

Using Reflexivity to Maintain the Integrity of Participatory Action Research: application to a proposed study on People and Environmental Science in the St. Louis River Watershed

A Thesis SUBMITTED TO THE FACULTY OF THE UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIERMENTS

FOR THE DEGREE OF

MASTER OF ENVIRONMENTAL EDUCATION

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June 2024

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Chapter 1: Introduction

Background

A great deal of environmental science is conducted in the St. Louis River watershed. Much of that science is aimed at remediating environmental degradation and contamination caused by industrial activities of the 19th and 20th centuries and the effects of climate change in the region. Many of these environmental science research projects articulate concerns for the adverse effects that the environmental harms at issue have on the local human population. Very few of these projects involve those populations directly and there is a lack of available information regarding the extent to which the local communities know about, care about, or are engaged with any of the environmental science activities happening in their backyards, often in the name of their health and well-being.

People's understanding of the environmental science taking place around them is important for two reasons. One is that while scientific innovation has the capacity to help manage the many environmental issues facing the planet, given the trajectory of human population growth, science alone will not be enough (Christie et al., 2019; Khan et al., 2021). The current environmental challenges require a synergy of scientific *and* social innovation. In order for that synergy to happen, people need to be a part of science for the science to be useful and science needs to be a part of people for people to want to use it (Nguyen et al., 2019). Ensuring that people understand the environmental science happening in their communities is also a sign of respect for their dignity and acknowledges the relevance of their participation as partners in universal knowledge production. Mutual respect and support between the scientific community and the public

leads to the most desirable outcomes for all. But the mutuality of that process must be foundational and inviolable in order for the work to achieve those outcomes.

Our current socio-political structures have generated a citizenry that often functions adjacent to the scientific process, occasionally coming into contact with it predominantly as research subjects with little to no agency (Bauer, 2019). This is where environmental education (EE), with its aim of creating a more sustainable future by developing the skills necessary to understand and address environmental issues, can and should serve to increase human connection with and concern for the natural world through connecting people with environmental science (NAEE, n.d.). In order to overcome the challenges presented by the current divisive civic discourse, EE needs to find effective ways to get people engaged with science and get science engaged with people.

A significant factor is the inequitable power dynamics in knowledge production that are driving a widening disconnect between people and communities and impeding the scientific innovations that could increase community well-being and individual flourishing (Meek & Lloro-Bidart, 2017; Lecuyer et al., 2018). New forms of collaborative research are gaining support to develop projects that have more meaning and value for those outside of the narrow knowledge pathways of dominant science (Broto et al., 2022; Macaulay, 2017). Interdisciplinary research involving researchers from diverse fields is particularly well suited to addressing environmental issues given the dynamic, multi-disciplinary factors that often shape environmental problems (Jenkins et al., 2003). Interdisciplinary research can provide opportunities to more effectively involve the community in the research process and thereby magnify the impact of the

work (Matson, et al., 2020). Within the fields of environmental sciences, ecological services, and environmental education there is particular impetus to move towards a participatory model with a view to furthering education for sustainability in the *process* as well as the *product* of scientific research (Kimmerer, 2012; Kemmis, 2006; Kindon et al., 2007).

Within the broad category of collaborative research, participatory action research (PAR) offers an approach that is specifically positioned to address the types of institutionalized power imbalances that exclude marginalized voices. PAR is a democratic research process premised on action and reflection, grounded in theory and practice, in pursuit of practical knowledge, and aimed at addressing the human needs within a community *as defined by* that community (Reason & Bradbury, 2008). Considered a “counterhegemonic approach to knowledge production” (Kindon et al., 2007, p. 9), PAR provides a framework to simultaneously examine peoples’ understanding of environmental science and to involve them in that same science. Given the extensive environmental science that takes place in and around the St Louis River watershed, this location is ideal for a PAR study that investigates community perceptions of scientific research.

With particular consideration for the centrality of doing science in a way that is mindful of existing power dynamics, this project as originally proposed sought to explore community relations with environmental science and in particular the dynamics between the community, science, and academic researchers within a community-focused, interdisciplinary environmental science research project. The examination was intended to be useful for researchers and community leaders seeking insights about collaborative

research and community participation as well as educators hoping to deepen their understanding about issues relevant to potential learning communities. The conceptual framework for the study was based on political ecology, ecofeminism, and grounded normativity, which offer a diversity of transdisciplinary perspectives and center the transcendence of dualism and relational accountability consistent with the underlying objectives of this study. These frameworks are defined and explored in more detail in Chapter 2.

