 launch of SEASAT, the first civilian oceanographic satellite. During just 3 months in orbit, NASA estimates SEASAT collected as much data—including sea surface temperatures, wind speeds, and ice conditions—as had been acquired by all ships during the previous century.

Now, automated devices are gathering even more data from more places, including far below the top centimeter of seawater that satellites can probe. Since 2004, for example, the global Argo program, comprised of 3500 drifting devices packed with electronics, has extensively profiled the oceans to a depth of 2000 meters (*Science*, 27 April 2012, p. 405). Costing roughly $10,000 each, the floats measure temperature, pressure, and salinity as they rise and sink over a 10-day cycle, reporting data continually by satellite. The floats collect some 120,000 profiles each year, dwarfing the 15,000 or so that ships collected just a few decades ago. Researchers slicing and dicing Argo data have already produced more than 1100 scientific publications, including papers with new insights into the ocean's heat content and major currents.

Physical and chemical oceanographers have benefited most, but biologists are eager to catch up. "We have physics envy," says biological oceanographer David Karl of the University of Hawaii, Manoa. He is just one researcher hoping to benefit from the next generation of Argo floats, which will include sensors able to monitor biological activity, such as the rate of marine photosynthesis.

Other cutting-edge automated instruments are essentially floating laboratories. The Lexus of these devices is called the Environmental Sample Processor (ESP), developed by MBARI. About the size of a large trash can, the ESP usually hangs roughly 20 meters below the ocean surface off a moored buoy. Inside, a robot draws in water samples, extracts RNA from them, and uses a microarray to detect certain microorganisms' genes. MBARI recently commercialized the machine and researchers hope to use it to monitor fisheries, sewage pollution, and harmful algal blooms. The ESP is "really the only show in town" when it comes to high-tech remote biological oceanography, Karl says.

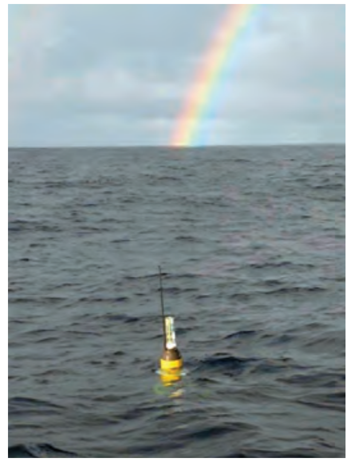
The ESP costs roughly $175,000, but its more affordable robotic brethren "democratize" the ability to do studies once within the reach of only larger laboratories, says MBARI's Bellingham. For example, submersible gliders like Oregon State's Bob and Jane can cost $125,000 to $150,000 each, making them "something that under a normal research grant you can buy," he says.

Falling technology prices are also spurring innovation. One barrier to developing new marine science gear has been the cost of the cruises needed to test it at sea. But many gliders, robotic submersibles, and floats now can be tested off small vessels near shore. At URI, marine engineer Chris Roman and colleagues are using that approach to develop a new device on a relatively small budget of $1 million. The tubular float snaps one high-resolution photo of the ocean floor every second as it drifts in shallow waters, where floats like Argo can't operate. "We approached it as: 'What could we do with a very simple instrument?'" Roman says. If it works, the floating photographer could make the weekly chore of catching and counting fish in nearby Narragansett Bay far less arduous for graduate students.

The marine technology renaissance isn't just about tinkerers building single instru-

CREDIT: OOI REGIONAL SCALE NODES PROGRAM AND THE CENTER FOR ENVIRONMENTAL VISUALIZATION, UNIVERSITY OF WASHINGTON ments; it is also enabling researchers to envision and install vast instrument networks that are linked to land by kilometers of fiber optic cable. The wired ocean includes a new Japanese 20-site seismology network, a 12-site network that will ultimately dot European seas, and a U.S. network that connects several coastal sensor arrays. The most ambitious project is the Ocean Observatories Initiative (OOI), an international, Internet-connected network featuring 804 physical, chemical, and biological sensors in six separate arrays from Greenland to southern Chile (*Science*, 16 November 2007, p. 1056). Whereas battery-powered seafloor sensors can conk out, sensors on the OOI network, now under construction, will get a steady supply of power from land. With an estimated cost of $770 million, scientists predict that OOI, which is scheduled to go live in the deep ocean next year, will give them immediate access to data, a rare treat. In the process they'll get a front-row seat to ephemeral or fast-moving seafloor phenomena, such as undersea methane burps, that can be hard to capture during relatively brief research cruises.

