



Using place-based, community-inspired research to broaden participation in the geosciences

Emily Geraghty Ward, *Geology Program, Rocky Mountain College, 1511 Poly Drive, Billings, Montana 59102, USA*; **Diana Dalbotten**, *National Center for Earth-Surface Dynamics, St. Anthony Falls Laboratory, University of Minnesota, 2 Third Ave. SE, Minneapolis, Minnesota 55414, USA*; **Nievíta Bueno Watts**, *Indian Natural Resources Science & Engineering Program, Humboldt State University, Walter Warren House #38, 1 Harpst Street, Arcata, California 95521, USA*; **Antony Berthelote**, *Hydrology, Salish Kootenai College, P.O. Box 70, Pablo, Montana 59855, USA*.

INTRODUCTION

There is no question that the geoscience community needs to be more diverse. The National Center for Science and Engineering Statistics (NCSES, 2017) reports over 80% of college and graduate degrees earned by U.S. citizens in the geosciences are awarded to Caucasians. The geoscience community has recognized this discrepancy. The National Science Foundation Directorate for Geosciences continues to make diversity a top priority and emphasizes broadening participation efforts through funding curriculum, instruction, and research opportunities designed to engage students from underrepresented populations.

Much research has been done on geoscience curricula and instruction that engage a broader audience (e.g., Kober, 2015; Singer et al., 2012). Others describe research experiences that have successfully engaged underrepresented students (e.g., Dalbotten et al., 2014; Haacker, 2015; Huntoon et al., 2015). These publications describe elements of Research Experience for Undergraduates (REU) models that prove successful in engaging and retaining students from underrepresented groups. We present another model for engaging underrepresented students—the REU site on Sustainable Land and Water Resources (SLAWR)—that is unique for its emphasis on recruiting Native American students and for its emphasis on place and community. For our model, “place” encompasses both the physical landscape related to the research sites and the human connections to those places. Under our approach, research topics are identified through systematic collaboration with communities tied to these places.

THE RESEARCH MODEL

The REU-SLAWR research sites are located on tribal lands and in urban environments where underrepresented students live and work. Students are advised by a team of researchers from the Confederated Salish and Kootenai Tribes, the Fond du Lac Band of Lake Superior Chippewa (FDL), Salish Kootenai College (SKC), the National Center for Earth-Surface Dynamics (NCED), and the University of Minnesota Twin Cities and Duluth (UMN/UMD). Projects are developed in collaboration with tribes’ resource management divisions.

The REU is rooted in an interdisciplinary team-oriented approach that emphasizes quantitative and predictive methods, indigenous research methodologies, and traditional ecological knowledge. Leaders incorporate a full-day seminar on indigenous research and community-based participatory research (CBPR) for students and mentors during orientation to help the students make connections between their research and local communities’ needs and interests. Projects typically focus on native species and habitat restoration to enhance biodiversity and support cultural values. Student projects at Fond du Lac have focused on wild rice, a plant that is culturally significant to the Ojibwe. Research projects have examined the impact of sulfides and sulfates on plant health. Data about these relationships provide tribal and non-tribal officials with information about mining impacts in Minnesota. Team SPAW (Salish and Pend D’Oreille Aboriginal Watershed) projects include habitat characterization of culturally significant blue camas and wild huckleberries. These characterizations include study of soils, plant communities, pollinators, macro-invertebrates, reptiles, amphibians, birds, and

mammals including bears and bats, water quality, invasive species, and other land and water resource issues. Team Stream has focused on issues of sediment transport related to stream restoration and debris flow prediction using state of the art facilities at UMN’s St. Anthony Falls Laboratory (SAFL) for computational modeling development. In 2017, Team Stream partnered with FDL to develop a project focused on Spirit Island, an island in Spirit Lake, which is an estuary of the St. Louis River that drains into Lake Superior, newly acquired by FDL in 2016. It is one of the most culturally significant sacred sites for the Ojibwe people. The tribe is concerned about the continued existence of the island because of shoreline erosion and changes to current patterns in the Lake Superior Estuary. Researchers at SAFL have been working on a computer model of the problem. A new project using complementary physical modeling was developed in conjunction with this research.

Teams in Montana and at FDL who work directly on projects of cultural significance present their research to governing boards of the tribes. For example, in 2017 both our wild rice team (Team Zaaga’igan) (whose research outcome showed that sulfates do impact wild rice growth) and the Spirit Island team (Team Spirit) worked on projects that were developed with FDL Resource Management. The students presented their results to resource managers from Minnesota and Wisconsin at the Great Lakes Indian Fish and Wildlife Commission Voigt Taskforce meeting. Furthermore, nine of 14 students from the 2017 REU went on to present at national conferences in the months following the REU. Dissemination of research

Table 1. Demographic data collected from REU* participants from 2012–2017

	No. students (%)	Age range (avg.)	>25 years old (%)	Parents (%)	No. of students who consider place important (%)
All REU participants	98	18–54 (26)	31 (32%)	26 (27%)	49 (50%)
Native American REU participants	41 (42% of total)	19–54 (29)	25 (61% of Native students)	22 (54% of Native students)	27 (66% of Native students)

*REU—Research Experience for Undergraduates.

findings occurs at different levels—locally to tribal governments as well as nationally.