Purpose Statement

The purpose of the originally proposed qualitative participatory action research study was to explore community relations with environmental science in the St. Louis River watershed (SLRW). The study intended to pursue its objectives through participatory action research. It proposed utilizing multiple forms of data collection to seek insight into the perceptions and attitudes of both the researchers and the community participants. The context of the originally proposed study was a community-engaged interdisciplinary environmental science research project addressing mercury bioremediation in the watershed. Action research was chosen as a particularly appropriate methodology for this study given the centrality of historic and pervasive power disparities in knowledge production (Poto & Porron, 2021). The questions proposed in the original research design included:

Research Questions

1. How do community members identify with and locate themselves in relation to environmental science and the production of knowledge in the SLRW?

- a. What are people's existing beliefs and attitudes about environmental science in the SLRW?
- b. What are the underlying considerations that contribute to these beliefs and attitudes?
- c. What dynamics surface within the community and between the community and the academic researchers during engagement with an interdisciplinary environmental science research project?

These questions were intended only as a starting point, because a central tenet of the PAR approach is the process of developing the research questions *in collaboration with* the research participants as co-researchers and continually refining the research direction through the iterative PAR cycles (MacDonald, 2012; Cornish, 2023). While this research purpose and these research questions were the center of this study as originally proposed, the direction of the research shifted during the course of its implementation toward an examination of the ethical considerations of using a PAR approach within a traditional academic setting. The developments that catalyzed this transition led to a new set of research questions that include:

1. How did the ethics that guide PAR specifically apply to this project?
2. Where were the points of influence for traditional hegemonic power systems to affect the integrity of the process?
3. What were the defining characteristics of those interactions?

These new questions and the transformation of the proposed qualitative study into an examination of the ethics of attempting to undertake participatory action research within the context of a two-year master's program embedded in traditional academic

systems organized around dominant research paradigms are explored in depth in Chapters 4 and 5.

Definition of Key Terms

The definitions provided here are the nominal definitions used for key terms relied upon in this study.

Interdisciplinary Research

Interdisciplinary research is defined as research that seeks to integrate theories, methodologies, and epistemologies from different academic disciplines and incorporate results generated from these diverse disciplines into research on a particular issue (Menken & Kestra, 2016, p. 32).

Collaborative Research and Participatory Research

Collaborative research and participatory research are used interchangeably in this paper and refer to research conducted in partnership with and in consideration of the needs and interests of the subjects of the research and other affected parties *as expressed* by those individuals and communities themselves (Given, 2008; Lenette, 2022). For purposes of this paper, collaborative research should be read in a broad sense and includes, but is not limited to: community-based research, community-based participatory research, action research, participatory action research, community-based action research (Lenette, 2022).

Dominant Science and Dominant Research

Dominant science and dominant research are used to describe ways of knowing rooted in Ancient Greek philosophical traditions, influenced by Judeo-Christian values, and further informed by enlightenment thinking (Liboiron, 2021). These ways of

knowing are what are widely considered today to be the only valid methods of knowledge production and consider other ways of knowing illegitimate (Liboiron, 2021, pp. 20-21). They are also a reflection of “insider science” or research, which is generated, validated, and standardized by individuals and institutions motivated by curiosity about the physical world and interested in the production of knowledge expressed in generalized understanding without specific regard to its utility towards decision making or action (Jenkins, 2003).

Participatory Action Research

Participatory action research (PAR) is both a methodology and an epistemological approach that centers the contribution of those with lived experience of the topic through their active collaboration in the research to simultaneously generate new knowledge and improve the lives of the co-researchers (Lenette, 2022). PAR utilizes an iterative process of exploration, knowledge construction, and action which is then repeated based on the knowledge created and action inspired (Cornish et al., 2023). PAR is elaborated on further in Chapter 3.

