



UNDERGRADUATE EDUCATION

Promoting inclusion in ecological field experiences: Examining and overcoming barriers to a professional rite of passage

Nia Morales¹, Kari Bisbee O'Connell ², Stacy McNulty ³, Alan Berkowitz⁴, Gillian Bowser⁵, Michael Giamellaro ⁶, and Maria N. Miriti ⁷

¹School of Forest Resources and Conservation, University of Florida, 136 Newis-Ziegler Hall, Gainesville, Florida 32611 USA

²Oregon State University, STEM Research Center, 254 Gilbert Hall, Corvallis, Oregon 97331 USA

³SUNY College of Environmental Science and Forestry Adirondack Ecological Center, 6312 NY-28N, Newcomb, New York 12852 USA

⁴Cary Institute of Ecosystem Studies, 2801 Sharon Turnpike; P.O. Box AB, Millbrook, New York 12545-0129 USA

⁵Colorado State University, Ecosystem Science and Sustainability, 1499 Campus Delivery, Fort Collins, Colorado 80523-1499 USA

⁶Oregon State University, Cascades Graduate & Research Center, 650 SW Columbia St., Bend, Oregon 97702 USA

⁷Ohio State University, 382 Aronoff Laboratory 318 W. 12th Avenue, Columbus, Ohio 43210 USA

Abstract

Field experiences can provide transformative opportunities for many individuals who eventually pursue ecology, natural resource, and conservation careers. However, some of the same elements of field-based programs that define and provide pivotal experiences for some represent barriers for others, especially students from underrepresented groups. Barriers may be financial, physical, cultural, or social. Issues of gender, identity, and race/ethnicity, for example, can be isolating or shut down learning during intensive field experiences when group leaders are not prepared to respond to interpersonal challenges. We explore some benefits and barriers presented by field learning

experiences as well as some challenges and potential strategies to broaden inclusivity with the hope of encouraging further conversation on diversity and inclusion in field experiences.

Key words: diversity; ecological education; field experience; inclusion; undergraduate.

Introduction

Understanding ecological systems as they occur in the world is core to the discipline of ecology. Thus, field experiences provide valuable disciplinary training for prospective ecologists and natural resource science professionals (Klemow et al. 2019). Learning that occurs in a field setting can be a powerful experience that promotes skill development and conceptual understanding, enhances environmental literacy, and instills social responsibility and a global mindset for new generations of scientists (Davis et al. 2012, Gretzel et al. 2014, Fleischner et al. 2017, Halliwell et al. 2020). Given the exceptional impacts of field learning, many university ecology and natural resource programs encourage or require a field experience at the undergraduate level.

Field work and the ability to apply natural history approaches are two of the ecology practices in the recently adopted Four-Dimensional Ecology Education Framework (4DEE), endorsed by the Governing Board of the Ecological Society of America (ESA) (Klemow et al. 2019). Employers in ecology typically expect students to have field experiences so they have proficiency with key field techniques, are able to identify species, and possess system knowledge to be competitive for positions (Pelaez et al. 2018). Klemow et al. (2019) recommend instructors “connect students to relevant issues related to global environmental problems through experiential learning.” Field experiences are well-positioned to facilitate such connections. For many ecologists and other field-based scientists, field experiences have served as a rite of passage by cementing their identities as ecologists (Armstrong et al. 2007, Mogk and Goodwin 2012, Cid and Bowser 2015, Streule and Craig 2016).

However, field work can be a barrier or a negative experience that discourages career choices in ecology. Unfortunately, this situation occurs more frequently among women, minorities, and other underrepresented groups (Bowser et al. 2012). As the community of ecologists aims to be more inclusive while also encouraging adoption of the 4DEE in ecology instruction, we need to consider the role of field work in engaging or discouraging students in ecology.