These new systems will produce unprecedented torrents of data. And like space and genome scientists before them, oceanographers now face the challenge of efficiently storing, using, and sharing their largess. One difficult task will be learning how best to combine and properly label incompatible data sets, says URI oceanographer Peter Cornillon. Another will be making sure all the data get used; it's becoming increasingly common that some data go unanalyzed after a cruise or project—a notion that would have been unthinkable just a few years ago.



New day. Three-thousand-five-hundred Argo floats provide unprecedented daily ocean data.

The arrival of big oceanography is engendering a new commitment to sharing data. Traditionally, scientists jealously guarded their data for 2 years after collection, giving them time to publish, says John Gould of the National Oceanography Centre in Southampton, U.K. Some geochemical data collected on cruises during the 1990s "didn't see the light of day for 10 years," he notes. Now, raw satellite, Argo, and glider data are available nearly instantly online, and sharing is becoming the norm.

A new process

Such changes are helping reshape and enhance a variety of oceanographic projects, which generally fall into two broad categories. One is "process" studies, which examine specific phenomena through experiments that can last days, weeks, or perhaps a month. The other includes monitoring or survey efforts that gather data over a long period in different places, or annually at the same spot, in order to track changing conditions.

Process experiments highlight the growing capabilities of modern ships, which can host big, multidisciplinary teams working in clean, roomy labs equipped with devices, such as DNA sequencers or mass spectrometers, that were previously available only on land.

The New Generation of Sea Scientist

Veteran oceanographer Margaret Leinen fondly remembers the regular stream of lengthy ocean cruises that she and her fellow students enjoyed during their training in the 1970s—and the outsized demand for their labor. Senior scientists asked: "How many times can we get students to go to sea before they rebel?" recalls Leinen, director of Harbor Branch Oceanographic Institute in Fort Pierce, Florida.

Now, however, "seafaring adventures are a much smaller part of the way we perceive our careers than those who are 15 or 20 years older," says Rebecca Walsh Dell, who recently received a doctorate from the Woods Hole Oceanographic Institution (WHOI) in Massachusetts. Of the five students who joined her Ph.D. program the same year, only one, who focuses on biology, has relied on data collected on ocean cruises for their graduate research, she says. The others have used remote sensing data, modeling studies, or data from the Argo network. "The traditional model—design an experiment, deploy equipment, collect the data, spend 2 years writing the paper—none of us did that." The students eventually made it on a cruise, she says, "but only to see how the sausage gets made."

That doesn't mean young scientists don't still dream of exploring the high seas. A summer fellowship that trains graduate students to lead research cruises has "more students signing up than we can accommodate," says Bruce Appelgate, who runs the program at the Scripps Institution of Oceanography in San Diego, California. "We've got a tremendous interest among students in getting out to sea."

Core curriculum. Time at sea is no longer a mandatory part of oceanographic education.

Overall, about 45% of the approximately 2500 graduate students in U.S. oceanography programs saw time at sea the year before, according to a 2011 survey conducted by the University-National Oceanographic Laboratory System. It also found that 75% of U.S. ocean scientists within 4 years of completing their postgraduate training planned to request future ship time. Still, that is less than the 85% of scientists with more than 20 years of experience who said the same. And WHOI oceanographer Peter Wiebe is dismayed that the institute's graduate students routinely turn down invitations to take a berth on an upcoming cruise. "We end up bringing European or Asian students," he says.

That's a danger sign for some oceanographers. Kipp Shearman of Oregon State University, Corvallis, says that the master's degree students he supervises "get real skilled real fast" at programming gliders and interpreting the data they provide. But that can't replace "the experience of doing ship-based research." John Gould of the National Oceanography Centre in Southampton, U.K., worries that data are being "handed on a plate to young scientists on the Web sites, and there might be this tendency [not to question] the numbers." But "turn the clock back 20 years," he says, and "you went out and collected your own data, you applied your own expertise to it, and you had to question whether things [were] what they seemed."

–E. K.

CREDITS (TOP TO BOTTOM): ADAM Ú/PICASA/NOAA; 2012 SCRIPPS INSTITUTION OF OCEANOGRAPHY/UNIVERSITY OF CALIFORNIA, SAN DIEGO

They also emphasize the evolving role of the research vessel as a mother ship for an array of mobile technologies. In 2011, for example, a 50-scientist team used a pair of big ships to help launch a study called LatMix that used a phalanx of tools to study surface stirring—a fundamental ocean process poorly described by computer models. Working in the Gulf Stream off the coast of Cape Hatteras, North Carolina, the researchers released tracking dyes, robotic submersibles, and floats, and even called in an airplane to help keep a close eye on moving water masses. The "impressive" project set a recent scientific meeting abuzz, says Rebecca Walsh Dell, a postdoctoral researcher at Scripps.

