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## SIDEBAR

### The Ocean Science Social Diversity Challenge

By Matt Gilligan and Sue Ebanks

As other articles in this issue point out, large and growing segments of the US population are not being adequately prepared, recruited, or retained in educational pathways leading to careers in the ocean science workforce. While rates of participation by underrepresented minorities (URMs) have increased at the undergraduate level (Figure 1; Lettrich, 2014), the numbers are so low that even substantial percent increases are likely to produce barely noticeable increases in the numbers of individuals entering graduate programs and the ocean science community. In this paper, as former and current faculty at one of the nation's historically black colleges and universities (HBCUs), we discuss key issues related to underrepresentation in the ocean sciences and challenge our community to go beyond talking about diversity.

#### Research on What Works

In the literature review cited by Johnson et al. (2016, in this issue), Tsui (2007) linked 10 factors to increased diversity and success of undergraduate minority students in science, technology, engineering, and mathematics (STEM) fields. These factors are early intervention, tutoring, strong mentoring, academic advising, research experiences, career counseling and awareness, campus learning centers, financial support, workshops and seminars, and curricular and instructional reform. To these we add "critical time" (beginning efforts with early undergraduates) and "critical mass" (more than one or two URM participants).

At our institution, such a multipronged approach has led to improvements in graduation and post-graduate outcomes (Gilligan et al., 2007; Hintz et al., 2015), and two marine programs (Association for the Sciences of Limnology and Oceanography Multicultural Program [ASLOMP] and Multicultural Initiative in the Marine Sciences Undergraduate Participation [MIMSUP]) described by Johnson et al. (2016, in this issue) underscore the value of such strategies for URM students. At the graduate level, over an eight-year period, pursuing these strategies has led to a doubling in the number of geoscience doctoral degrees awarded to URMs at institutions associated with the National Science Foundation (NSF)-funded Alliances for Graduate Education and the Professoriate (AGEP) program (AAAS, 2011).

One word of caution is needed, however. Successfully adopting even the best model in its entirety at a different institution may not

The end-of-program group photo from the summer 2015 Bridge to Research in Marine Sciences Research Experiences for Undergraduates program at Savannah State University reflects their collegiality, pride, confidence and, perhaps, a hint of what all professional research teams and scientific societies and organizations should look like some day.

be easy. Although the Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC) is a model proven to be effective, efforts to replicate the program in other places have been less successful. Gewin's (2014) analysis suggests that site-specific culture and demographic adaptations, as well as the quality of ongoing assessment, are important and may be difficult to replicate. Furthermore, institutional buy-in, leadership, and personality dynamics clearly can make or break such efforts.

#### Undergraduate Challenges

Drawing on our experiences at Savannah State University (SSU), an HBCU that has produced a significant number of URM students earning advanced ocean and related degrees, we see two challenges. First, HBCUs, other minority-serving institutions (MSIs), and community colleges with a strong tradition of interventional support educate a disproportionately large number of US STEM URM graduates (President's Board of Advisors on HBCUs, 1999; NRC, 2007; Gilligan, 2002), but lack ocean science programs and the depth of curricular and research support typical of research intensive (RI) institutions. Second, RI institutions typically do not have the supportive interventional systems necessary to attract and retain URM students interested in STEM degrees.

It is essential that faculty and administrators understand the value of using methods that engage the target demographic in ways that increase academic skill, understanding, and passion for the ocean sciences. To ensure that STEM undergraduates at both types of institutions thrive, admissions processes and subsequent programs should be designed to identify and provide continuing support for underprepared, but otherwise academically able, STEM scholars who are willing to commit the time and effort to succeed in the ocean sciences. Some useful best practices are:

- Across-the-curriculum efforts to improve reading comprehension, writing skills, and appreciation for the importance of professional writing, especially in introductory emails and application processes
- Interventions such as mandatory study sessions, help in submitting competitive applications for research opportunities and

internships, as well as targeted training in analytical techniques, critical thinking, and quantitative assessment

- Better comprehensive GRE test preparation (an institution must teach students how to study in conjunction with offering a preparatory course such as Kaplan)
- Communicating the consequences of delayed preparation for post-undergraduate life (e.g., the importance of acquiring valuable skills as an undergraduate versus having to do remediation in a graduate setting)
- Ensuring that students clearly understand the commitment needed to achieve goals (students must be advised and mentored to understand that true success requires getting good grades, mastering knowledge, and developing professional skills)

### Graduate Issues and Recommendations

The challenge of creating a diverse graduate ocean science community can be addressed at community, individual, and programmatic levels. At the community level, the key question appears to be: is doing what is needed (and what has been shown to work) an investment our discipline is willing to make? If so, the individuals and institutions that comprise our community must believe (and be willing to say) that such efforts should receive higher priority within the budgets of the agencies that fund ocean science. Leaders and program administrators in our field need to make personal commitments to diversity and create opportunities where they are in a position to do so.