Co-researchers

Co-researchers refers to community members identified at the beginning of the research process, who agree to participate as partners in the research endeavor. The extent of co-researchers’ involvement is typically discussed and formalized at the outset of the relationship and should at a minimum involve meaningful input at all stages of the research process (design, implementation/data collection, analysis, and review of the findings prior to publication or dissemination). The role of co-researchers as partners in a research project is in contrast to the traditional role of research participants. The

traditional role of research participants situates them as passive subjects within a study conceived of and designed, implemented, and analyzed by an academic research team. In contrast, co-researchers are active partners in identifying the research questions, designing the study, implementing the data collection, conducting the analysis, and disseminating or utilizing the results.

St. Louis River Watershed

St. Louis River watershed (SLRW) refers to the area outlined in Figure 1.

Figure 1

St. Louis River Drainage Basin



Note. Reprinted from American Rivers (n.d.). *St. Louis River*. Retrieved October 31, 2023, from <https://www.americanrivers.org/river/st-louis-river/>

Conclusion

It is more important than ever that people understand and feel connected to environmental science. Where people live in areas particularly affected by environmental stressors or susceptible to the effects of climate change, that connection is even more

relevant, and the SLRW is one of those areas. Given that there has been very little study of the way that people in the SLRW connect with the environmental science of the area, a meaningful examination of that relationship is necessary to begin building deeper connections between these people and this science. While this study sought to advance that examination through participatory action research, emerging institutional and epistemological challenges arose that catalyzed instead a reflexive analysis of the ethical feasibility of PAR in this context in order to maintain the mutuality of the process and protect the integrity of the outcomes.

Chapter 2: Review of Literature

Significant environmental science has been done and is ongoing in the St. Louis River watershed (SLRW). There are also many historic and ongoing efforts to understand how people and communities relate to the environment and other spaces within the SLRW. Less attention has been paid to the intersection of the two: how people relate to the environmental science happening in the watershed. In an increasingly polarized world in which alternative facts and disinformation represent significant barriers to the kinds of social and political transformation necessary to build resilient communities, these relationships are more important than ever.

To make a meaningful contribution to these issues, it is important to first review the existing body of research within which this work will be situated (Creswell & Creswell, 2022). In this chapter I first provide the theoretical framework that shaped the project and guided the literature review. I then review existing research on people's understanding of science and the environmental science and community work being done in the SLRW. I also examine how environmental education (EE) relates to environmental science literacy and engagement and the power dynamics inherent in knowledge production systems and how collaborative approaches can address those dynamics. An additional review of relevant research on the ethical dynamics of participatory action research is included in Chapter 3 relating to the study's proposed methodology. This review demonstrates the value of this project in supporting approaches to environmental science research that can improve the utility of the knowledge created and outcomes for the communities affected and underscores the importance of pursuing such objectives

through participatory action methods grounded in relationships, reciprocity, respect, and relevance for the community.

Political Ecology, Ecofeminism, and Grounded Normativity

There are a number of frameworks that have been leveraged to address disparities in knowledge production that can be useful in connecting people with environmental science. This study relied on a blended framework grounded in political ecology, ecofeminism, and grounded normativity (all of which are defined in depth below) in order to center the deconstruction of essentialism and the rejection of dualism. This blended philosophical foundation, congruent with the objectives of PAR, provided the conceptual framework for the critical reflexive analysis that led to the necessary transformation of the direction of the study. Deconstruction of normative knowledge production frameworks are fundamental to ensure an authentic PAR based research approach (Miller, 2017). This includes challenging the application of existing qualitative research methodologies, including the separation of data, data collection, and data analysis (St. Pierre, 2011), which is consistent with the disassembly of those methodological mechanisms in the iterative PAR process (Lennette, 2022; Kindon et al., 2007). The strength of this approach lies in its embrace of transdisciplinary perspectives which forces a continuous process of thinking differently (Miller, 2017).

Political ecology is one framework that provides an epistemological foundation for PAR work. Neimark et al. (2019) found that political ecology is premised in part on a criticism of the epistemological injustice created by the domination of knowledge by culturally homogenous, historically hegemonic institutions. Political ecology offers a rich history of critical analysis of environmental science and an alternative strategy of

building coalitions that transcend academic institutional knowledge production to create a “politically engaged and informed resistance” or what Neimark et al. refer to as “reflexive scientific knowledge production” (2019, p. 615). Political ecologists seek to challenge dominant narratives surrounding environmental science and demand inclusion of diverse perspectives in an attempt to expose and correct disparate environmental outcomes for historically marginalized communities (Neimark et al., 2019).