Similarly, MBARI researchers have deployed ships, robot submersibles, and ESP, their floating gene analyzer, in multifaceted efforts to study California's Monterey Bay. In one 2009 campaign, the scientists used real-time data from an ESP to guide the submersibles to interesting sampling locations. Combining the data revealed in new and startling spatial detail how zooplankton flock to otherwise invisible boundaries between warm and cold water masses.

Autonomous or remotely controlled assets are also allowing researchers to collect data in rough seas or remote areas that can be too dangerous for ships. When Superstorm Sandy hit the New Jersey coast last year, for example, Rutgers University researchers were able to deploy a glider that offered a unique look at how the storm scrambled near-shore sediments and water layers (*Science*, 9 November 2012, p. 728).

Biological oceanographers are also hoping to chart new territory, for example by building devices that can track individual organisms. Measuring biological activity has often meant sampling creatures as they waft by one particular spot in the ocean. Advanced sensors and software, however, could enable a submersible to follow visual, chemical, or biological cues. "Smarts on board—that's the nirvana we'd like to move towards," says Oregon State's Mark Abbott.

The closest thing so far is a torpedo-shaped robot called *Tethys* which combines aspects of a propeller-driven submersible and a buoyancy-driven glider. It can wait for weeks in areas of interest before racing to a specific site—and it travels four times faster than previous gliders. One of its designers, MBARI's Bellingham, hopes that similar tools will one day travel alone to an algae bloom during its initial stages of development and then monitor its growth and decline, which generally takes a month.

Ahoy, Telepresence

One way oceanographers are coping with dwindling ship time is by using "telepresence" video technology to connect landlocked scientists with colleagues at sea. Last summer, one such virtual cruise marked the first time the technique was used to help direct an autonomous submersible mission.

The 3-week expedition explored seafloor seeps near the Blake Ridge, roughly 500 km off the South Carolina shore. The research team was split between a small group of scientists and engineers aboard the National Oceanic and Atmospheric Administration vessel *Okeanos Explorer*, which features a suite of cutting-edge video and data communication tools, and about a dozen scientists and students on shore at the University of Rhode Island, Narragansett Bay. To find seeps, the shipboard team deployed an autonomous robotic submersible called *Sentry* each evening and retrieved it the following morning.

Screen time. Scientists on shore wave to colleagues at sea during a telepresence cruise.

Sentry's sonar, image, and sensor data were sent daily via satellite to the scientists in Rhode Island for analysis. The shipboard team, meanwhile, analyzed ship sonar data for clues to possible seep areas. Together, the two groups used the information to identify promising areas for *Sentry*'s daily dive and plan the spacing of its zigzag search pattern. Scientists call the virtual cruise a modest scientific success, noting that it discovered five new seeps in an area previously known to contain only one.

Equally important, perhaps, was that the effort demonstrated how virtual cruises can enhance training for students, even undergraduates. It's tough for a college student to get a spot on a research cruise, notes one of the students on the shore team, junior Meghan Rose Jones of the University of Miami in Florida. So it "was an opportunity which would have not been otherwise possible," she says. Even if she had gotten a berth, Jones thinks she might have spent many more hours standing watch than analyzing data. Instead, she learned to use two mapping software programs and participate in research decision-making.

By the end of the cruise, Jones and several graduate students "were the ones discovering what the seafloor was like" and making dive plan suggestions, says lead scientist Cindy Van Dover, director of the Duke University Marine Laboratory in Beaufort, North Carolina. The team expects to get even more out of a 5-day return expedition next year to Blake Ridge. It will feature the *Jason* tethered submersible, which can collect samples of water, rocks, and sea life. **–E. K.**

A watchful eye

The growing mix of technologies is also reenergizing the once relatively obscure world of long-term monitoring studies, enabling what Hawaii's Karl calls a shift from the "snapshot view of the ocean to the full-length movie perspective."

