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PERSPECTIVE

UN Decade on Ecosystem Restoration

Ecological restoration at the University of Wisconsin–Madison Arboretum and beyond: Building and sharing collective knowledge through a participatory leadership framework

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Abstract

1. The Society for Ecological Restoration defines restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." The United Nations Decade on Ecosystem Restoration is an "all-hands-on-deck" call to revive imperilled ecosystems around the world. The task at hand is more than professional practitioners and organizations can handle alone. Volunteers play a critically important role in restoring the structure and function of the world's most degraded ecosystems.
2. The 485 ha University of Wisconsin–Madison Arboretum is the site of some of the oldest restored ecological communities in the world. Like many restoration sites, long-term management of these communities requires expertise and sustained volunteer engagement. The Arboretum fosters expertise and engagement with a two-pronged approach. This includes (1) the Arboretum's Restoration Team Leader Program, which trains and empowers restoration volunteers to lead community members in on-the-ground restoration, and (2) the Restoration Managers Who Work with Volunteers group that convenes restoration managers from multiple organizations for collaborative projects. These programs facilitate ecological restoration by working directly with volunteers and are models of participatory leadership and communities of practice.
3. Here, we share the principles, practices and frameworks behind these programs and illustrate how this model can be replicated to strengthen community-based restoration around the globe.

KEYWORDS
community engagement, ecological literacy, ecological restoration, participatory leadership, volunteers

1 | INTRODUCTION

The 485 ha University of Wisconsin–Madison Arboretum (hereinafter Arboretum) is the site of some of the oldest restored ecological communities in the world and played a pioneering role in the development of ecological restoration (Jordan et al., 1987) The first land acquisitions took place in 1932 and a formal dedication ceremony occurred in 1934. The restoration of an abandoned agricultural field to a tallgrass prairie began with men from the Civilian Conservation Corps in 1935, directed by prairie ecologist Theodore Sperry (Court, 2012; Jordan, 1984).

In 1991, Arboretum staff began restoration of a highly visible degraded oak savanna. Volunteers were not part of this restoration effort, and the importance of the site to the neighbouring community was not taken into consideration prior to initiating restoration. These omissions generated intense pushback from the public, who saw trees being removed without any understanding of the project goals. The tension was between the neighbours' concern about short-term visible and aesthetic changes and the Arboretum's priority of long-term scientific research to maintain ecological health (Weng, 2015). The project was put on hold, and Arboretum staff commenced community engagement with neighbourhood residents. Engagement developed into routine volunteer restoration work parties co-sponsored by the neighbourhood association. This experience was the genesis of the Arboretum's Restoration Team Leader Program in 1992 (hereafter: Team Leader Program; Bader & Egan, 1999). The Team Leader Program is designed to train and empower restoration volunteers to lead community members in on-the-ground restoration activities.

The United Nations General Assembly has proclaimed 2021–2030 as the Decade on Ecosystem Restoration (United Nations, 2020). This is a rallying cry to mobilize individuals, communities, businesses and governments to halt the degradation of global ecosystems and restore them in order to protect biodiversity and sustain human health, as well as mitigate the effects of climate change (Gann et al., 2019). To meet these goals, community participation and relationship building will be critical to best prioritize restoration projects, organize resources including volunteers and educate the public. While not in the scope of this paper, we also acknowledge that private lands and landowners play a critical role to meet the lofty UN General Assembly global ecosystem restoration goals. Here, we describe the evolution of the Team Leader Program from an environmental education approach to one that includes social change frameworks and socioecological thought, how it was the seed for the creation of a novel, multi-pronged community participatory approach to ecological restoration, and how it expanded to foster gatherings of restoration managers from multiple organizations for collaborative projects.

2 | NEED FOR VOLUNTEER ENGAGEMENT IN ECOLOGICAL RESTORATION

The need for volunteers to understand the implications of ecological restoration and become engaged in the process has never been more important than it is today. Global biodiversity has experienced widespread net losses (Newbold et al., 2015) driven by habitat modification, degradation, and fragmentation; climate change; over-harvesting; and pollution (Tittensor et al., 2014). The loss of biodiversity is not only an environmental problem but also a developmental, economic, security, social and moral issue (UN Sustainable Development Goals, 2019).