For individual faculty who rely on extramural funding, the situation is more complex. At RI institutions that award very few PhDs to URM students, a good first step may be to introduce ocean science faculty to resources and recommendations stemming from the National Research Council's 2007 workshop entitled "Understanding Interventions that Encourage Minorities to Pursue Research Careers." This workshop brought together a multidisciplinary community of specialists including faculty and program directors in various STEM disciplines, social and behavioral science researchers, and project/program evaluators. Subsequent Understanding Interventions conferences (UI, 2015) have focused on sharing information on

research-based practices known to change student outcomes (see DePass and Chubin, 2015, for the latest report). The ocean science community should take advantage of the UI model and the opportunity to work with diversity-focused colleagues who have a broad range of expertise. In addition to these American Association for the Advancement of Science (AAAS) resources, the Council of Graduate Schools has produced a report with valuable advice (see Sowell et al., 2015, and Ortega and McCarthy, 2016, in this issue). Additionally, some RI campuses have internal diversity offices that can provide valuable support.

At the programmatic level, in selecting students for their programs, some doctoral programs rely too heavily on GRE scores, grade point averages (GPAs), and the applicant's undergraduate institution. Evidence of research skills through participation in Research Experiences for Undergraduates (REU) or other internship programs, attendance and presentation at research conferences, and thesis-option MS degrees all provide evidence that an applicant is capable of doctorate-level work.

Ideally, graduate programs will provide the following for all students (not just URM):

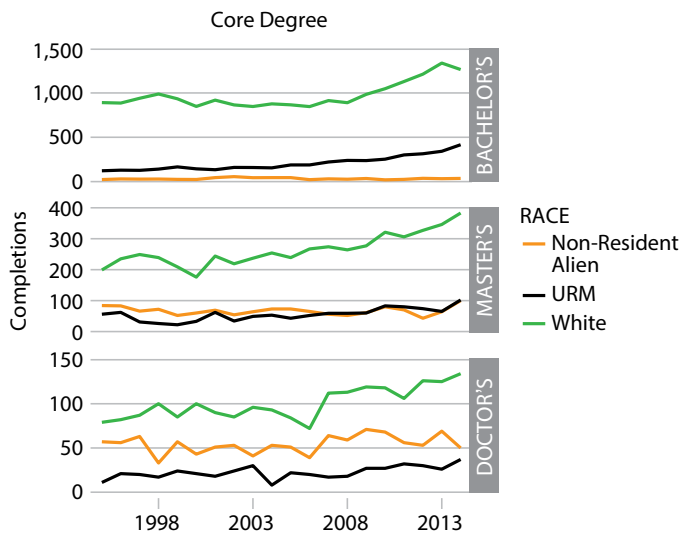
- Diverse mentor structures that include mentors from RI institutions, government, industry, policy/management, and multicultural experiences, as well as early exposure to research and mentors outside of academia
- Robust partnerships with industry and government so students can see and explore a range of career paths
- Strong monitoring structures and communication about the consequences of falling behind
- Policies that put students within a well-developed probationary structure (e.g., mandatory tutoring) if grades fall below a 3.0 GPA, rather than automatically eliminating them from the program.

The largest challenge to achieving real progress in social diversity within the ocean science community is incorporating the above values and goals into RI institution departments by recognizing and rewarding minority mentoring and intervention in evaluation processes. Funding agencies can help by explicitly stating that these kinds of broader impact activities have merit in all their programs.

Beyond this institutional change, more emphasis should be placed on providing fellowship support that is relatively flexible to give URM students the leverage they need to apply to and attend graduate programs. Currently, most ocean science graduate programs will not accept students unless there is an identified source of funding for tuition and stipend, and faculty at RI institutions are having an increasingly difficult time supporting graduate students on their research grants. Fellowships such as NSF's Graduate Research Fellowship Program (GRFP, <https://www.nsfgrfp.org>; Cook, 2016, in this issue) can be earned before admission to a particular graduate program and give an academically strong student a better chance of being accepted as well as increase the likelihood of finding an appropriate and supportive advisor.