As recently as the 1990s, "environmental monitoring" was seen as anathema to funders interested in big experiments focused on specific questions, Karl says, and "something you would never put in a proposal, especially to NSF." But now, analyzing how ocean ecosystems influence and react to climate change, pollution, and overfishing have become important to researchers and policymakers alike. And that means developing baseline information on the ocean's "normal" conditions—such as water chemistry and seasonal fluxes in plankton—and then keeping an eye on how things change.

Human-crewed ships will continue to be essential for some survey projects, such as a global effort to understand climate variability called CLIVAR, because only they can perform complex measurements at sea, such as genetic and chemical isotope analyses. But automated devices, such as the Argo float network, are also demonstrating the value of monitoring for monitoring's sake. In part, that's because the floats go places that ships often don't, with the network covering every ice-free region of the open ocean. "The Southern Hemisphere has been so poorly observed almost anything we find will be new," says NOAA oceanographer Levitus, a member of the Argo science team.

And Argo is extending into new frontiers,

CREDIT: ALEX DECICCIO/INNER SPACE CENTER, URI

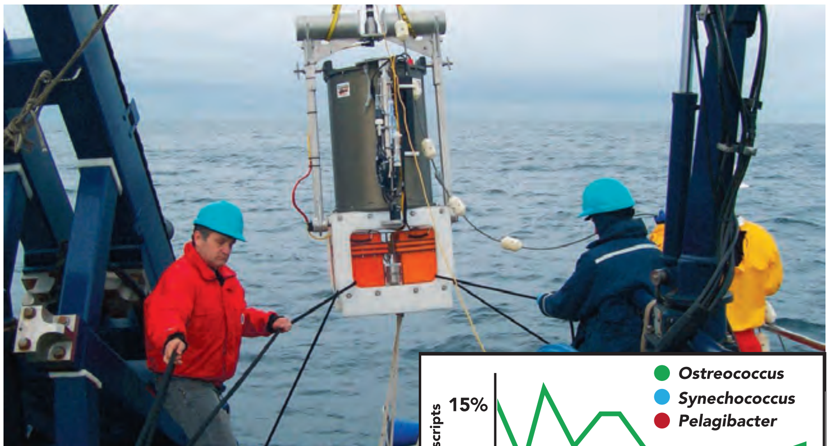
Published by AAAS

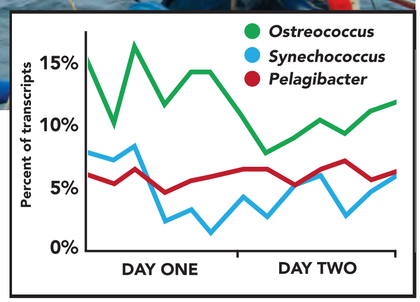
as polar scientists begin to deploy new rugged floats below sea ice. Argo is also helping eliminate a seasonal bias in oceanographic data, created by the tendency of researchers to avoid cold weather cruises. "A main finding has been that the ocean is more variable than we thought," Levitus says. Charting those changes and fluctuations is helping researchers do weather, climate, and fisheries "forecasting much better than we have ever done in the past," he adds.

Evolving technology is underscoring the power of sustained monitoring in other ways. In the late 1980s, researchers established sites near Bermuda and Hawaii, dubbed BATS and HOT, where ships and moored instruments take monthly readings. The sites have played a key role in helping scientists determine the fluctuating physical, chemical, and biological patterns that make up the ocean's baseline. But even monthly readings may not be enough to detect certain phenomena, researchers say. In 2011, for example, UW's Matthew Alford published new findings that suggest the breaking of seafloor waves happen more rarely than expected. Key to that finding were readings from a moored profiler he deployed on a cable at the HOT site that sampled the whole water column each hour for more than 2 years. "Most of the time, monthly readings taken from ships will completely miss the phenomenon" he says. Other researchers say the success of BATS and HOT suggest that it would be worth setting up new monitoring sites in areas important to global climate, such as the Arctic or northern mid-Atlantic.

Seafloor scientists are hoping to literally see fireworks with some of their new monitoring tools. Researchers have never witnessed an undersea volcanic eruption from beginning to end, notes oceanographer John Delaney of UW Seattle, one of OOI's leaders. But the payoff could be so great that researchers have built one section of the groundbreaking sensor network on the Axial Seamount, an active underwater volcano about 500 kilometers west of the Washington state coast that erupts every 10 to 15 years. "Next time it erupts we can be there," Delaney says. He's got his fingers crossed that the sensor array, which includes video, chemical, and seismic equipment, can survive the harsh environment.

