

Better Science Through Diversity: Disciplinary and Cultural Diversity in the Environmental Sciences

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SUMMARY

Environmental science is inherently diverse. Diversity in disciplines is the expected norm. Oddly, the embrace of disciplinary diversity has not extended to cultural diversity in our field. There is an impending demographic shift with the minority becoming the new majority and an expanded public awareness of environmental issues. Still, environmental sciences are a cultural diversity desert. We, as a community, have failed to recruit and retain minority environmental scientists. Through an exploration of disciplinary diversity we can gain insights into what is needed to increase cultural diversity in our field.

KEY WORDS

Diversity, interdisciplinary, minority, environmental science

Many environmental scientists embrace diversity each day. Diversity of disciplines is inherent to the profession; it is idealized in our teaching and practiced in our research. While environmental sciences integrates the sciences, including the social sciences, mathematics and engineering, it is intriguing to note that disciplinary turf wars still occur. The debate between pure and applied research rages. Academically, I was immersed in the pure sciences, completing an undergraduate degree in biology, a master's in geology and a PhD in geochemistry. My PhD is technically in Earth and Environmental Sciences but I can honestly say I never took a course in anything approximating environmental sciences. Sure I took ecology, geomorphology, aqueous geochemistry and all those disciplinary courses that claim to be environmental, but I suspect it typical of my "generation" that there was no real opportunity to take a course that integrated these disciplines. Now I find myself a chemistry professor and Director of a graduate program in environmental sciences. Perhaps it is because I switched disciplines so often that I now avoid the pratfalls of behaving as a stalwart defender of disciplinary purity.

I should be clear that by "interdisciplinary" I am not referring to educational or research programs that tout themselves as interdisciplinary because faculty from two or three sub-disciplines are involved. By interdisciplinary education I mean those programs, both research and education, that integrate natural and social sciences.

DISCIPLINARY DIVERSITY

In investigating disciplinary diversity in the environmental sciences over the past few decades some trends emerge. The tradition of renaming academic departments by adding "and Environmental Sciences" seems to have slowed if not disappeared (Romero and Silveri, 2006). I suspect that trend emerged in an attempt to stave off low enrollments and take advantage of the environmental movement of the 1970s into increasing college enrollments. I also suspect that this naming trend has ceased because it is inherently fraudulent. Disciplinary faculty cannot be asked to teach a truly interdisciplinary curriculum without training, just as one cannot shift research focus overnight. There has to be a driving force in developing truly interdisciplinary educational programs.

In my experience, the exemplary programs are those that developed around the interdisciplinary research activities of its faculty. Interdisciplinary research is an exploration of an environmental issue from different disciplinary perspectives with no single discipline dominating the research efforts of the team. This process may be initiated because of the perceived increase in extramural funding opportunities in the environmental sciences, but it is a committed and competent team of researchers from seemingly disparate science, engineering and social science perspectives that sustains it.

Understanding diversity in the environmental sciences from a disciplinary perspective begs the question “What is environmental science?” According to EnviroEducation.com, a website visited by potential environmental science majors, environmental science is the study of natural cycles and processes involving soil, plants, water and air and human impact on them and ecology is its disciplinary foundation. That is not what environmental science means to me as a practitioner or educator. Exploring relationships between the disciplines contributing to environmental science could lead to a better definition of environmental science.

Recently, at the American Chemical Society meeting, I attended a talk about the Map of Science project (Börner, 2007). The “map” represents the relationships between 1.6 million scientific articles. Most major disciplines are represented (physical and natural sciences, social sciences, medicine, engineering); however, no node on the map (<http://mapofscience.com>) is identifiably “environmental science”. Recall that the map is based on citations of scientific articles. For some of our academic institutions, the “pure” versus “applied” argument has been put to bed. Faculty at many institutions are now able to apply articles towards tenure and promotion that do not appear in specialized disciplinary journals. Still, the vast majority of environmental science research is published in discipline-specific journals. Drilling into the map of science, clear connections exist between the ecological and earth sciences, with earth sciences serving as a conduit for connections to physics and chemistry, and ecology serving as the nexus to connect to the social sciences. Environmental science, however, has not reached the position in research or education that merits it a disciplinary node on the map of science.

Perhaps the embrace of diversity with regards to disciplines is more loose and tenuous than we think.

