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Beyond Academia

Professional Society Resources and Programs for Ocean Sciences Graduate Students

By Linda E. Duguay and Susan B. Cook

ABSTRACT. Resources and programs offered by six professional societies for graduate students and early career professionals in the ocean sciences are cataloged and profiled. The organizations range from very large and international (American Geophysical Union), to two mid-size organizations (Association for the Sciences of Limnology and Oceanography and Society for Advancement of Chicanos/Hispanics and Native Americans in Science), to three smaller ones (Coastal and Estuarine Research Federation, The Oceanography Society, and Marine Technology Society). All of these societies support focused programs for undergraduate and graduate students as well as early career professionals including postdoctoral fellows. Three of the societies co-sponsor the large biennial Ocean Sciences Meeting in even years that have, in the last decade, offered a wide variety of programs for student and early career groups.

INTRODUCTION

Professional societies have historically been important to science, technology, engineering, and mathematics (STEM) graduate students because they help establish an individual's career through presentations at meetings, networking with potential mentors/colleagues, and job boards and on-site meeting interviews linking students to future employers. Societies also provide a mechanism for graduate students to gain recognition of their research through publishing in professional society journals.

More recently, membership-based societies have recognized that young scientists need to develop relatively broad skill sets to succeed in today's competitive employment climate, and they have addressed this need by providing opportunities for training not always available or emphasized at the students' home institutions. Moving beyond the research training that

is the primary focus of graduate programs and faculty advisors, societies have developed programs that focus on the transferable skills increasingly recognized as necessary for a successful career in the sciences. Such skills include technical writing (proposal and journal articles), non-technical writing, proposal reviewing and participation on science panels, effective teaching of students, effective oral communication to scientific peers and non-scientific audiences (community outreach to policymakers and the general public), and project management (Miller and Briscoe, 2012). In addition, professional societies have recently taken the lead in providing information for young scientists on careers outside of academia.

Most societies also offer special mentoring and networking programs that address the need to engage and increase the participation of underrepresented minorities (URMs) in STEM fields and

professional organizations. Such efforts are badly needed because the US population is becoming more diverse; by 2050, underrepresented minorities (URMs) will constitute more than 40% of the population but, based on current trends, they make up only a very small fraction of STEM undergraduates or graduate students (National Action Council for Minorities in Engineering, 2013).

This article focuses on the resources, opportunities, and programs provided for graduate students and early career professionals by six professional societies/organizations. The information was gathered through direct contact with the leadership/career/education staff of the societies as well as from their websites. The six organizations range in size, scope, and mission. Five of the six (ASLO – Association for the Sciences of Limnology and Oceanography; TOS – The Oceanography Society; AGU – American Geophysical Union; CERF – Coastal Estuarine Research Federation; and MTS – Marine Technology Society) each have a significant ocean science or technology focus and actively recruit student members from ocean-focused disciplines. One society (SACNAS – Society for Advancement of Chicanos/Hispanics and Native Americans in Science) is not an ocean science organization per se, but it includes ocean scientists as role models in its meetings to engage and mentor its

TABLE 1. Society resources for students and early career professionals.

Focus and Membership	Meetings	Publications	Reduced Dues and Registration	Awards: Travel, Best Paper/Poster	Mentoring Programs	Regional/ Student Chapters
Association for the Sciences of Limnology and Oceanography (ASLO)						
<ul style="list-style-type: none"> > Oceanography, limnology (the study of lakes), and related sciences > 4,200+ members > Student membership includes primarily graduate students with some undergraduates 	<ul style="list-style-type: none"> > Ocean Sciences Meeting (OSM; even years) > Aquatic Sciences Meeting (odd years) 	<ul style="list-style-type: none"> > <i>Limnology and Oceanography</i> (L&O) > <i>L&O Methods</i> > <i>ASLO Bulletin</i> > <i>L&O Letters</i> (new in 2016) 	✓	✓	✓	
The Oceanography Society (TOS)						
<ul style="list-style-type: none"> > All aspects of ocean science > 2,200+ members > Student membership includes primarily graduate students with some undergraduates 	<ul style="list-style-type: none"> > OSM (even years) > Ocean Optics Conference (even years) 	<ul style="list-style-type: none"> > <i>Oceanography</i> (open access) > <i>Supplements to Oceanography</i> 	✓	✓	✓	
American Geophysical Union (AGU)						
<ul style="list-style-type: none"> > Earth, ocean, hydrological, atmospheric, space, and planetary sciences > 60,000+ members (more than 6,000 members in ocean sciences section) > Student membership includes primarily graduate students with some undergraduates 	<ul style="list-style-type: none"> > AGU Fall Meeting (annual) > OSM (even years) > Chapman Conferences 	<ul style="list-style-type: none"> > <i>EOS</i> > <i>Journal of Geophysical Research</i> > <i>Paleoceanography</i> > <i>Global Biogeochemical Cycles</i> > <i>Geophysical Research Letters</i> > And others 	✓	✓	✓	
Coastal and Estuarine Research Federation (CERF)						
<ul style="list-style-type: none"> > Estuarine and coastal ecosystems worldwide > 1,600+ members and regional affiliates of 1,000 more members > Student membership includes primarily graduate students with some undergraduates 	<ul style="list-style-type: none"> > CERF Conference (odd years) > Regionals (even years) 	<ul style="list-style-type: none"> > <i>Estuaries & Coasts</i> 	✓	✓	✓	✓
Marine Technology Society (MTS)						
<ul style="list-style-type: none"> > Technological issues > 2,500+ members (ocean engineers, technologists, policymakers, and educators, including a large industry representation) > Student membership includes undergraduates and graduate students 	<ul style="list-style-type: none"> > Oceans Conference (annual) > MTS technical symposia and workshops 	<ul style="list-style-type: none"> > <i>MTS Journal</i> > <i>Currents Newsletter</i> (bimonthly) > E-news (members only) 	✓	✓	✓	✓
Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS)						
<ul style="list-style-type: none"> > Advancement of underrepresented minorities in all STEM fields (original focus was biomedical) > 6,000+ members > Half of membership is undergraduates and 15% is graduate students 	<ul style="list-style-type: none"> > SACNAS Annual Meeting (in fall, usually October) 	<ul style="list-style-type: none"> > Electronic distribution of materials and resources to members 	✓	✓	✓	✓