To address this challenge, the Undergraduate Field Experience Research Network (UFERN), funded through the National Science Foundation’s Research Coordination Network-Undergraduate Biology Education Program, aims to develop a collaborative network of field educators and social scientists that fosters effective undergraduate field experiences. This paper draws upon content and discussion from an ESA 2019 Inspire session featuring presentations by a group of interdisciplinary professionals and members of UFERN to describe the field experience and its benefits, discuss the challenges faced by underrepresented groups in accessing and having successful field experiences, and call for more discussion and research about access and inclusion efforts within undergraduate field experiences. This paper is designed to highlight existing work on the field experiences, discuss challenges for underrepresented groups, identify opportunities to create inclusive field experiences for all, and to expand on the content presented at the ESA Inspire Session (rather than provide a comprehensive literature review) to foster discussions among ESA members and beyond.

The Field Experience

Undergraduate field learning experiences can take many forms. These include short (1–3 hr) outdoor laboratories as part of traditional university courses, immersive courses located at field stations and marine laboratories, traveling courses occurring at many locales, or weeks-to-months-long research experiences (Lonergan and Andresen 1988, Hodder 2009, Whitmeyer et al. 2009, Halliwell and Bowser 2019, Halliwell et al. 2020). Undergraduate field experiences, as we are defining them for this paper, are opportunities for learning in natural settings (as opposed to more controlled, indoors settings) that provide students with hands-on practice in doing disciplinary work. Field experiences are inherently place-based and intended to promote student acquisition of scientific content knowledge and practices in the environments in which that knowledge and practice can be readily observed and applied. The approach centers on observations of, and interactions with, the biotic or abiotic elements of an ecosystem and engages all of the senses, providing students with a “primary contextualization” experience (Giamellaro 2014).

Natural environments as platforms for learning expose students to system novelty and variability, concepts that are important to ecology, and they allow students to hone skills by performing short- or long-term projects that allow refinement of research questions and experimental approaches. Greater learning gains in a field-based undergraduate biology compared to a classroom laboratory have been empirically demonstrated. Kloser et al. (2013) compared an inquiry-based field ecology laboratory underpinned by research questions to a traditional instructional approach where students follow “cook-book” instructions to reach known answers and found that the field research experience led to larger student gains in confidence as well as scientific abilities. Authentic field experiences are valued in part because unexpected events create potential for student learning; the capacity for discovery is high, and there may be no set answer at which students are expected to arrive. Unlike a structured science laboratory, the risk of failure is ever-present in the field. This setting exposes students to the reality that there may be no fixed solution to the problems ecologists face in their work and creates an opportunity for instructors to be a co-learner with the students.

Field experiences generally facilitate learning that is immersive and sustained, structure social interactions that build students’ sense of agency and career affinity, and promote development of specialized skills and content knowledge (Billick and Price 2010, Jolley et al. 2018, Halliwell and Bowser 2019). Student interest and motivation are engaged by aspects of the environment called out by the curriculum as well as by those that generate contextual interest for individual students. Learning is situated in the authentic practice of meaningful interactions with the environment and can create attachment to place (Jolley et al. 2018), strong connections to their cohort (Haywood et al. 2016), and feel part of something larger.

For those undergraduate field experiences that include living at a field station or marine laboratory or camping together, profound social interactions are generated as students join and contribute to a defined social group and are live and problem-solve within this group. Given this immersion into authentic ecological and social communities, field experiences are often associated with transformative events and a sense of liminality. Liminality is a transitional condition where conventional social structure is suspended and the participants are separated from their regular social ties and daily residence (Graburn 1977, Urry 2002). Students who successfully navigate the field experience rite of passage embody the norms and rules of professionals; program graduates may feel a sense of membership across new communities, cultures, and environments of ecology (Fleischner et al. 2017).