Biologists are also eager to examine the exotic bacteria that the volcano spews with an underwater mass spectrometer and DNA sequencer. "By the time we [usually] get there, they've diluted or wafted away," Delaney says. Now, researchers can relax on shore in comfort, knowing OOI is always watching.





Extrasensory. The Environmental Sample Processor (*above*), a floating genetics laboratory, can track the occurrence of marine microbes (*right*).

A sea of tradeoffs

These high-tech tools are also bringing some contentious issues to the surface: The relatively high cost of systems like OOI is forcing U.S. oceanographers to confront difficult choices over how to spend limited funds. The unfolding debate sometimes pits building bigger ships against smaller ones, or ships against unmanned robotic craft—or mobile robots against static sensor networks. Deciding which tradeoffs to make will be "very, very important," UW's Delaney says. Researchers might "go to sea less," for instance, "but the data flow from these new systems is around the clock, 365 24/7, for decades."

Others are challenging the ship-centric mindset that dominates planning in marine science. At URI, for instance, Cornillon has weighed in on a campus debate about what sort of vehicle should eventually replace the university's 38-year-old research ship, *Endeavor*, which it operates for NSF. He's not against obtaining a new vessel, but says his colleagues should focus on "very quickly" evolving oceanography technologies. "The development of these will be as or more important to an institution such as URI than having its own ship," Cornillon says. He and his colleagues have envisioned a scenario for 2030 in which phalanxes of airborne drones and submersibles conduct a tightly choreographed analysis of sea-air interactions, with a ship's role undefined. Colleagues applaud such creativity, but questioning the need for a big vessel has made Cornillon "not terribly popular with many," he admits.

There's also disagreement about the value of large seafloor observatories like OOI. Floats, gliders, and robotic submersibles are well-suited for tough economic times, advocates say, because of their relatively low prices and flexibility. In contrast, OOI will require expensive ship time for maintaining the network, which could command as much as 16% of the NSF Division of Ocean Science's budget beginning in 2015. The project "really is a huge tax on everything," Alford says. "Are there other places that we haven't seen that we could be studying instead?" asks WHOI engineer Dana Yoerger. "There's a whole world to explore."

To help set priorities, the U.S. government's main ocean research advisory panel is working on a report, due next year, that will review fleet needs. At NSF, ocean science chief David Conover wants scientists to go even further. He'd like the field's diverse constituencies to write a consensus "decadal survey" with numbered priorities for projects, as scientists in astronomy and other facilities-intensive fields have done. "It's not just about how you slice the pie, it's about making the case to grow the pie," he says.

That's certainly a case researchers feel has been poorly made in Washington. "Studying the oceans should be funded comparable to research in outer space," says UW's Delaney. But with a depressing budget outlook and the oceanographic community at odds over its future path, that's "a dialogue nobody has the guts to be having."

–ELI KINTISCH

Working Group Summaries

Scientist Engagement Working Group (SEW-G)

The COSEE-wide project Enhanced Engagement of Scientists for Broader Societal Impacts ended with the publication of the final case study March 21, 2013 on the website www.cosee.net/engaging_scientists. This grant, from the National Science Foundation through the American Recovery and Reinvestment Act, provided funds to all Centers in existence at that time to work together on a single project for the National COSEE Network. Representatives of each Center met monthly as the Scientist Engagement Working Group to guide the production team in producing a series of 13 case studies documenting scientists' individual efforts in education and public outreach.

CENTERS	CASE STUDY FEATURED SCIENTISTS	CENTER REPRESENTATIVES
National Office	Dr. Isaac Ginis, University of Rhode Island	Andrea Gingras, Gail Scowcroft
Alaska	Dr. Michael Castellini, University of Alaska Fairbanks	Robin Dublin, Nora Deans
California	Dr. Adina Paytan, University of California Santa Cruz	Craig Strang, Lynn Tran, Jennifer Skene, Cheryl Peach
Central Gulf of Mexico	Dr. Crystal Johnson, Louisiana State University	Jessie Kastler*, Sharon Walker, Brian McCann*
Coastal Oceans	Dr. Michael Kemp, University of Maryland	Laura Murray, Cassie Gerbisz
Great Lakes	Dr. Joel Hoffman, Environmental Protection Agency	Rochelle Sturtevant
Networked Ocean World	Dr. Scott Glenn, Rutgers University	Sage Lichtenwalner, Janice McDonnell
New England	Dr. Bob Chen, University of Massachusetts Boston	Catherine Cramer*
Ocean Learning Communities	Dr. Rick Keil, University of Washington	Tansy Clay
Ocean Systems	Dr. Mary Jane Perry, University of Maine	Carla Companion, Lisa Taylor*
Pacific Partnerships	Dr. Jude Apple, Western Washington University	Jan Hodder, Coral Gehrke
Southeast	Dr. Carrie Thomas, North Carolina State University	Carrie Thomas
West	Dr. Peggy Fong, University of California Los Angeles	Linda Duguay, Lynn Whitley, Jane Lee
Inverness Researchers, Inc.		Pam Castori, Jenifer Helms, Mark St. John
* Production team members		