student members from underrepresented minority groups and to recruit SACNAS students to the Earth, ocean, and environmental science professions.

To give readers a way to rapidly review what various societies offer, we first

present information on the size, membership, and disciplinary focus of each group, and list the type of resources available for graduate students and early career professionals (Table 1). This overview is followed by a more detailed Society Portraits

section that contains information on the specific goals and unique contributions that each group makes to the professional development of student members. We end with thoughts on the future value and scope of such efforts.

OVERVIEW

As Table 1 documents, the six societies differ in size and subdisciplinary focus, but all provide reduced (or in one case free) student memberships and discounted registration fees at meetings. They all fund a limited number of student travel awards to their periodic meetings and conferences and encourage student participation in oral and poster sessions. All provide best paper awards for student presentations and organize student social events at meetings. Each society's conference website is the best source of information on professional development opportunities at specific meetings. All of the groups produce disciplinary publications. Three are national organizations while three have more distributed structures with regional affiliates and/or student chapters.

Three of the five societies (ASLO, TOS, and AGU) biennially co-sponsor the Ocean Sciences Meeting (OSM), an international gathering of ocean scientists with a very large variety of special events for graduate students and early career professionals.

Society Portraits

ASSOCIATION FOR THE SCIENCES OF LIMNOLOGY AND OCEANOGRAPHY

Vision

The purpose of ASLO is to foster a diverse, international scientific community that creates, integrates, and communicates knowledge across the full spectrum of aquatic sciences, advances public awareness and education about aquatic resources and research, and promotes scientific stewardship of aquatic resources for the public interest. Its products and activities are directed toward these ends. (<http://aslo.org/information.html>)

Membership and Focus

Most members focus on biological and chemical aspects of ocean and aquatic systems (lakes, rivers, estuaries); 80% have

doctoral degrees, and most are faculty or research scientists. People living in the US and Canada make up 42% of the membership. Students represent 23% of the membership, and 73% of student members are graduate students. ASLO has been increasingly involved over the years in sponsoring special programs to develop student leadership and communication skills, and in providing networking and professional development opportunities. A second important strategic focus has been to increase opportunities for minorities in the aquatic sciences. The majority of specialized professional development sessions and focused activities for students and the general membership take place at one of the ASLO-sponsored or co-sponsored meeting venues, including Aquatic Sciences Meetings (ASMs), OSMs, and Joint Aquatic Sciences Meetings (JASMs).

Resources, Activities, and Products

1. Leadership Opportunities

ASLO's voting board includes two elected student members who help to develop and lead graduate-student-centered activities at the meetings. The board slots offer invaluable networking opportunities and allow young scientists to see how the society's boards and committees work at the highest level. Student members are also welcome on all working committees and on the meetings committees. Working with established scientists on the society's board and/or its various committees provides students outstanding opportunities to be mentored, to network, and to develop leadership skills.