If we accept the argument that environmental science is a field of science linking disciplines from chemistry and biology to sociology and economics, yet our research does not yet demonstrate this, perhaps our educational programs do. There are approximately 278 undergraduate Environmental Science (title of department or major) programs in the U.S. Of these, less than ten percent are located at minority serving institutions. Of the sixty eight master's and thirty four doctoral programs in Environmental Sciences only Florida A&M University, Hampton University (joint with the College of William and Mary, Virginia Institute of Marine Science and Old Dominion University), Morgan State University, and the University of Maryland Eastern Shore offer "environmental science" doctoral programs. Maniates and Whissel (2000) and Romero and Silveri (2006) reviewed the structure of a number of undergraduate environmental science/studies programs in response to early criticism that such programs are inherently weak and hobble students (Soulé and Press, 1998). Both Maniates and Whissel (2000) and Romero and Silveri (2006) found that undergraduate environmental programs are diverse in their focus and so cannot be easily compared.

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Environmental science programs have evolved so that the overwhelming majority integrate environmental education across the curriculum. These programs offer students concentrations within disciplines, and provide creative integrative electives and/or research opportunities so that students may extend their disciplinary knowledge into collaborative multidisciplinary areas. Most undergraduate and graduate environmental science programs emphasize the natural sciences, but many graduate programs also

provide course options in the social sciences to ensure that science students are introduced to issues such as environmental justice, economics, etc. My contention is that most environmental science graduate programs, unlike undergraduate programs, are outgrowths of faculty research interests and strengths. Ultimately though, the graduate programs that grew through opportunistic name addition have floundered and no longer populate, to any great extent, the undergraduate environmental science landscape.

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CULTURAL DIVERSITY

Accepting that environmental scientists embrace disciplinary diversity begs the question of why there are so few minority environmental scientists. I believe that diversity in disciplines is vital to studying environmental issues such as pollution of water bodies, sustainable use of natural resources etc., and I trust that my peers would concur. I do not, however, believe that my peers accept the parallel argument that cultural diversity in the environmental sciences is equally vital to studying these issues. I say this because I see limited evidence that the “creed” has become the “deed”. By 2050 minority groups will constitute the new majority (Day, 1996). In 2000 the U.S. population was 75.1% Caucasian, 12.3% African American, 12.9% Hispanic, 0.9% Native American, 3.6% Asian and 0.1% Pacific Islander. By 2050 it is expected that the demographics of the U.S. will be markedly different, with 47.8% of the population being Caucasian, 15.8% African American, 25.7% Hispanic, 1.0% Native American, and 9.7% Asian and Pacific Islander. To serve the nation’s population and address environmental issues, we must respond proactively to the impending

demographic shift. With pressure on Earth's resources, and focused attention on environmental issues, we will need environmental scientists to reflect the U.S. population.

Of the environmental science programs in U.S. colleges, very few are located at minority serving institutions. The lack of such programs has been addressed through value-added programs at minority and majority campuses. Such programs as Multicultural Students at Sea Together (M.A.S.T.) at Hampton University and Research Experiences in Science of the Environment at Arkansas State University (R.I.S.E.) have leveraged federal funding into programs that provide meaningful research in the environmental sciences with a clear focus on enhancing diversity. In addition to enrichment programs, unique linkages between minority serving institutions and scientific societies have led to a transformation in the aquatic sciences. Such is the case for the American Society of Limnology and Oceanography (ASLO) – National Science Foundation – Hampton University, a minority student program that provides students with the opportunity to present their research at a national meeting. The program integrates mentorship, opportunities to meet minority role models, and cultural enrichment experiences – ultimately integrating young minority students into the culture of the aquatic sciences.

If we continue to fail them by not integrating them into the culture of research, our science is, frankly, doomed. More and more environmental issues emerge in regions of the country where the population is predominantly minority. If practitioners do not reflect the population, it will be difficult to engage stakeholders and difficult to effect meaningful change.

While a number of efforts to enhance diversity in the environmental sciences exist for K-12 students, we still lack the diversity necessary to reflect the demographics of the U.S. There is a critical shortage of M.S. and Ph.D. level minority environmental scientists. If we continue to fail them by not integrating them into the culture of research, our science is, frankly, doomed. More and more environmental issues emerge in regions of the country where the

population is predominantly minority. If practitioners do not reflect the population, it will be difficult to engage stakeholders and difficult to effect meaningful change. We will not solve issues of sustainability or global change, or whatever the hot button issue of the day might be, without diverse perspectives and new approaches. In my opinion, by failing to increase representation of minorities in the environmental sciences, we are failing our planet.