Case Study Content and Format

The case studies were produced to showcase the efforts of individuals Centers as part of a network that helps scientists address broader impacts of their research. They also share the efforts of scientists who conduct exemplary education and outreach (EPO) in addition to their capable research. Users may explore individual case studies to learn more about a featured scientist or consider connections among case studies that might be useful to researchers wanting to learn more about how to address the broader impacts of their work. Similarities in approaches used are illustrated under the heading "Projects" on the home page. The "Top Ten" heading uses featured scientist comments to address scientists' questions about outreach. One of the most interesting results of the project was the collection of insights from scientists and their colleagues about challenges they face in conducting education and outreach. These insights are included with each case study under the heading "Viewpoints." Many scientists addressed common themes; a section at the foot of the "Viewpoints" page makes connections among these insights.

Scientist Engagement Working Group (SEW-G) continued

Evaluation Results and Recommendations

Inverness Research, Inc. conducted a final project evaluation in June 2012 to generate insights and ideas about how the case studies are and might be used. The evaluation included a comprehensive website review by six ocean scientists who were subsequently interviewed for up to one hour and a two-question survey sent to featured scientists (returned by four). Brief results of both inquiries are provided here.

- The most appropriate audience for the project's website and case studies is young scientists. With the variety of scenarios of use identified for new scientists, the final website is well positioned to engage this audience more broadly.
- The project's website and case studies send a strong message about the value of outreach, the importance of broader impacts of research, and how to integrate research and outreach.
- The case studies provide a rich research resource that might be used as a 'legacy site', for COSEE and its constituents. The project addresses what it means to 1) broaden impacts of ocean science research through education, outreach and collaboration, and 2) be a part of a larger international community committed to high quality research that can and should be translated to public audiences through education and outreach.

In response to the formative evaluation, the SEW-G and production team worked to make the website more user-friendly and accessible. Additional adjustments could 'broaden the impact' of this website and help realize the potential for use of these rich case studies.

Continue cross-case analysis of cases studies to validate themes that have already been identified, and identifying other themes, variables and effects.

Generate simple materials for distribution (e.g. brochures, QR codes, etc.) or mechanisms that would direct young scientists to the resource (e.g. active links to other organizations or websites beyond COSEE).

Develop a short pop-up survey to post on the website to learn who visits the website and for what purpose.

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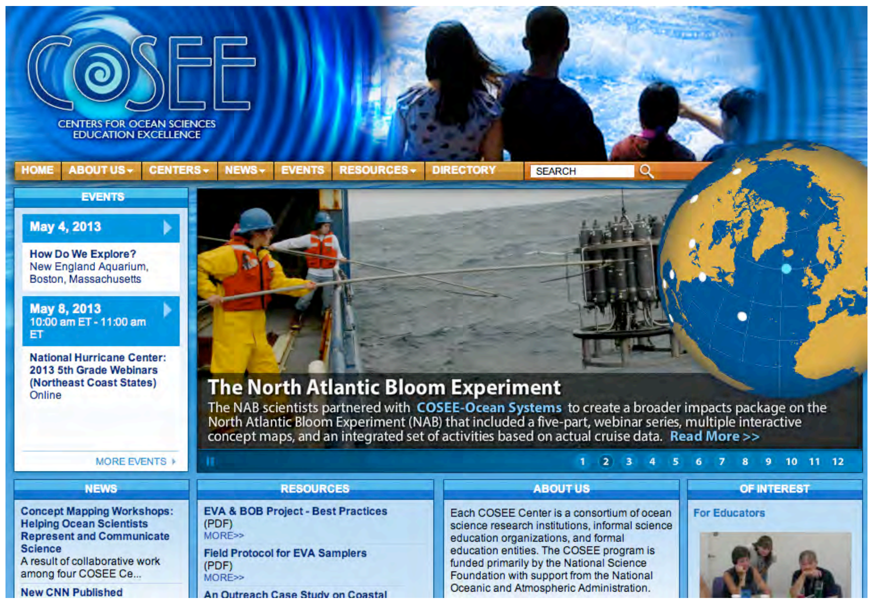
Working Group Summaries