2. Communications and Professional Development Programming at Meetings

Hollywood Comes to the Ocean Sciences. Since the 2000 OSM in San Antonio, former marine biology professor turned Hollywood filmmaker Randy Olson has worked with ASLO and organizers of various ocean sciences meetings to offer a series of talks, film festivals with critiques by screen writing and acting colleagues, and workshops on narrative

structure, communication, and "improv" skills for scientists. Most recently, they offered the Snap It Up program at the 2014 JASM and 2015 ASM where Olson's team held workshops on techniques, visited scheduled science talks, and offered personalized advice and guidance. These various programs on methods of communicating science to all audiences have been very popular and have helped participants see how effective communication based on proven storytelling principles can help their science communication. For more detail on these events and tips on effective communication, read the 2013 book *Connection: Hollywood Storytelling Meets Critical Thinking* by Olson and colleagues, and the review of the book published in the *ASLO Bulletin* (2014, 23(1):19–20). It is anticipated that these types of communications programs will be continued at ASLO and ocean sciences meetings into the future.

GEARS: A Workshop for Broadening the Impacts of Your Research. In order to effectively communicate their research to both students and colleagues, scientists need to become more skilled in teasing out and conveying complex concepts and facts. Indeed, the US National Science Foundation (NSF) requires a Broader Impacts Statement for all proposals submitted for funding. The all-day GEARS workshop at the 2013 ASM addressed various topics such as deconstructing your science, understanding how people learn, building effective knowledge for a variety of audiences, and broadening the reach of your science. Led by Ari Daniel Shapiro, Annette DeCharon, and Bob Chen, outreach experts from three Centers for Ocean Sciences Education Excellence (COSEE) locations, attendees were encouraged to think creatively about how to integrate their research and education activities to communicate effectively with a broader audience than just specialized experts in their own field. For more information on this workshop and future COSEE contributions, see the article by Peach and Scowcroft (2016) in this issue.

Career-Focused Luncheon Talks.

These are a standard, ongoing feature at nearly all ASLO-sponsored meetings. For example, Jim Yoder, Vice President for Education at the Woods Hole Oceanographic Institution and a former COSEE Networked Ocean World (<http://coseenow.net>) member, is a frequent luncheon and workshop speaker on the student-focused topic “How to Interview and Negotiate for an Academic Position.” Typical questions addressed at these sessions include: (1) How do you prepare for an on-site interview? (2) What questions can you expect? (3) How do you deal with inappropriate questions? (4) What are some of the “hidden agendas” of search committee members? (5) What do you need to ask of the institution when offered a job?

Diversity Programming: The ASLO Multicultural Program (ASLOMP). Although primarily a program focused on engaging URM undergraduates in the ocean sciences, this NSF-supported project directed by Hampton University professor Ben Cuker funds a significant percentage of graduate students (30% of program participants). Students are fully supported to attend either the ASLO Aquatic Sciences Meeting or OSM (whichever is happening in a given year). Students present their own research in a student symposium or in some cases at regular science sessions, are exposed to the most recent developments in the aquatic sciences, and make valuable professional contacts that have helped many achieve their academic and career objectives. Field trips, keynote addresses from leading scientists, a strong meeting mentoring program, and free membership in ASLO with a subscription to ASLO’s journal *Limnology and Oceanography* round out the roster of benefits.

3. Beyond Meetings

Communications Internships. Recently, ASLO has offered 14-week paid internships for current or recent graduate students to support the society’s science communication activities. The internships

provide real-world experiences to students who are potentially interested in science-related careers outside of academia, and allow recipients to build a large professional network very quickly.

Publications and Online Products.

In addition to its two international journals (*Limnology and Oceanography* and *Limnology and Oceanography: Methods*), the society publishes the quarterly *ASLO Bulletin* and in 2016 will begin publication of *Limnology and Oceanography Letters*, a new open access and electronic-only journal. *Letters* is designed to feature innovative and trend-setting research in all areas of the aquatic sciences and will focus on high-impact, cutting-edge results, discoveries, or conceptual developments in any area of limnology and oceanography as well as integrated aquatic science papers.

Two online products may be helpful to graduate students tasked with giving lectures to undergraduate or public audiences. The ASLO Online Media Library (<http://aslo.org/photopost>) is a member-generated collection of images

and videos for use in education. L&O e-lectures (<http://aslo.org/lectures>) consist of visuals (PowerPoint presentations and pdfs) along with lecture notes and reading lists developed by noted research scientists on specialized topics that are downloadable and available for use by all.

THE OCEANOGRAPHY SOCIETY

Vision

The Oceanography Society was founded to disseminate knowledge of oceanography and its application through research and education, to promote communication among oceanographers, and to provide a constituency for consensus building across all the disciplines of the field. (<http://tos.org/about-tos>)

Membership and Focus

TOS is a relatively small international society with a major focus on encouraging and supporting students. Students make up about 46% of the membership, and US members are 73% of the membership.

GRADUATE STUDENT TESTIMONIAL

Amy Burgess, Oregon Institute of Marine Biology, University of Oregon

I became involved with the ASLO and TOS boards shortly after having the opportunity to serve as a student representative (for TOS) on the scientific planning committee for the 2012 Ocean Sciences Meeting. Being on the board of directors of a scientific society is more than just planning meetings and workshops. I gained a wealth of knowledge about what it takes to run a scientific society. I also had the opportunity to contribute to making major decisions about the future direction of these societies.