Constructive movements within critical political ecology underscore the power of mobilizing both discourse and collective action in order to generate an advanced, nuanced practice of scientific knowledge production which harnesses resources traditionally excluded from the scientific process (Neimark, 2019). Consistent with the principles underlying PAR, the point of these trends in political ecology is to enable change to occur throughout the scientific process simultaneous with knowledge production (Castree, Chatterton, & Heynen, 2010). Feminist political ecologists have pioneered efforts in collaborative knowledge production that move beyond the boundaries of academia and leverage the expertise of local communities to shape resilient and equitable solutions for community and environmental well-being (Neimark 2019; Harcourt & Nelson, 2015).

Ecofeminist approaches also have a unique ability to tackle difficult issues and to tease out nuances of uneven power dynamics (Gustafson et al., 2019). Pursuing epistemological justice requires thinking critically about what is researched, how it is researched, and how the knowledge produced is translated and disseminated (Gustafson et al., 2019). The feminist lens in PAR research prompts critical reflection intended to avoid the “othering” of participants that commonly occurs when participant voices are

drowned out by academic jargon stripped of any meaning for those very participants (Gustafson et al., 2019). Ecofeminism's rejection of dualist paradigms is particularly useful to PAR work generally (Tuana, 2001; Alaimo, 2012) and was valuable to the reflexive examination of the ethical feasibility of this PAR project as the process developed. A grounded normativity framework synthesizes many of the themes underlying political ecology and ecofeminism and adds an element of "deep reciprocity" and place-based ontology (Coulthard & Simpson, 2016, p. 254). Coulthard's theory of grounded normativity proposes that solidarity within non-authoritarian, non-dominant, and non-exploitative political systems is possible if those systems are created through relationship with the land (Coulthard & Simpson, 2016).

It is important to acknowledge that environmental justice and PAR work are used in some contexts to raise critical consciousness in ways that perpetuate settler moves to innocence (Tuck & Yang, 2012, pp. 20-21). As Tuck and Yang (2012) pointed out, ongoing Indigenous repatriation efforts (including the elimination of the concept of land as a resource within the paradigm of private property rights) are undermined by use of decolonization metaphors in social justice movements (p. 26). The institutional power structures that create gross injustices in knowledge generation and utility, the critical consideration of which is central to the present inquiry, are intricately related to many of the same processes that underpin the colonial legacy. These dynamics were considered independently here, however, in order to avoid the appropriation of decolonization narratives. This was done specifically by focusing on language that addresses institutional power disparities in knowledge production rather than rhetoric centered on

colonialism that could minimize struggles for repatriation of Indigenous Land and Ways of Life.

People's Understanding of Science

The significant work that has been done on people's understanding of science provides a foundation for exploring people and science in the SLRW. In a review of available studies on people's understanding of science, Jenkins (2003) found that the relationship of people with science is complex and interactive and "cannot be conceptualized in terms of 'what people don't know'" (p. 438). Instead, the relationship is characterized by uncertainty, contingency, and adaptation as required by the circumstances of people's lives. The research shows that information generated through curiosity about the world and produced to yield generalizable knowledge which is coded by and for the scientific community, is often not the most useful information for people to use in their everyday decision making (Jenkins, 2003).

The circumstances of people's lives that affect their propensity to consider scientific or other forms of knowledge in their decision making include both people's personal identities and experiences as well as the social and political contexts of their lives (Noy & O'Brien, 2019). These include education levels, access issues, cultural factors, and even gender (Jenkins, 2003). When considering environmental science, people weigh that information against other sources of information and forms of knowledge that might offer alternative forms of responsiveness to the individual or community needs (Jenkins, 2003).