Web Working Group (WWG)

The Web Working Group (WWG) was formed by consensus at the July 2007 Council meeting to examine how the Centers could work together to make existing and future COSEE information more accessible, engaging, and up-to-date. Today, the WWG supports productive collaborations and connections between institutions, organizations and individuals involved in COSEE's web-based ocean sciences education efforts by centralizing the online posting of news, events, educational and scientific resources, and people; encouraging the sharing of these across Centers and the NCO; and promoting the use of common terminology among Centers.

In 2012, the WWG, with Raytheon Web Solutions:



- Designed, developed, and implemented a new home page for COSEE.net featuring the scientists from the COSEE Engaging Scientist's website and an interactive globe pinpointing their research areas.
- Modified the home page to display randomly-selected "Making an Impact" and "Featured Center" content each time the page is loaded.
- Added a Resource box to the home page.
- Delivered a 508-compliant, public web site for one new Center (Island Earth) which preserves that Center's individuality while maintaining the unified "look and feel" of COSEE's web presence.
- Developed new functionality to allow administrators to add slideshows to content pages.
- Published "About Us" pages for five partner organizations (see www.cosee.net/about/network/aboutpartners/).
- Consolidated the Resource categories to make our resources easier to find.
- Moved the former COSEE New England web pages to the COSEE server at UMaine and created links or content pages for four legacy Centers.
- Met twice monthly to collaboratively identify, evaluate, and prioritize action items to enhance the look and functionality of the websites. Currently under development: templates for showcasing high-level COSEE accomplishments (e.g. models, events, resources).
- Continued to populate the CMS database and test system components, providing feedback to the developers for system refinements while tentatively identifying desired improvements.
- Updated the Network as to WWG activities and CMS improvements with regular articles in CNN.

Web Working Group (WWG) continued

From April 1, 2012 to March 31, 2013 COSEE.net had a total of 15,640 visits generating 45,649 page views (an average of about 3,800 page views per month). Thirty four percent of the visitors to COSEE.net over the last year were new visitors, an increase of nine percent over the previous year. The most visited pages on the site continue to be the "For Educators" resources (www.cosee.net/resources/educators), followed by the Directory. Eighty three percent of all the visits to COSEE.net were from the United States, with visitors from all 50 states.

COSEE File Manager

The WWG continues to oversee use of the COSEE File Manager, which cultivates linkages and promotes collaboration within the Network by supporting the sharing of files between Centers, working groups, the NCO, and other COSEE entities in a password-protected environment readily accessible by all COSEE personnel.

Excellence in Networking Tools Subgroup (ENTs)

In July 2009, the WWG formed the ENTs, which is used as a vehicle for ongoing dialogue regarding the use, development and implementation of social networking tools. In 2012, the ENTs assisted the Network in a variety of projects by providing feedback, testing new tools, and tracking the use of tools in Network efforts.
See the ENTs "About Us" page here: http://www.cosee.net/about/aboutgroups/ents/.

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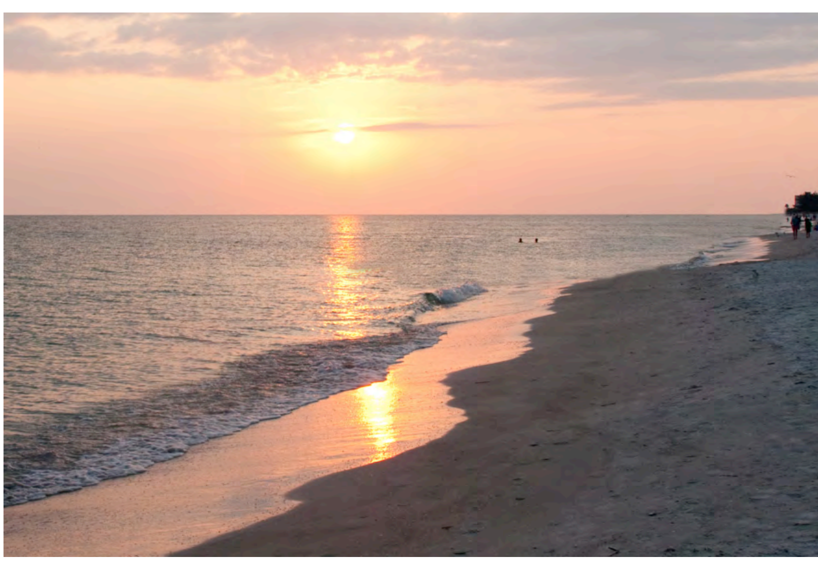