The networking opportunities have been incredible and I will continue to benefit from those connections throughout my career. The most rewarding part of being involved in these societies was the realization that the board members and a majority of advanced scientists in these societies are invested in the success of the student and early career members.

Amy is willing to advise graduate students interested in becoming a board member for a professional society/organization.



Disciplinary areas represented in the membership and on the TOS Council include: applied technology; education; biological, chemical, geological, and physical oceanography; and graduate students. In addition to co-sponsoring the Ocean Sciences Meeting with ASLO and AGU, TOS also sponsors the Ocean Optics Conference (<http://oceanopticsconference.org>).

Resources, Activities, and Products

1. Leadership Opportunities

A graduate student serves on the TOS Council along with representatives from multiple aspects of ocean science (<http://tos.org/governance>). The student is elected by the entire TOS membership. Students can be nominated or self-nominate, and three students are selected for the final ballot based on their biographical sketches and letters of reference.

2. Communications and Professional Development Programming at Meetings

As a sponsoring society for the biennial Ocean Sciences Meeting, TOS encourages its members to serve as meeting mentors along with colleagues from ASLO and AGU. Each mentor is matched with no more than two students, and several meetings and activities are hosted so that mentors and mentees have opportunities to interact. TOS hosts an informal and lively “TOS breakfast” that students are encouraged to attend and network with other students and TOS scientists.

Beginning in 2015, TOS is waiving dues for student members and has established a modest special travel fund for student members to attend the OSM beginning with the 2016 New Orleans meeting. At this meeting, TOS sponsored a Town Hall on “What’s Right and What’s Wrong with Graduate Education in the Ocean Sciences” (Lozier, 2016, in this issue).

3. Beyond Meetings

Publications and Online Products. A major TOS contribution to graduate education and resources for students occurs via its open access *Oceanography*

magazine (<http://tos.org/oceanography>), supplements to the magazine (e.g., *Scientifically Speaking*), and the society’s website resources.

The website includes a “Careers” page that offers a variety of resources: <http://tos.org/careers-2>. One of the most viewed resources is the Career Profiles: Options and Insights section <http://tos.org/career-profiles>. Two profiles have been published in each issue of *Oceanography* since June 2010. This resource addresses nonacademic careers, provides advice about job hunting, and was started specifically at the request of graduate students interested in learning more about careers outside of academia.

Other TOS website resources include a new and expanded jobs center, materials from career workshops at meetings, and articles in past *Oceanography* issues focused on career pathways and professional development topics. Archived issues of the magazine also contain articles written by students as part of university courses, and additional student-written articles are welcomed and encouraged as excellent learning experiences.

AMERICAN GEOPHYSICAL UNION

Vision

The purpose of the American Geophysical Union is to promote discovery in Earth and space science for the benefit of humanity. AGU galvanizes a community of Earth and space scientists that collaboratively advances and communicates science and its power to ensure a sustainable future. (<http://sites.agu.org/leadership/strategic-plan/mission>)

Membership and Focus

AGU is a large international society representing the Earth, ocean, hydrological, atmospheric, space, and planetary sciences. It is composed of 23 sections, which are disciplinary based, and focus groups, which are interdisciplinary based. The Ocean Sciences Section is one of the oldest and largest with over 6,000 members and four subsections: biological

oceanography (BO), marine geochemistry (MG), marine geology and geophysics (MGG), and physical oceanography (PO) (<http://oceans.agu.org/about-us>). A spectrum of ocean science career types are represented in the membership—academic, federal employee, nongovernmental organization (NGOs), consulting, and industry. Students make up 22% of the total AGU membership, and 61% of all members are US based.

Resources, Activities, and Products

1. Leadership and Networking Opportunities

Six student and early career professionals serve on the AGU Council along with the presidents and the presidents-elect of each of the sections. There are also student leadership positions within the scientific sections and focus groups.

2. Communications and Professional Development Programming at Meetings

AGU holds its annual Fall Meeting in San Francisco in December of each year with over 20,000 attendees. As the largest ocean-related society, AGU takes the organizational and administrative lead for about two-thirds of the OSMs sponsored jointly with ASLO and TOS, which are held in even years and usually host 5,000–6,000 attendees. AGU co-sponsors international attendees at Joint Assemblies and Meetings of the Americas and also hosts a series of smaller topic-focused Chapman Conferences (<https://meetings.agu.org>).