The research establishes that while public perceptions of science in the United States are mostly positive, there is increasing polarization within attitudes towards certain

areas of science, including health science and environmental science (Goldfarb & Kriner, 2017; Egan & Mullin, 2017). Where this polarization manifests as skepticism of climate science, research has found that the underlying adverse public perception stems from beliefs about biased incentive structures, concerns over the data and models employed, and perceptions about the exclusionary practices of climate science (Sarathchandra & Haltinner, 2020). Similar attitudes have been attributed to an ambivalence towards scientific research and innovation linked to contemporary science's alliance with "commercial, military, or political power" (Jenkins, 2003, p. 441) and public perceptions that science is often used to protect interests associated with these industries. Further research has demonstrated that on polarized issues, seeking to communicate additional scientific information to overcome skepticism can have the opposite effect and lead to a deeper distrust of the scientific community (van Swol et. al., 2022).

Additionally, increasing political polarization and the growing influence of disinformation are key challenges when seeking to engage people with environmental science. Heightened polarization fosters greater inclination to rely on disinformation, which reinforces the use of disinformation campaigns, generating further polarization in a self-perpetuating feedback loop. Research confirms that since the 1990s the United States has become increasingly polarized particularly with regard to issues related to environmental science (Egan & Mullin, 2017). This polarization creates opportunities for political ideology to dominate critical thinking on politicized issues, including many areas of environmental science (van Swol et. al., 2021).

The research also shows that despite distrust of some of the systems and institutions underlying the climate science process, there is paradoxically a relatively high

degree of confidence in the scientific process itself (Sarathchandra & Haltinner, 2020). This suggests that increased transparency in the process of conducting environmental science could address the sources of distrust leading to public skepticism of climate science. Studies also indicate that perceptions about the integrity of environmental science activities is improved through establishing common ground, acknowledging social identity, and building cohesion through group activities (van Swol et al., 2022).

Environmental Science and Community Engagement in the SLRW

The SLRW is a focal point of environmental science activity and a confluence of unique cultural, economic, and physical histories (Fletcher & Christin, 2015). A necessary precursor to building environmental science literacy within the SLRW is first exploring how people interact with the environmental science that is already happening around them. The following is an overview of the environmental science of this area and the pre-existing community engaged environmental programs and organizations in the watershed. To review literature in this area, both academic and non-academic sources (e.g., reports) were consulted.

Environmental Science in the SLRW

There are a number of reasons for the concentration of environmental science in the SLRW. First, the St. Louis River flows into Lake Superior via the St. Louis River Estuary, one of only two fresh water estuaries within the National Estuarine Research Reserve (NERR) network (About the Lake Superior Reserve, n.d.). Second, there are two major research universities situated within the SLRW, the University of Minnesota Duluth and the University of Wisconsin Superior. Third, the area is home to the largest concentration of peatland within the contiguous United States (Minnesota Scientific and

Natural Areas, n.d.). Finally, part of the SLRW lies within an area designated as a federal Area of Concern (AOC) due to the high levels of contamination from historic mining, shipping, and other industrial activity (St. Louis River AOC, n.d.).

The Lake Superior NERR coordinates some of the environmental science research that happens in the St. Louis River watershed (Projects, NERR, n.d.). Environmental science research is also undertaken by the Universities of Minnesota (UMN) and Wisconsin (UW), via their Duluth and Superior campuses respectively, which both have research arms that partner with the National Oceanic and Atmospheric Association (NOAA)'s Sea Grant program. UMN Duluth also houses the Natural Resources Research Institute (NRRI) and UW Superior houses the Lake Superior Research Institute (LSRI). Additionally, the U.S. Environmental Protection Agency (US EPA), the Wisconsin and Minnesota Departments of Natural Resources (WI DNR), and the Minnesota Pollution Control Agency (MPCA) all maintain personnel and programs in the SLRW area undertaking a wide range of environmental science aimed at both monitoring and remediation of contamination and climate change related issues.

Table 1 provides a snapshot of some of the environmental science initiatives that took place in the SLRW during 2023. The snapshot includes information on the degree to which these initiatives contain a community element. The three primary community elements are (1) consideration of the community as *consumers* in which the knowledge produced is intended to be publicly available, (2) consideration of the community as *beneficiaries* in which the knowledge produced is intended to have some direct positive affect for the community, and (3) consideration of the community as *participants* in

which the knowledge is intended to be produced with some level of involvement from community members.