### The Role of Marine Laboratories in Connecting Pathways

Finally, we want to raise awareness of the unique opportunities offered by marine laboratories that are part of the National Association of Marine Laboratories (NAML) network. At many of the 90+ NAML member labs, research, education, and outreach programs introduce students to relevant, often life-changing, place-based experiences that span the breadth of marine and ocean sciences (Klug et al., 2002; NRC, 2014). Successful pathways to graduate school often begin at such institutions when pre-college and early undergraduates are exposed to ocean issues and participate in genuine research experiences that engage, demystify, and build confidence in science achievement. Both NSF and the National Oceanic and Atmospheric Administration (NOAA) fund such programs—NSF through programs such as REU, AGEP, Louis Stokes Alliances for Minority Participation (LSAMP), HBCU Undergraduate Program (HBCU-UP), and Improving



**FIGURE 1.** Core marine degree completions from 1993 to 2014 by degree level for nonresident alien, white, and underrepresented minority (URM) groups. Core degree = Classification of Instructional Programs (CIP) Title (CIP-6 Code), ocean engineering (14.2401), marine biology and biological oceanography (26.1302), marine sciences (30.3201), oceanography, chemical and physical (40.0607). URM = American Indian/Alaska Native, Asian/Pacific Islander, Black/African American, Hispanic/Latino, two or more races, and unknown race. From Trends in Marine Science Degree Completions, with permission of Matthew Lettrich, NOAA contractor, pers. comm., 2014

Undergraduate STEM Education (IUSE), among others, and NOAA primarily through the agency's Office of Education's Educational Partnership Program (EPP).

Marine laboratories in the NAML network can help bridge the gap between HBCUs/MSIs and RI institutions. For example, SSU and Harbor Branch Oceanographic Institute pioneered an innovative "pre-REU" summer "bridge" to research based on ideas of "critical time" and "critical mass" (Gilligan et al., 2007). Seventy-five percent of the program's 40 participants surveyed in 2009–2013 were still in STEM fields, indicating that their experiences in the program created foundations for their paths in science. Thirty-one (78%) of those individuals are pursuing graduate education (Hintz et al., 2015). Today, three of the 32 ocean science REU programs include a similar critical time/critical mass focus designed to recruit more URM students.

A second NSF-supported program, the Collaboration to Integrate Research and Education Program in Marine Sciences partnership between NAML members, SSU, and the Skidaway Institute of Oceanography, has led to a successful MS degree in marine sciences at SSU (Gilligan et al., 2007). From 2002 to 2012, SSU graduated nine of the reported 19 (47%) African-American master's degree recipients in the ocean sciences and 43 of the 48 (89%) reported African-American bachelor's degree recipients in the ocean sciences (NSF, 2014).

Another NAML member, the University of Connecticut's marine facility at Avery Point, recently used NSF Centers for Ocean Sciences Education Excellence (COSEE) funding to partner with the LSAMP Northeast Alliance to add a pioneering ocean-focused component to the region's NSF-funded LSAMP (Ivar Babb, University of Connecticut, *pers. comm.*, 2015). We encourage faculty to develop similar collaborations with the other 34 existing LSAMP awards and work with colleagues committed to diversity to create new LSAMPs that include ocean science research centers. Such efforts offer extraordinary opportunities to further diversity in the ocean-focused supply network at the undergraduate level.

## Conclusions

At RI institutions, in particular, we urge faculty and administrators to first seek to better understand the diversity of preparation that exists among URM undergraduates and to network with programs that engage large numbers of URM STEM major undergraduates. Second, guiding principles from successful collaborative models used in other disciplines should be reviewed, discussed, and applied more widely within our community. Third, departments and the faculty that comprise them should recognize that developing student support structures and faculty multicultural competence will pay off in the long run by creating more innovative, flexible, and competitive futures for the ocean science institutions and workforce. A good start toward developing the community buy-in that is needed would be departmental discussions of the societal benefits of diversity coupled with support for faculty to build collaborations that are similar to successful models in other disciplines.

We argue that it is time for the community to stop debating the issue of the importance of diversity in the ocean sciences and decide if the time, effort, and cost of moving forward are worth it for our community, and take the necessary steps. This is our challenge.