Student & Early Career Scientist Conferences. Beginning in 2014, AGU has hosted a Student & Early Career Scientist Conference the day before the Fall Meeting begins. The conference provides opportunities for networking and workshops on sharpening career skills. In 2015, Alaina Levine, author of Wiley-Blackwell’s *Networking for Nerds* was the keynote speaker (<https://fallmeeting.agu.org/2015/students/student-early-career-scientist-conference>).

During the Fall Meeting proper, AGU sponsors a Career Opportunities

Networking Lunch where students and early career professionals can practice their networking skills, learn about careers in a wide range of employment sectors outside of academia, and meet with representatives from national labs, federal agencies, NGOs, and small and large private corporations. Two networking receptions are also usually held: one celebrating female scientists, with presentations by AGU's female leaders and members, and another focused on traditionally underrepresented groups in the geosciences and the progress that AGU has made in engaging these members.

3. Beyond Meetings

Publications and Online Products. In addition to its specialty journals and affiliation with the Wiley publishing group, AGU produces *EOS*, a weekly print newspaper for the Earth and space sciences containing articles on current topical science areas, the Union's activities and awards, as well as job postings (<https://eos.org>), and *EOS Buzz*, a weekly electronic roundup of Earth and space science news selected by the editors of *EOS*.

The only society with a permanent staff focused on education, AGU supports an active Career Center at its headquarters in Washington, DC. This center provides an array of valuable online services, including: (1) an extensive and searchable database of academic institutions that offer PhD programs in the ocean sciences and the broader geosciences, (2) a job board listing hundreds of jobs all over the world, (3) a monthly e-newsletter, (4) quarterly career guidance webinars, (5) an Education Special Interest Group monthly newsletter that includes a special section for students, and (6) a Career Toolkit that provides advice and career-focused articles. Subjects range from networking skills to transitioning from academia to industry and include Paths through Science profiles of AGU members. The Career Center also allows employers and recruiters to access the most qualified applicants with relevant work experience to

fulfill their staffing needs. Job seekers can develop and advance their careers by attending regular career advice webinars and workshops. They can also post their resumes online and apply for hundreds of jobs. For more detailed information, visit <http://sites.agu.org/careers>.

COASTAL & ESTUARINE RESEARCH FEDERATION

Vision

The Federation advances understanding and wise stewardship of estuarine and coastal ecosystems worldwide. Its mission is to promote research in estuarine and coastal ecosystems, support education of scientists, decision makers, and the public, and facilitate communication among these groups. (<http://www.erf.org>)

Membership and Focus

CERF is a relatively small society composed of seven regional affiliate societies (<http://www.erf.org/affiliates>), including all of the coastal regions that border the United States, Canada, and Mexico. Students make up about 11% of the membership, and the majority of those are

graduate students. Academics account for 60% of members, federal managers about 15%, local/regional managers 10% each, and NGOs about 5%. International members constitute 12% of the membership. Student attendance at meetings is typically around 35%. Many of the problems that CERF scientists approach involve applying basic research to solve socially important questions such as climate change, organism response to multiple stressors, big data issues, increasing urbanization, and conflicting resource uses that impact both local species and human activities and well-being.

Resources, Activities, and Products

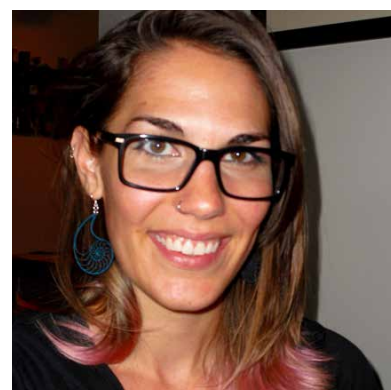
1. Leadership Opportunities

CERF initiated including student members on the CERF governing board in 2011, and all of the affiliate societies have student members on their governing boards. An Outreach and Career Development Committee made up of all the student representatives from the affiliate societies is charged with developing student-oriented programs for the biennial conference and for webinars at other times of the year.

COMMENTARY ON LEADERSHIP OPPORTUNITIES

Leanna Heffner, Research Fellow/Postdoctoral Researcher, Coastal Sustainability Studio/School of the Coast & Environment, Louisiana State University

When I was an undergraduate, I was lucky enough to be introduced to CERF and its New England regional affiliate society, NEERS, early on. The people I met at those meetings have become close friends and mentors over the years, and every time I attend a conference I'm buzzing with excitement to reunite with my fellow CERFers. The amiable, inclusive, and supportive culture within the society is truly unique and provides an environment in which ideas are enthusiastically exchanged and collaborations are built. Having served on the boards of both NEERS and CERF, and having helped to organize several conferences, I truly owe so much of the early success of my career to CERF. The opportunities afforded to me by the society have greatly enhanced my personal career development. I've grown my professional network.