Significant barriers to meet restoration needs include lack of political will, insufficient funding and lack of public awareness (Cortina-Segarra et al., 2021). In addition to the need for more people to restore habitats, a parallel goal is to use the process of ecological restoration as a vehicle to educate volunteers about ecology and land management generally and open a dialogue about why caring for the land is a worthwhile endeavour and a moral obligation. The American public has consistently performed poorly in environmental literacy and knowledge (Coyle, 2005; NEEF, 2015), and many states still have not developed or implemented K-12 environmental literacy plans (NAAEE, 2019). Ecological restoration is one way for a public education institution to engage with the community as a democratic practice that helps overcome a "people versus nature" dichotomy (Weng, 2011), to increase ecological literacy, and to enhance place-based learning and care. Yet conflicts arising from hierarchical power dynamics between volunteers, restoration practitioners and university researchers, as well as the difference of emphasis on short-term gains and long-term goals, need to be addressed (Weng, 2015).

The social science dimensions of ecological restoration, including the roles that cultural values, environmental education and levels of public participation play, are still evolving (Biedenweg et al., 2021; Choi et al., 2008; Egan et al., 2011; Higgs, 2003; Martin, 2017). Integrating socioecological research is critical for improving the success of restoration projects (Guerrero et al., 2018; Takahashi et al., 2022). While we are not social scientists, we are committed to imparting one aspect of the Arboretum's mission, which is to "foster the Land Ethic" as articulated by Aldo Leopold (Leopold, 1949). The Land Ethic includes care for the entire biotic community, including humans, and is embraced by a "thinking community" which considers ethics and aesthetics in addition to economics when making decisions. Additionally, positive relational values such as perceived benefits to wellbeing, may drive preferences and virtues associated with nature (Chan et al., 2018; Stålhammar & Thorén, 2019). Through the process of restoration, humans not only restore the land, but we also restore our relationship to nature, thus cultivating a broader sense of community. In this way, ecological restoration as a process can help to meet many of the 17 goals outlined by the United Nations 2030 Agenda for Sustainable Development, such as "Good Health and Well-Being", "Sustainable Cities and Communities", and "Life on Land" (United Nations, 2022).

3 | ARBORETUM RESTORATION TEAM LEADER PROGRAM

The Team Leader Program, originally called the Earth Partnership program (Bauer-Armstrong & McCann, n.d.), began in 1992 as a

TABLE 1 Portion of Restoration Team Leader Program Logic Model. This excerpt of the model identifies inputs and target audiences involved in the training. The "logic" is that specific activities and outputs will influence participants' outcomes in knowledge, attitudes and skills, which will in turn lead to the desired impacts.

Inputs	Audience	Activity	Outputs	Outcome: Knowledge	Outcome: Attitude	Outcome: Skill	Impacts
Staff expertise Land management work plan Ecological principles document Articles about different ecosystem types	Volunteers—students, community members	Ecosystem principles exercise Ecosystem comparisons exercise Read descriptive articles about ecosystems and management plans; make poster	Ecosystem comparison chart Poster of ecological principles, ecosystem characteristics and management goals of different ecosystems	Understand ecological principles Understand composition, structure and functions of ecosystems	Comfortable with teaching ecological principles Appreciates ecosystem functions and differences	Can identify different ecosystem characteristics	Increase ecological literacy
Evaluation							
Number of staff involved	Number of participants	Evaluation form	Evaluation form	Pre- and post-test	Pre- and post-test	Pre- and post-test	Requires longitudinal studies

community engagement program to restore people's connection to the land by doing ecological restoration. From the beginning, community building was a pillar of the program and an essential component of ecological restoration. Volunteers are trained as Restoration Team Leaders (hereafter Team Leaders) to guide restoration work parties composed of other volunteers, and these work parties are held at specific sites around the Arboretum. Community members can participate with no prior experience in restoration and conduct a variety of tasks such as removing invasive shrubs and forbs, preparing sites for prescribed burns, and collecting and broadcasting native seeds (Farrior, 2010). Team Leaders provide "teachable moments" during breaks, which include information and discussions about natural history, ecology and environmental issues.