Table 1

Environmental Science in the SLRW 2023 Snapshot

Environmental Science Project	Lead Research Agency(ies)	Focus	Community Element
Collaborative Water Quality Monitoring Strategy	NERR; UMD	Publications; online data access platform, recommendation for future monitoring strategy; targets local and national communications	Yes-consumers
Synthesizing long-term SWMP data sets	NERR	Applications of SWMP Data	No
Greener Shores	NERR; GLIFWC; WI DNR	Native Coastal Habitat Native plant guide for Lake Superior shoreline. Relevant Ojibwe cultural perspectives alongside environmental research (knowledge gathering and cultural advisory committee)	Yes-consumers; beneficiaries
Microplastics	UW-Superior	Microplastics	Unknown
HiTIDeR	NERR	Climate Change/Habitat Restoration information sharing to improve decision making in estuary management	No
Protecting Wetlands	NERR; UMD; UWS	Habitat Restoration Researchers evaluated stakeholder perceptions of wetlands in order to develop workshops to increase community knowledge of wetland function, land use, planning, and environmental polices	Yes-participants
Manoomin Restoration	NOAA	Habitat Restoration: Great Lakes Basin Manoomin Restoration with emphasis on tribal engagement	Yes-beneficiaries
Light Pollution	International Dark Sky Association	Light Pollution in the St. Louis River Estuary	Unknown
Clean Water and Energy	WLSSD	Wastewater treatment, pollution (mercury, pharmaceuticals, and per-and polyfluoroalkyl substance (PFAS)), and renewable energy initiatives	Yes-consumers
Mercury and Sulfur Studies	USFS	USFS Northern Research Station was directed to generate science to inform policy regarding mercury and sulfur pollution and to implement demonstration sites for proposed remediation technologies.	No
Spiny Water Flea	Douglas County	Monitoring of invasive spiny water fleas and their effects on aquatic food web	Yes-consumers; participants

Environmental Science Project	Lead Research Agency(ies)	Focus	Community Element
Water quality monitoring	NRRI (with NERR and UMD)	high-frequency sampling throughout the estuary to quantify and characterize the nutrient dynamics that lead to degraded algal communities, toxic cyanobacterial blooms, and hypoxia.	Yes-consumers
Fire as forestry management and cultural heritage	UMD, Fond du Lac CC; UW-S	Documenting fire history on MN and WI points	Yes-beneficiaries
Algal blooms	ORISE; US EPA	Turbidity, Light Intensity, and Temperature Stress on Microcystin-Production by Toxic Cyanobacteria in Oligotrophic Systems and Batch Experiments ORISE (Oak Ridge Institute for Science and Education)	No
Habitat Mapping	NERR; Fond du Lac; Wisc. Cartographer's office	Mapping habitat in the 17,000 acre estuary to classify existing habitat, track changes, monitoring restoration activities, etc.	No
Lake Sturgeon Movement	US EPA		Yes-consumers
Sturgeon Restoration	Fond du Lac		Yes-beneficiaries
Contaminated reservoir sediment	MPCA; US EPA	Activated Carbon treatment for contaminated reservoir sediment	No
Mercury and restored peatlands in the SLRW	USGS; US EPA	Examining the effect of peatland restoration on mercury release	No
Alternative deicer	UMD	Potassium Acetate as alternative deicer	No
Manoomin	UMD; Fond du Lac, 1854 Treaty; GLIFWC	Land Use and Climate Change: Effects on Manoomin GLIFWC (Great Lakes Indian Fish and Wildlife Commission)	Yes-beneficiaries
Non-human being vulnerability	GLIFWC	Vulnerability assessment for beings central to Ojibwe ways of life	Yes-beneficiaries
pH, Alkalinity and Inorganic Carbon	UMD	Seasonal and Storm related fluctuation in pH, Alkalinity and Inorganic Carbon Concentrations	No
Pollution	Fond du Lac	Study of nonpoint source pollution on the Fond du Lac reservation	Yes-beneficiaries
Ecosystem services	USFS	1) protecting manoomin from sulfur; 2) continued accessibility for recreation; 3) mercury reduction for fish/angler health	Yes-beneficiaries