2. Communications and Professional Development Programming at Meetings

CERF hosts a biennial meeting in odd years in the fall, and the seven regional affiliate societies host smaller (100–200 attendees) local meetings more frequently. Both sets of meetings have high student attendance, and students who volunteer to help at the meetings are granted free registration. Volunteering involves service on two six-hour shifts over the course of the meeting in a variety of conference-related activities. Details can be found at: <http://www.erf.org/student-volunteer-opportunities>.

For the last two biennial meetings, 2013 and 2015, CERF has organized a mentorship program, matching established scientists as mentors with student mentees. Usually the mentors and mentees have similar interests and meet several times over the course of the meeting. The mentors provide guidance on how to navigate the conference, suggest talks and posters to attend, and introduce students to their colleagues so that they can broaden their networks.

At the meetings, a number of special workshops are also offered, many geared directly toward student and early career professionals. See <http://www.erf.org/workshops-for-students-early-career> for more information.

3. Beyond Meetings

Publications and Online Products. In addition to publishing *Estuaries & Coasts*, CERF has initiated a continuing webinar series for students and early career professionals focusing on graduate students mentoring undergraduates about research projects, career directions, and potential graduate school applications. In the “members only” portion of its website, CERF maintains a current listing of job openings and publishes a newsletter. Additional regional and local resources are available on the websites of various affiliate societies listed on the main CERF page.

MARINE TECHNOLOGY SOCIETY

Vision

The Marine Technology Society was incorporated to give members of academia, government and industry a common forum for the exchange of information and ideas. The society's guiding purpose is: to promote awareness, understanding, advancement and application of marine technology. (<https://www.mtsociety.org>)

Membership and Focus

MTS is a small international society focused on technological issues. Its members include businesses, institutions, individual professionals, and students who are ocean engineers, technologists, policy-makers, and educators. The society does not differentiate between undergraduates and graduate students. The MTS leadership team includes an elected Vice President for Research and Education as well as Education and Scholarship Chairs also elected by the membership.

Resources, Activities, and Products

1. Leadership Opportunities

Student Leadership Forum. MTS education leadership implemented a new Student Leadership Forum (SLF) for the fall OCEANS '15 meeting. Its website is accessible to MTS student members.

The SLF program requires that students apply for the program and be prepared to make a two-year commitment. No more than five students are accepted per year, with a maximum of 10 SLF students attending the OCEANS meeting each fall. Student travel and accommodations are covered by MTS. Students applying to the program need to submit a plan to carry out a local or national activity to promote marine technology. Forum members can apply for a modest level of funding from MTS headquarters to support these special activities.

In the first year of their participation, students present and discuss their activity plans with other MTS members and the leadership of the program. Second-year students report on how the project plan

worked and their plans for the future. Students are encouraged to mentor each other, and guidance is provided by MTS staff. Second-year students are required to prepare posters about their projects. These posters are displayed in the OCEANS conference exhibition hall with designated times for the students to discuss their projects with interested attendees. These SLC posters differ from typical research-focused student competition posters because they focus on activities promoting marine technology rather than on research.

2. Communications and Professional Development Programming at Meetings

MTS annually hosts two meetings—North American OCEANS in the autumn and a non-North American OCEANS that alternates between Europe and Asia in the spring. The OCEANS meetings are co-hosted by the IEEE ocean engineering society. In addition, the MTS Remotely Operated Vehicle Committee and the Association of Diving Contractors International co-host the Underwater Interventions conference in the spring.

Each OCEANS conference includes a special Student Poster Competition. Posters submitted for this competition differ from standard student posters submitted as part of the scientific program for most other societies. The goal is to increase the number of student presentations at the conference, expose students to the activities of professional societies, and provide students with opportunities to interact with working professionals. For the students selected, travel expenses and registration are covered, and three best-poster prizes are awarded.

3. Beyond Meetings

Student Sections. MTS provides opportunities primarily for ocean engineering undergraduates, but often involving graduate students from institutions of higher learning, to network with each other and with professional members through its many student sections. Student sections

each have a faculty councilor and are hosted at colleges/universities with marine science or marine technology programs. Student section members participate and attend meetings of the professional MTS chapters as well as the MTS national and international conferences (<https://www.mtsociety.org>).

Scholarships. Each year, MTS offers scholarships to college graduates, college undergraduates, and senior high school students accepted into full-time marine-related programs with a focus on marine technology, marine engineering, and/or marine science. Funding is through the generosity of the MTS membership. Applicants must be MTS members and must either attend or plan to attend domestic or international colleges/universities as full time students. Application details and a listing of the scholarships can be found at <https://www.mtsociety.org/education/scholarships.aspx>.

Publications and Online Products. In addition to its journals and newsletters, MTS has produced *The Guide to Marine Science and Technology Programs in Higher Education* (available at <https://www.mtsociety.org/education/resources.aspx>). The guide, a 2008 collaboration of MTS and the Marine Advanced Technology Education (MATE) Center, is geared toward helping students find programs that prepare them for careers in ocean technology. Although the majority of entries are for undergraduate programs, detailed information on MS and PhD graduate programs is also provided.