One element underpinning the Team Leader Program is the incorporation of the core competencies in volunteer administration, which include: plan for strategic volunteer engagement, advocate for volunteer involvement, attract and onboard a volunteer workforce, prepare volunteers for their roles, document volunteer involvement, manage volunteer performance and impact, and acknowledge, celebrate and sustain volunteer involvement (Council for Certification in Volunteer Administration, 2021). We also consider Arboretum land management goals, organizational needs, staff capacities, motivations and how all these elements relate to each other. These varied threads are used to develop: a written job description for Team Leaders, a recruitment strategy to attract strong volunteer candidates, a training program that will equip the Team Leaders with needed knowledge and skills, and benchmarks against which we can evaluate the Team Leader Program. These elements are incorporated into an intensive training program that covers ecological, social, and interpersonal topics.

For the Team Leaders to be more adept at community engagement and to help us achieve our restoration goals, we provide several leadership and communications tools. We created a leadership self-assessment tool, based on the Leadership@UW framework that was designed by students, faculty, and staff across the University of Wisconsin–Madison campus to support leadership skills and values (Leadership@UW, 2016). We also conduct land ethic discussions with Team Leaders based on the Aldo Leopold Foundation's former Land Ethic Leaders training curriculum.

Team Leaders learn additional communication tools such as the steps in conflict transformation, and practice various scenarios for interacting with the public. Experienced Team Leaders mentor newly trained leaders. This format for volunteer engagement is an example of one of the myriad models seen in ecological restoration projects around the world (Lee & Hancock, 2011; Peters et al., 2015).

We celebrate and acknowledge the contributions of the Team Leaders at a formal annual appreciation party, by offering Team Leader-only environmental education classes, in newsletter stories and social media posts, and providing guided field trips to rare ecosystems in our region. Team Leaders join several Arboretum employees at an annual end-of-year event, during which we share food, celebrate achievements and highlights of the past year, and discuss plans and aspirations for the coming year.

4 | CONCEPTUAL FRAMEWORKS USED IN THE TEAM LEADER PROGRAM

We have used several conceptual frameworks to design the program, including the logic model, integral ecology and TheoryU. A logic model helps identify knowledge, attitude and behaviour (or skills) outcomes for specific audiences (UWEX, 2003), and is a tool to understand the relationships among the resources, audiences, activities, and the changes or impacts expected from a program or campaign (Farrior, 2010). The logical sequence is that if an organization has certain inputs (such as grant money, reports, staff expertise, etc.), these can be used to accomplish certain activities with specific audiences, which will theoretically deliver the desired product or service (W. K. Kellogg Foundation, 2004).

Logic models also help identify evaluation measures. Team Leader training is evaluated based on pre- and post-tests about key knowledge (e.g. ecosystem types found in Southern Wisconsin, ecological principles, plant identification), attitudes (e.g. comfort level with leading a group, driving a pick-up truck, using herbicide), and skills (e.g. using tools, teaching management techniques, leading discussions). Test results help identify how to refine or improve our training (Table 1).

While the logic model and evaluation plan have been useful, the complexities and nuances of a volunteer-based restoration program have been difficult to capture. In response, we incorporated both integral ecology (Esbjorn-Hargens & Zimmerman, 2009b) and TheoryU frameworks (Scharmer, 2016; Scharmer & Kaufer, 2013) into our training design.

Integral ecology draws upon integral theory and the "All Quadrants, All Levels" (AQAL) framework that incorporates subjective, objective, individual and collective perspectives into four quadrants (Esbjorn-Hargens & Zimmerman, 2009a). Integral ecology recognizes that people have different perspectives about nature and are influenced by different values and motivations (Esbjorn-Hargens & Zimmerman, 2009b). Using integral theory, we identified important aspects of restoration leadership that may have been left out if the learning objectives were focused solely on changes in knowledge, attitudes, and skills (Table 2).

TheoryU is a social change approach that addresses nuances and subtleties of social interactions experienced at different levels of relationships, including self to self, self to other, and self to nature (Scharmer, 2016; Scharmer & Kaufer, 2013). In the Team Leader Program, we developed activities that address the relationship of Self:Self with leadership plans, a leadership self-assessment tool,

TABLE 2 Topics covered within an Integral Theory Framework in the Team Leader Program.