Challenges for underrepresented groups

Many of the same elements of field experiences (e.g., novelty, liminality) that create positive transformative experiences for some students create barriers for others. For example, field experiences can be physically and mentally demanding due to the rigors of field life which may include long days with few breaks, rugged terrain, unpredictable weather, or isolated settings. These strains may add to the potential for conflict with peers and/or instructors. Safety can be compromised by physical and biological dangers present in the field. Similarly, issues of power imbalance, racial prejudice, and sexual harassment can occur in field settings where institutional oversight may be minimal or hard to enforce (Clancy et al. 2014, Nelson et al. 2017). Further, the intersectionality (the complex interactions that can occur among marginalized identities including race, gender, class, and sexuality; Crenshaw 1989) of these issues presents challenges that could be exacerbated for particular groups of students. For example, women of color face the stressors of sexual harassment plus racial prejudice.

Overall, the issue of underrepresentation and lack of diversity in ecology and related sciences is well documented (NSF 2019). Racial and ethnic minorities constituted just over a quarter of the life, physical, and social science workforce (US Department of Labor 2014), yet they made up only one-eighth of the staff of mainstream environmental organizations and less than 7% of these groups' executive staff (Taylor 2015). In a recent survey, just 6% of The Ecological Society of America's (ESA) members reported belonging to underrepresented minority groups (Mourad et al. 2018).

Research about LGBTQ students in STEM is scarce, especially for specific fields like ecology, but some estimates suggest that LGBTQ people are 17–21% less represented in STEM fields than expected (Cech 2015, Cech and Pham 2017). For individuals with disabilities (including physical, psychological, emotional, cognitive), barriers to STEM careers include factors related to educational experiences and preparation (e.g., less time in structured math and science) as well as employment issues (e.g., lack of understanding of disabilities and their implications for employment) and the obstacles faced vary depending on disability type (Atchison and Feig 2011, Lee 2011, Dunn et al. 2012). Achieving diversity, equity, and inclusion is desirable for many reasons (Hettinger et al. 2019), and undergraduate field experiences should be designed to accommodate a diversity of people and perspectives.

Underrepresentation is correlated with social isolation and marginalization (Foor et al. 2007, McGee 2016, Estrada et al. 2016). A student's sense of belonging within a given ecological discipline can be profoundly shaped by a field experience which is constituted by both the settings of the experience and the intersectionality of race, gender, and socioeconomic background of the participants. In addition, field experiences can have identities created by past participants, faculty, and the paradigms underlying the discipline itself. These identities can be rigid and marginalize those students who do not fit the "model." Also, marginalized students may be the only people of color, disabled, or otherwise self-identified in their cohort, and unrepresented among their faculty supervisors or mentors (Cid and Bowser 2015, McGee 2016, Puritty et al. 2017). They may experience subtle forms of bias (microaggressions) which confer additional burdens and challenges on learning (McCabe 2009). For individuals with cognitive or physical disabilities, challenges could include accessibility, lack of infrastructure to accommodate needs, and also isolation and lack of support.

Creating diverse and inclusive field experiences

Given these challenges, how can educators, mentors, and administrators increase inclusivity by creating field experiences suitable for the full diversity of students? A useful goal is to design student-centered field experiences that speak to the learning identities of participants. These experiences should be “interactive, inquiry-driven, cooperative, collaborative, and relevant” to increase retention of concepts and spark student interest (Brewer and Smith 2011). One strategy could include broadening what constitutes “the field” as suggested by Fleischner et al. (2017). Field experiences do not have to be conducted in remote wilderness areas or require participants to be able-bodied. Opportunities for discovery and learning exist wherever an individual’s attention is captured by nature (Dijkstra 2016). Whether a farm, an urban schoolyard or abandoned lot, a suburban lawn, or a park, starting where students are may be a way to broaden participation and inclusivity in ecology and help students who have grown up in these environments understand how complex natural ecosystems within urban landscapes can serve to answer important bio-

Box 1. What Does an Inclusive Field experience Look Like?

There is no magic formula to create an inclusive field experience. Rather, one needs to consider the real people that are to be included and the real gaps that traditionally tend to prevent them from doing so (Fig. 1). Many programs and instructors have made inroads toward inclusivity and some of these efforts have been reported in the literature.