SOCIETY FOR ADVANCEMENT OF HISPANICS/CHICANOS AND NATIVE AMERICANS IN SCIENCE

Vision

SACNAS is a society of scientists dedicated to fostering the success of Hispanic/Chicano and Native American scientists—from college students to professionals—to attain advanced degrees, careers, and positions of leadership in science. (<http://www.sacnas.org>)

Membership and Focus

SACNAS is a medium-sized society with an outstanding track record of engaging minority undergraduates in the biomedical sciences. Currently, 50% of the members are undergraduates and 15% are graduate students. The remaining 35% of members are faculty, research scientists, postdocs, and federal scientists. In terms of disciplines represented in the membership, 70% are biomedical/medical, 20% biological sciences, 5% physical sciences, and 5% geosciences/ocean sciences.

Although SACNAS is not an ocean science-oriented society per se, it is included in this review because of its large membership and special focus on promoting STEM careers and the advancement of underrepresented individuals into STEM fields, including geo/ocean sciences. Over the last 12–15 years, a small cadre of geo/ocean scientists have been working to increase membership and interest in these fields within SACNAS by sponsoring general science and professional development sessions as well as field trips at the annual SACNAS National Conference.

Resources, Activities, and Products

1. Leadership Opportunities

Leadership Program. “The objective of the SACNAS Summer Leadership Program is to develop the next generation of underrepresented minority scientists whose leadership contributions will serve to strengthen and unify our

communities at the national and local levels. The institute prepares participants (doctoral, postdocs and early career professionals) to assume leadership roles in the global scientific community by offering advanced strategic trainings that develop critical leadership skills.” Details on the program can be found at: https://sacnas.org/news/SLI_launches_new_year and <https://sacnas.org/civicism/event/info?reset=1&id=96>.

Chapters. SACNAS has 110 chapters throughout the United States that provide year-round, local support and leadership development for students and professional scientists from underrepresented backgrounds. Chapter members are encouraged to share information and resources and to engage in peer-to-peer mentorship, as well as to take part in opportunities to give back to their communities and develop leadership skills. No specific geo/ocean-focused chapters have as yet been organized but this might be an important investment for the geo/ocean community.

2. Communications and Professional Development Programming at Meetings

These efforts concentrate primarily on the geo/ocean-focused activities that have been supported at the national conference by geo/ocean scientists and educators.

Activities at National Conference. The SACNAS National Conference



SACNAS students participated in a field trip off Los Angeles, California, aboard R/V *Yellowfin*, which included collection of water samples with a conductivity-temperature-depth (CTD) rosette. Photo courtesy of University of Southern California San Pedro Ocean Time Series (SPOT) staff

held annually in the fall showcases cutting-edge science and features mentoring and training sessions for students and scientists at all levels. Attendance is usually in the range of 3,600, with high participation by students (a ratio of five students for every three professionals who attend).

Professional and Leadership Development Sessions. These include presentations and posters by students and postdoctoral researchers and highlight the academic and career pathways of professional scientists in the ocean sciences. They provide students with concrete examples of how to pursue paths in the ocean sciences and of the career options that are available. In addition, there typically is an undergraduate poster session in ocean science as well as a graduate student talk session. NOAA and Sea Grant provide awards for the best presentations.

Scientific Symposia. These sessions highlight original research in the ocean sciences by leading scientists and often have an applied theme to provide students with examples of how ocean science can be used in the service of communities. A recent example was the ocean acidification session at the 2014 Los Angeles conference that featured Gretchen Hoffman (University California Santa Barbara), Chris Sabine (NOAA Pacific Marine Environmental Lab), and Fritz Stahr (University of Washington).

Networking and Mentoring. The SACNAS “conversations with scientists” program at each conference offers

two-hour sessions where students informally discuss educational and career opportunities with ocean scientists. Students can get advice on how to navigate problems they may be encountering in their current academic trajectory and learn about potential ocean related Research Experiences for Undergraduate (REU) programs.

Exhibits. At each conference, exhibitors share information about their institutions and programs. At past meetings, MTS/COSEE representatives have helped organize an ocean science row of exhibits where students can go to get information on graduate programs, job opportunities, and summer internships in the geo/ocean sciences. One good example is the booth hosted by Ocean Opportunities, a partnership between science, math, and engineering faculty at minority-serving institutions and graduate program administrators to recruit students for ocean science and engineering graduate programs. The partnership is dedicated to promoting the development and training of a diverse and thriving ocean sciences workforce and is based at Woods Hole Oceanographic Institution (<http://www.oceanopportunities.org>).