	Internal/subjective	External/objective
Individual	Comfort level with skills Ecosystem observations Leadership skills Leadership@UW values & competencies Nature therapy practices Observation journals Personal motivations Reflection exercise Safety issues Constructivist learning, brainstorms, dyads	Communication skills Ecosystem observations First Aid/CPR training Leadership skills Plant identification—native and invasive Presentation skills Reading the landscape Safety guidelines Teachable moments Observation exercises, descriptive exercises
Collective	Arboretum &UW policies and regulations Context of restoration ecology & ecological restoration History of Arboretum Land ethic, Leopold's influence Motivational analysis Nature writing, poetry Sharing snack Teachable moments and engaging dialogue Team building skills Traditional Ecological Knowledge Volunteerism Work parties process (community building, team building, etc.) Small group exercises, facilitated group discussions	Citizen science monitoring at Arboretum Definitions of ecological restoration, restoration ecology, adaptive management Ecological principles Ecosystem descriptions Management plans Management techniques Organizational structure of Arboretum Phenology Plant communities Reading the landscape Research at Arboretum Steps in restoration ecology Urban impacts—stormwater, invasive plants, etc. Work parties content Presentations, readings, brainstorms, small and large group exercises

motivation assessment, and reflection questions; Self:Others with land ethic and land acknowledgement discussions, communication and listening skills, team building, and learning opportunities; and Self:Nature with observation journals, field trips and classes, and nature therapy practices. These psychosocial activities improve both learning outcomes and relationship skills.

Based on these frameworks, we modified the structure of the Team Leader Program training which now begins with asking participants reflective questions about leadership and their motivations for engaging in ecological restoration. We incorporated more recent research and activities focused on the importance of being in nature to improve physical and mental health, with practices derived from shinrin-roku (or forest bathing) and nature therapy (Hansen et al., 2017; Williams, 2017).

We are discovering new ways to discuss difficult issues and embrace the more complex and nuanced aspects of ecological restoration, such as herbicide use, "control and management" of land, inclusivity and accessibility, and the history of colonization of both land and people (e.g. Native American forced relocations, African American slavery, immigrant experience [Nelson, 2020]). We also discuss issues related to eco-anxiety and pre-traumatic stress disorder due to climate change and biodiversity loss. The practices we teach are awareness of one's emotional and physical responses to difficult issues and sense of place, quiet reflection, deep observation skills, asking questions from a place of curiosity and how to have respectful, constructive dialogue.

5 | MEASURED OUTCOMES OF THE TEAM LEADER PROGRAM

Based on evaluations, focus groups and informal conversations, participants express that the program creates community, deepens learning and understanding about ecological and social complexity, provides a way for community members to have a positive impact on biodiversity, and advances the goal of public participation in ecological restoration.

The Team Leader Program has reached a significant number of people since its inception. Besides land care measures, we track the number of Team Leaders trained (many of whom become restoration professionals), the number of hours they volunteer, the number of volunteers on an annual basis and the number of hours they serve, and the number of groups that volunteer.

Another benchmark we use to evaluate the Team Leader Program is volunteer retention. Given the extensive training provided and staff resources needed to carry out the training and subsequent support, we ask the Team Leaders to commit to 2 years of once-per-month service leading work parties. We believe our retention rates of Team Leaders who continue to volunteer after 2 years reflects satisfaction with their training and ongoing support from paid staff. Team Leaders report appreciation for the educational materials they receive, visible progress made in restoring different sites, involvement in training of new Team Leaders, and the awareness that they are directly addressing biodiversity loss in their region.

6 | RESTORATION MANAGERS WHO WORK WITH VOLUNTEERS: PARTICIPATORY LEADERSHIP AND COMMUNITY OF PRACTICE

While the Team Leader Program focuses solely on restoring Arboretum lands, we recognized an opportunity to collaborate and share resources with organizations with similar missions. To this end, we contacted restoration managers who work directly with volunteers among different organizations: state natural areas and parks, city and county government agencies, friends' groups and non-profit environmental organizations. We refer to the group as: Restoration Managers Who Work with Volunteers (RMV).