## REFERENCES

- AAAS (American Association for the Advancement of Science). 2011. *Measuring Diversity: An Evaluation Guide for STEM Graduate Program Leaders*. 83 pp., <http://www.nsfagep.org/files/2011/04/MeasuringDiversity-EvalGuide.pdf>.
- Cook, S.B. 2016. NSF's Graduate Student Support Programs: An overview and reflections from a former fellow. *Oceanography* 29(1):86–89, <http://dx.doi.org/10.5670/oceanog.2016.20>.
- DePass, A.L., and D.E. Chubin, eds. 2015. *Understanding Interventions that Broaden Participation in Research Careers, vol. VI: Growing the Community*. Summary of a conference, Baltimore, MD, May 16–18, 2014, 91 pp., <http://understanding-interventions.org> for information regarding earlier conferences and summary reports.

- Gewin, V. 2014. Diversity: Equal access. *Nature* 511:499–500, <http://dx.doi.org/10.1038/nj7510-499a>.
- Gilligan, M. 2002. Statement by Matthew R. Gilligan before the U.S. Commission on Ocean Policy, 15 January 2002, Charleston, South Carolina. 9 pp., [http://govinfo.library.unt.edu/oceancommission/meetings/jan15\\_16\\_02/gilligan\\_statement.pdf](http://govinfo.library.unt.edu/oceancommission/meetings/jan15_16_02/gilligan_statement.pdf).
- Gilligan, M.G., P.G. Verity, C.B. Cook, S.B. Cook, M.G. Booth, and M.E. Frischer. 2007. Building a diverse and innovative ocean workforce through collaboration and partnerships that integrate research and education: HBCUs and marine laboratories. *Journal of Geoscience Education* 55(6):531–540.
- Hintz, C.J., T. Cox, M. Gilligan. 2015. Savannah State University's Bridge to Research Model for Summer Research Experiences for Undergraduates. Paper presented at the Coastal and Estuaries Research Federation 23rd Biennial Conference. Portland, OR, November 2015, Abstract OCC–B 116.
- Johnson, A., M.J. Huggans, D. Siegfried, and L. Braxton. 2016. Strategies for increasing diversity in the ocean science workforce through mentoring. *Oceanography* 29(1):46–54, <http://dx.doi.org/10.5670/oceanog.2016.11>.
- Klug, M.J., J. Hodder, and H. Swain. 2002. Report of a Workshop, "Education and Recruitment into the Biological Sciences: Potential Role of Field Station and Marine Laboratories," Washington, DC, February 11–12, 2002, 23 pp., [http://www.obfs.org/ed/FSML Complete Report 2004.pdf](http://www.obfs.org/ed/FSML%20Complete%20Report%202004.pdf).
- Lettrich, M. 2014. Trends in marine science degree completions. Presentation at the Ocean Sciences Educators' Retreat 2014 in Savannah, GA, <http://oceanleadership.org/education/ocean-sciences-educators-retreat>.
- NRC (National Research Council). 2007. *Understanding Interventions That Encourage Minorities to Pursue Research Careers: Summary of a Workshop*. National Academies Press, Washington, DC, 84 pp.
- NRC. 2014. *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*. National Academies Press, Washington, DC, 84 pp.
- NSF (National Science Foundation). 2014. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2013*. National Science Foundation 13-304, Arlington, VA, 293 pp., [http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304\\_full.pdf](http://www.nsf.gov/statistics/wmpd/2013/pdf/nsf13304_full.pdf).
- Ortega, S.T., and M.T. McCarthy. 2016. The big picture: National initiatives in graduate education. *Oceanography* 29(1):44–45, <http://dx.doi.org/10.5670/oceanog.2016.10>.
- President's Board of Advisors on HBCUs. 1999. *Historically Black Colleges and Universities for the 21st Century*. Department of Education Annual Report of the President's Board of Advisors on HBCUs, Washington, DC, 41 pp., <http://files.eric.ed.gov/fulltext/ED428626.pdf>.
- Sowell, R., J. Allum, and H. Okahana. 2015. *Doctoral Initiative on Minority Attrition and Completion*. Council of Graduate Schools, Washington, DC, 84 pp., <http://cgsnet.org/minority-attrition-and-completion-stem-doctoral-programs>.
- Tsui, L. 2007. Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education* 76(4):555–581.
- UI (Understanding Interventions). 2015. <http://understanding-interventions.org/2015-conference>.

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