Working Group Summaries

Evaluation Working Group (EWG)

The Evaluation Working Group has been evolving since its establishment in 2007. The group was inactive in 2008 and became extremely active with weekly teleconferences starting in 2009 with work for the decadal review, administration of Network surveys, and future evaluation planning. In September 2012, the EWG completed a study of scientists to look at the effects of scientists' professional activities on their research, teaching, and education and outreach. This work was funded through a COSEE EWG supplemental proposal by NSF.

Members of the EWG include: PI Craig Strang; Gail Scowcroft and Romy Pizziconi from the NCO; Center Evaluators Andrea Anderson, Rena Dorph, Patricia Kwon, Ted Repa, Diana Payne, Pam Van Dyk, Patti Bourexis, Genevieve Manset, Carol Baldassari and Dave Plude; National Advisory Committee member Gordon Kingsley; and Lisa Rom from NSF. Patricia Kwon is the current EWG Chair, Council liaison, and liaison to the Center Evaluators.

EWG Mission: To serve the COSEE Network, NSF, and Center Evaluators by providing information and advice on 1) collective evaluation needs, and 2) existing resources and collaborative opportunities that document the extent to which COSEE goals and objectives are achieved, as well as the Network's impacts.

Scope of Work: The EWG will perform the following tasks and report to the COSEE Council on all plans, recommendations and activities.

- Task 1: Provide a forum for identifying collaborative opportunities among the Center Evaluators (CEs):
  - a. Assist in the identification of and mechanisms for integrating specific evaluation research being conducted in the Centers;
  - b. Establish the scope of CE input to the portfolio of COSEE evaluation products, research, and lessons learned;
  - c. Establish the standards for reporting existing or new "return on investment" data being collected by the CEs;
  - d. Assist in brokering relationships among CEs and between the Network and CEs; and
  - e. Provide logistical support for projects involving multiple CEs and the Network.
- Task 2: Provide periodic review and assessment of Network plans
- Task 3: Publicize results of the COSEE Scientist Study looking at professional activities and their effects on research, teaching, and education outreach
- Task 4: Provide recommendations for a cross-Center evaluation plan*
- Task 5: Provide a conceptual framework for a COSEE Network database*

The primary work of the EWG in 2012-2013 is publicizing the results of the COSEE Scientist Study completed in 2012, through journal articles and presentations at major scientist, education, and evaluation research conferences, and identifying and applying for funding opportunities for evaluation of COSEE program activities. Results of the COSEE Scientist Study were presented to the evaluators in September 2012, COSEE Council in February 2013, and to the COSEE community at the Network meeting in May 2013.

The EWG also continued their evaluation café discussion series to explore conceptual frameworks, theories, metrics, and evaluation practices related to traditional knowledge learning communities, scientist presentation protocols, concept mapping, COS/COSIA, Citizen Science, and distance learning (and future topics TBD).

The EWG will participate in a discussion of next steps for evaluation at the May Network meeting.

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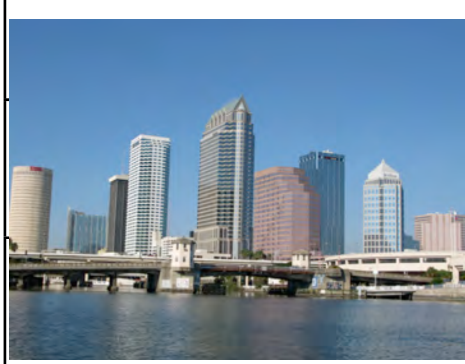

Ways to "Go Green"

- Pack your water bottles; water dispensers will be placed in the meeting areas. Bottled water will not be available.
- Recycle a name-tag from a previous meeting (name-tags will not be provided). We all have a ton of them, who needs one more!!
- Meeting booklet is printed on recycled paper.
- Share a taxi from the airport or take a shuttle with other travelers.

Map of the Tampa Marriott Waterside

All meeting rooms are located on the second floor.
General Session Room: Salons H, J and I
Breakout Rooms: Salon G and Meeting Room 7
COSEE Council Meeting Space: Salon G