Few environmental science graduate programs exist at minority serving institutions despite the great need for such (e.g., McManus et al., 2000). Therefore, it is incumbent on majority serving institutions to fill the gap. Doing so in partnership with a minority serving institution (i.e., the Hall-Bonner Program at Hampton University, Old Dominion University, the College of William and Mary, and the Virginia Institute of Marine Science) is one mechanism to assist in transitioning students from undergraduate to graduate programs. It is vital that majority institutions buy into the critical need to increase minority representation in the environmental sciences and design and offer meaningful rigorous graduate programs that allow minority students to enroll and complete graduate degrees. In other words, academia has to shift from a culture of exclusion to a culture of inclusion.

The first step to increase diversity in the environmental sciences is to establish a stable and significant effort behind effecting change. Majority graduate program administrators and faculty mentors must embrace the importance of the issue in the way that disciplinary diversity in the environmental sciences has been embraced. Environmental science is inherently interdisciplinary and it is also inherently culturally diverse. Several universities have developed scholarship programs to increase diversity, but have made the error of naming these scholarships “diversity” awards or variations of that theme. This sends the unintended message to the recipient that they are different, and contributes to the imposter syndrome leading the student to feel that they would have no funding at all, were it not for their ethnicity. While set aside funding can help graduate programs in their recruitment efforts, it is vital that students who receive funds know that they competed on an even playing field with other applicants and that the award was merit based.

Majority programs must understand that education is not one size fits all. There are meaningful and important cultural differences that

programs and faculty should recognize and respect. Whether connection to family, tribe or religion, minority students bring unique cultural perspectives that, if nurtured, add significant depth to the graduate experience for all students. Programs and faculty need to watch for and be sensitive to exclusive behaviors and attitudes, regardless of student race or ethnicity. How this transformation occurs and what mechanisms are best to maintain a culturally competent program varies with individuals and program focus. Transformation will only occur if there is a proactive, campus-wide commitment to enhancing diversity – not just for diversity sake, but because education and scholarship are enriched by diverse perspectives.

CONCLUSION

There is a clear need for disciplinary and cultural diversity in the environmental sciences. Disciplinary diversity appears to be the norm in both environmental research and education programs. Rigor in curricula and scholarship are expected in our field. What is lacking is the accompanying cultural diversity that will lead to truly transformative research and education. To achieve diversity in all aspects, environmental science education programs must embrace the importance of cultural diversity as they have disciplinary diversity. To paraphrase Laura Réndon (1992) we will change environmental sciences even as environmental sciences changes us and more and more of us will integrate diversity in all aspects of what we do.

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Dr. Robyn Hannigan is the Director and Judd Hill Chair of Environmental Sciences at Arkansas State University. She is an Aldo Leopold Leadership Fellow and the 2007 American Chemical Society Medal awardee for Encouraging Disadvantaged Students into Careers in the Chemical Sciences. Her research and student mentoring have been highlighted by the Society for Advancement of Chicanos and Native Americans in Science (SACNAS), the American Association for the Advancement of Science (AAAS), and the National Science Foundation (NSF).

Dr. Hannigan’s circuitous route to a career in environmental chemistry began at the College of New Jersey where she earned her BS

in Biology. She completed her master's and doctoral degrees in Earth and Environmental Science at the University of Rochester, focusing on high temperature trace element chemistry. During her post-doctoral fellowships at Woods Hole Oceanographic Institution and at Old Dominion University, she leveraged her expertise in high temperature chemistry into collaborative research projects with biologists and oceanographers. Ever inspired by the unique behavior of metals and small biomolecules during phase transition from aqueous to vapor, her research has developed unique analytical techniques and technologies to study the behavior of chemicals in natural systems. The underlying theme of her research and that of her students is mass spectrometry. She and her students hold several patents in areas of sample introduction technologies of mass spectrometric identification of important biological molecules.

In 2005 Dr. Hannigan formed a new company, Hyphenated Solutions, with two of her graduate students. This company now provides sample introduction systems to industry leaders such as PerkinElmer and Cetac Technologies.

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