While residential and extended forays into the field may result in transformative experiences for students, they cannot be if this format is a barrier to entry. Programs that have experimented with closer-to-home and punctuated field experiences have reported significant learning and value to students, particularly those students that are home-bound or have culturally or physically bound concerns with extended travel (Heard 2016, Peacock et al. 2018). Similarly, there is a growing literature base that suggests virtual field experiences can be a close approximation to the real thing, particularly for field-reluctant students (Stumpf et al. 2008, Ketelhut and Nelson 2010, Stokes et al. 2012, Stephens et al. 2016).

Scott et al. (2019) and Haacker (2015) further point out that recruitment and design are not enough. They report how students and particularly underrepresented students’ motivations to work in the field can vary day to day and therefore these evolving perceptions need to be attended to in a culturally responsive way throughout the course. Indeed, Hughes (2016) showed that underrepresented students’ pretrip worries can be mitigated over the course of a trip with careful and culturally responsive planning.

Perhaps most importantly, it is important to include the people who are to be taught in the design of the experience. Ward et al. (2018) describe a program in which they built an undergraduate research experience situated within a sense of place that includes not only the physical environment but the cultural heritage of the Native American tribes with whom the course is designed and enacted. Others have also reported positive learning and affective outcomes when underrepresented students contribute to the course design (Peasland et al. 2019) though instructors may need to concede some core values to be truly inclusive (Stokes et al. 2011, Madden et al. 2012).



Fig. 1. The Rocky Mountain Sustainability and Science Network (RMSSN) is a field experience based on Yellowstone and Grand Teton National Parks funded by a National Science Foundation grant on underrepresented minorities (URM) in the sciences. RMSSN uses project-based learning teams to introduce URM students to the environmental sciences. Photo credit: Gillian Bowser.

logical questions. This idea counters the notion that nature and wildness are beyond the reach of students in urban areas and promotes novel connections to nature and ecology (Box 1; McCleery et al. 2005).

To facilitate effective learning environments for students of all abilities, field instructors can apply universal design for learning (UDL) in their courses by considering the concept of access in their education elements (lectures, print, and online media, considerations for field work). Instead of adapting materials “on the fly” to meet the needs for a few individual students in a course, accessible products or experiences can be designed to benefit all students (Scott et al. 2003, Bernacchio and Mullen 2007). Developing student-centered experiences means creating field activities and settings where students feel safe and welcomed among their peers and group leaders. Codes of conduct for students, course instructors, researchers, and support staff can clarify inappropriate behaviors, consequences, and reporting routes (but consistency and follow-through by leaders is needed). Cultural competence training for field instructors and students could be a promising way to create inclusive environments and create a sense of belonging to a team during the field experience (Halliwell et al. 2020). Setting expectations in advance can foster inclusivity by helping everyone appreciate that individual and collective identities influence learning experiences and promote the recognition that there is a demographic skewness that exists in higher education and that favors white, middle-, and upper-class people (Miriti 2019).

Well-designed field learning activities that engage underrepresented students can facilitate cognitive and affective gains by all students and create communities of practice focused on ecology principles at the human-ecosystem nexus. Higher institutions’ field-based resources and faculty reward structures should be examined for possible shifts in responsibility for more inclusive mentoring to all, not just underrepresented, faculty (Jimenez et al. 2019). Further, Bowser et al. (2014) recommend small cohorts

that have a common sense of purpose around a research topic in the field (Halliwell and Bowser 2019). These project-based learning models in the field give the students an identity as researchers and equals in a group that in turn can facilitate problem solving and advance student learning.

Continuing the conversation

This paper presented some of the existing challenges and potential innovative strategies to broaden inclusivity in field experiences. We seek to spark a continuing conversation about creating student-centered field experiences that represent positive and formative experiences for all participants while removing real or imagined barriers to any student participating in field research. We envision these conversations taking place within the community of ecologists and educators seeking to refine and implement the ESA's 4DEE framework, in the Undergraduate Field Experience Research Network (UFERN), and in collaborations with other fields of study such as Geosciences that have similar concerns.

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