SUCCESS OF THE SLAWR MODEL AND LESSONS LEARNED

Data collected from participants (Table 1) highlight the importance of place and community for Native American participants. When project evaluators asked students if the location of the REU site influenced participation in the summer program, about half said “yes,” which was not necessarily surprising. What was surprising were responses that students provided to the open-ended question of *why* place mattered. A thematic content analysis of all responses from Native American students revealed that the majority listed family responsibilities (36%) and being close to home (28%) as reasons they selected and applied for the REU-SLAWR. Others noted interest in the unique landscape of the area (14%), the place-based nature of the research projects (14%), and working in Native communities (8%) as factors that played into their decision to apply. In comparison, non-Native students who indicated that place was important identified the landscape/geography and field-based research topics as reasons why they applied to the REU, with far fewer noting family responsibilities or proximity to their home as reasons they decided to participate.

These responses to the importance of location were different than expected, but understandable given that the Native American REU-SLAWR students were, on average, slightly older and made up the majority of the participants with children (85%). The data from participants suggest that physical proximity of the REU site to their homes helped facilitate Native student participation by allowing participants to meet their family obligations while also gaining research experience. That research topics were locally relevant was also an important draw as participants were aware that their research findings would directly impact their home communities in which the research was conducted.

As the project evolved, student feedback helped REU leaders appreciate how

important and interrelated place, community, and family were for Native American students in particular. In interviews, students noted that while it was difficult to balance family responsibilities with the responsibilities required of the REU, accommodations for family made it possible to participate in the project when they would not have otherwise been able. Leaders also responded to student feedback indicating needed clarity on how or why their projects were community-based because planning occurred before the students arrived onsite. In response, the leaders made the connections with the projects and local communities more explicit and included more CBPR material as part of orientation.

NEXT STEPS

The REU-SLAWR completed its sixth season and continues to refine its model to best support the needs of the diverse students who participate each year. In addition to annual project evaluation, the project leaders are planning to conduct a longitudinal analysis of student data collected since the start of the REU to identify the most influential model elements that recruit, support, and retain students from underrepresented groups in the geosciences. These essential elements can be used as a model for other REUs who wish to broaden participation in the geosciences.

The REU-SLAWR is developing new approaches to undergraduate research that focus on place-based projects that are relevant to students and their communities. A few of the things that the REU-SLAWR does to support diversity in the program include: (1) ensure that students have a paycheck the day they arrive; (2) encourage students to let the leaders know if they have any cultural events (e.g., powwow) or other issues and make allowance for these things; (3) value and incorporate traditional knowledge and cultural information and encourage students to share it; and (4) put students on teams and emphasize teamwork over individual success.

The REU-SLAWR offers a new paradigm for undergraduate research that incorporates

place-based and community-based participatory research, and all mentors and participants are trained in this approach. The hope is that this experience will prepare Native Americans to fill resource management positions and prepare the next generation of researchers in best practices for doing research on tribal lands.

ACKNOWLEDGMENTS

The REU projects are currently funded by the National Science Foundation EAR 1461006, and were funded by 2012–2014 NSF EAR 1420467 and 2011–2012 NSF EAR 1156984.

REFERENCES CITED

- Dalbotten, D., Haacker-Santos, R., and Zumbirker, S., 2014, New voices: The role of undergraduate geoscience research in supporting alternative perspectives on the Anthropocene, *in* Dalbotten, D., Roehrig, G., and Hamilton, P., eds., *Future Earth—Advancing Civic Understanding of the Anthropocene*: New York, John Wiley & Sons, p. 77–88.
- Haacker, R., 2015, From recruitment to retention: *Nature Geoscience*, v. 8, p. 577–578, <https://www.doi.org/10.1038/ngeo2501>.
- Huntoon, J.E., Tanenbaum, C., and Hodges, J., 2015, Increasing diversity in the geosciences: *Eos*, v. 96, 9 March 2015, doi:10.1029/2015EO025897, <https://eos.org/project-updates/increasing-diversity-in-the-geosciences> (last accessed 17 May 2018).
- Kober, N., 2015, *Reaching Students: What Research Says about Effective Instruction in Undergraduate Science and Engineering*: Washington, D.C., National Academies Press, 256 p.
- National Science Foundation, National Center for Science and Engineering Statistics, 2017, *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017*: Arlington, Virginia, Special Report NSF 17-310, <http://www.nsf.gov/statistics/wmpd/> (last accessed 24 May 2018).
- Singer, S., Nielsen, N., and Schweingruber, H., editors, 2012, *Discipline-Based Education Research: Understanding and Improving Learning in Undergraduate Science and Engineering*: Washington, D.C., National Research Council, National Academies Press, 282 p.

MANUSCRIPT RECEIVED 19 OCT. 2017

REVISED MANUSCRIPT RECEIVED 9 MAY 2018

MANUSCRIPT ACCEPTED 11 MAY 2018