At the initial RMV meeting, we conducted an Appreciative Inquiry exercise (Cooperider et al., 2000; Magruder Watkins et al., 2011) to identify the characteristics and conditions of a successful work party, identified training needs and created an overall training calendar for the year. We looked at the challenges and opportunities regarding leadership development, volunteer management, age-appropriate activities and risk management (Figure 1). We explored potential structures for future gatherings and identified other people to invite. We ended the meeting with a speed networking activity, during which participants met briefly to talk about collaboration ideas and possibilities, then moved to another partner.

We used participatory leadership techniques, such as World Café (Brown & Isaacs, 2005) and Liberating Structures (Lipmanowicz & McCandless, 2013), to build a sense of community and collaboration among the group. Participatory leadership is an inclusive style of leadership where everyone is encouraged to contribute ideas and help make decisions. It fosters the self-organizing capacity and collective wisdom of the group.

We operate as a community of practice, which is a group of "people who engage in a process of collective learning in a shared domain of human behavior" (Wenger-Trayner et al., 2023). The structure of a community of practice includes the domain, community and practice (Wenger-Trayner & Wenger-Trayner, 2015). In our case, the domain is conducting volunteer-based ecological restoration programs, the community is restoration managers (paid and volunteer) in Dane County, and the practice is ecological restoration management techniques and volunteer engagement practices. Members operate as peer-to-peer mentors rather than experts, set meeting agendas and foster full participation during discussions. Several notable outcomes of the RMV include new partnerships and collaborations, addition of a "Partner Opportunities" tab to the Dane County Parks-Natural Areas Program web-based interactive map which identifies all our volunteer restoration sites and guided field trips to visit each other's restoration sites.

FIGURE 1 Participants in the RMV community of practice participate in a World Cafe exercise (Brown & Isaacs, 2005) and help create a map of Dane County restoration sites. Photos taken by Bryn Scriver, 2018 and 2019.

7 | CONCLUSIONS

7.1 | Lessons learned

The development, growth and productivity of both the Team Leader program and RMV community of practice have been rewarding from ecological restoration, teaching and learning perspectives. One of the most important lessons learned is the value of having an anchor institution: an organization with a mission that mirrors that of a given program. As the anchor institution, the Arboretum provides resources such as staff time, meeting space and established partnerships for the Team Leader Program and RMV community of practice. We are an established research centre at a large, public university and as such our existence is relatively stable. For almost 90 years, we have been a global leader in shaping the ideas that have built the science of restoration ecology and the practice of ecological restoration. We also have a strong reputation of recruiting, retaining, and recognizing volunteers that engage in many opportunities across the Arboretum. The combination of these components as well as passionate and engaged full and part-time staff ensures the long-term sustainability of the programs.

The Arboretum also greatly benefits from the engagement of volunteers and outside groups. External partners share new ideas about how to restore lands utilizing volunteers, novel teaching and learning exercises and experiences, provide professional development opportunities for Arboretum staff and partners, as well as important social interaction around a common purpose.

7.2 | Model replication

The Team Leader program and RMV community of practice provide models that can be replicated at other organizations regardless of scale. While this paper describes initiatives designed to engage volunteers in restoration activities on several hundred hectares (the Team Leader Program) to dozens of properties throughout a county (RMV), and from a handful of volunteers to dozens, the general structure can be scaled up or down to meet specific situations. When scaling up, resource availability and the number of anchor institutions needed to support large programs are important considerations. For organizations or groups of organizations that are considering implementing similar programs, our suggestion is to start small with an engaged volunteer core. While it may be tempting to build out programs quickly in order to conduct more ecological restoration, building a solid program structure first which includes measuring impact and outcomes, is more likely to result in a robust and sustainable initiative.

AUTHOR CONTRIBUTIONS

Marian Farrior, Judy Kingsbury and Bradley M. Herrick conceived the ideas; Marian Farrior led the writing of the manuscript. All authors contributed critically to the drafts and gave final approval for publication.

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This work does not contain any original data.

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