Field Trips. Before or after national meetings, field trips are often organized by a local university or research institution. For example, in 2014, the University of Southern California (USC) organized an oceanographic research experience on board R/V *Yellowfin* for

27 undergraduates, six PhD students, and two MS students. The students explored the Southern California coastal environment, including a highly impacted site near the Los Angeles Harbor and a relatively pristine ecosystem further offshore. Discussions ranged from coastal and marine resources to research investigating the human impact on the ocean. On board the vessel, students collected plankton samples; were exposed to state-of-the-art oceanographic research instruments, including sensors used to collect in situ measurements of environmental variables; and networked with faculty, graduate students, ship personnel, and the San Pedro Ocean Time (SPOT) series data coordinator. The field trip included tours of lab facilities both on Catalina Island and on the USC main campus. Trip sponsors included USC’s Marine Environmental Biology program, the university’s NSF-funded Center for Dark Energy Biosphere Investigations, and the Southern California Marine Institute.

Regional Meetings. SACNAS chapters or partner institutions host SACNAS Regional Meetings each spring that provide an opportunity for chapters, general members, area high schools, and professionals to learn about SACNAS programs, activities, and upcoming events while providing opportunities for student members to talk, share ideas, and present their research at small local venues with lower costs than is possible at national meetings. We are not aware of any outreach activities at regional meetings by geo/ocean scientists, but this again might be an important avenue to pursue to increase participation by underrepresented groups.

3. Beyond Meetings

Since most activities and opportunities outside of meetings are geared toward the undergraduate portion of the society and few are geo/ocean oriented, they are not described here but can be accessed on the main SACNAS website (<http://sacnas.org/students>).

ADVICE FOR STUDENTS

- > Join at least one society at the reduced student rate.
- > If travel funds are available, plan to attend at least one professional development activity at your national society’s annual meeting. If funding is tight, attend a regional meeting to get started.
- > Network with other students and talk with one or more early career professionals who are in your research area but are not at your institution.
- > After belonging to a society for a year or two, consider taking a leadership role.
- > Learn from others, and enjoy yourself!

CONCLUSIONS AND RECOMMENDATIONS FOR THE FUTURE

Students (graduate and undergraduates), postdocs, and early career professionals are the future of all of the societies we report on here. Through conversations and correspondence with the various society representatives and leaders, it is very clear that all six groups are fully aware of the importance of this subset of members for their organization's futures and for the continued health of their disciplines. All six societies provide a very rich and varied set of resources and activities for ocean science graduate students as well as undergraduates, postdocs, and early career professionals. The professional development programs that societies offer are constantly evolving and adapting to the needs of members and meeting participants. These resources add significant value because they complement and extend academic programs, and they help students tap into community-wide networks and build professional toolboxes to ensure successful careers in the ocean sciences.

The leadership teams of all the societies featured in this article told us that their student membership soars just before meetings. We view these pre-meeting surges as evidence that reduced fees, travel awards, and professional development programs do work and are of value to young scientists. Of equal importance are continuing society efforts to periodically survey student and early career members about their interests and needs and provide programs and resources to help individuals prepare for and succeed in both traditional academic careers and the many existing nonacademic pathways that are not always obvious to people in academic programs. Efforts to involve younger colleagues in society governance and leadership are also valuable and should be continued.

To continue to attract a robust student cohort, we anticipate that in the future all the societies reviewed here will provide increased financial support

for students to participate in meetings, including for travel and scholarships. We envision an increase in student awards and professional development programs both at meetings through onsite workshops and various networking activities as well as new programs that occur outside the meetings. Most likely, the use of targeted webinars will expand, and online resources and the use of social media will continue to grow in order to engage younger members. We applaud the recent adoption of a variety of focused mentoring programs by all of the societies and encourage the future expansion of such programs as a strategy that may help engage, support, and retain members throughout their entire careers. In addition to their obvious value in providing the guidance, role models, and community-level connections essential for successful careers beyond graduate school, such programs have the potential to add value for the mentors themselves and the society as a whole. Mid-career and older professionals who serve as mentors grow personally and professionally as they expand their capacities to communicate effectively and foster the successful careers of younger people in their disciplines. Individuals who find these opportunities of value may be more likely to renew and become life-long society members.

A major challenge for any professional development effort that hopes to thrive and grow is the need to document program outcomes with appropriate metrics for identifying which activities and strategies work best for specific audiences. As ocean-focused professional associations move forward and expand their efforts to support and enrich both graduate education and the career pathways of their members, we feel that the societies could benefit greatly by forming collaborative partnerships both with each other and with the STEM education evaluation community. A good example of the value of such a cross-organizational approach comes from our experience with the "Birds of a Feather" sessions at annual COSEE Network meetings.

In these one- to two-hour focused discussions between program designers and evaluators working on similar programs at different Centers, the opportunity to compare notes and share ideas was an important collaborative element that helped both individual programs and the network as a whole become more focused and successful. ☑

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