Environmental Science Project	Lead Research Agency(ies)	Focus	Community Element
Climate change	USFS	Monitoring the effects of climate change Specifically on mercury and sulfur cycles, fish concentrations and habitats, and ecosystem services	No
Sulfur remediation	USFS; UMD	Looking at performance efficiencies and final products of biological sulfate treatment systems and water chemistry and site-specific characteristics for increasing the reliability and development of large-scale treatment	No
Phytoremediation	USFS; UMD	Utilizing short rotation woody crops to remediate mercury and sulfur in the watershed	No

Community Engaged Environmental Programs in the SLRW

There are currently also a number of organizations operating within the SLRW that work at various levels to connect people with the environment and with issues affecting community and environmental health. Community based environmental programs range from hands on engagement including habitat restoration and invasive species removal to more informational campaigns including addressing respectful recreation habits and expanding community members knowledge of migratory birds and wild edibles (Past Projects, n.d.). Some of these community engaged programs seek to connect people with environmental science, but primarily as consumers rather than participants (e.g. River talks: Harmful algae blooms in the estuary with Euan Reavie, n.d.). Table 2 provides a snapshot of some of the organizations and programs that operated in the SLRW in 2023 focused on connecting people with the environment.

Table 2

Community Based Environmental Programs in the SLRW 2023 Snapshot

Organization/Program	Focus	Mission
St. Louis River Alliance	Connecting community to SLR; Protect and restore habitat	Membership organization committed to supporting the resiliency of the St. Louis River. Serve as stewards and the voice of the river, working together

Organization/Program	Focus	Mission
		to protect, restore and enhance the St. Louis River. We envision a clean and healthy St. Louis River with a thriving ecology, economy and community.
Friends of the Lake Superior NERR	Supporting the Lake Superior NERR	Volunteerism, advocacy and engagement to support the Reserve
UMD, NERR, NRRI, US EPA	Cultural Ecosystem Services	Study examining how place and identity interact to facilitate the experience of CES by the community
Rivers2Lake	Environmental Education in Schools	Uses the watershed as a foundation for engaging place-based learning, stewardship and restoration
MN Environmental Partnership	Mercury in the SLRW	Holding MN EPA accountable to the community in the TMDL Study
Ecolibrium3	Building Community Climate Resiliency	Providing support for community members in accessing climate resilience and food security programs
American Indian Community and Housing Organization	Food Sovereignty and Water Protection	Offers multiple programs to increase food sovereignty and art programs focused on the protection of regional water ways and bodies
Starry Skies North	Dark sky initiatives	Educating and advocating to reduce light pollution and protect and preserve the right to dark sky spaces

Environmental Education, People, and Science

Environmental education (EE) provides a useful framework for approaching an examination of people and environmental science as one of its foundational goals is fostering environmental science literacy within communities (NAEE, n.d.). As the Earth experiences increasingly catastrophic effects of human-caused climate change including historic heatwaves, droughts, floods, increased hurricane severity, melting glaciers, and release of PFAS and other toxic chemicals into the environment (IPCC 2021; Guarino et al., 2020; Harvey, 2022; Williams, A.P. et al., 2019; U.S. Fish and Wildlife Service, 2023), development and implementation of transformative environmental and social movements is imperative.

EE has unique potential to catalyze the transformation necessary to address anthropogenic climate change and improve health outcomes for people and the planet.

This potential is based in EE's commitment to integrating personal, social, economic, cultural, and scientific dimensions. The research on people's understanding of science, particularly with regard to skepticism of environmental science, supports the use of interdisciplinary and community engaged approaches (Sarathchandra & Haltinner, 2020) and approaches that foster community-building (van Swol et al., 2022), both of which EE is particularly well suited to advance. EE is also well positioned to serve as a transformational mechanism by challenging traditional knowledge production and transmission pathways through its critique of existing siloed educational frameworks (Jenkins, 2003). Finally, EE holds environmental sustainability as a foundational objective and accordingly stresses the importance of building capacity for critical thinking and climate resilience (NAEE, n.d.).

EE's Capacity to Build Environmental Science Literacy

In order for environmental science engagement to be effective, researchers and educators need to understand the existing knowledge, beliefs and attitudes of those with whom they are seeking to engage (de Bruin et. al., 2020; Kollmus & Agyeman, 2010). Jenkin's (2003) review of the available literature on people's understanding of science revealed that in order to build critical thinking capacity and foster pro-environmental attitudes, programs need to embrace diversity, understand local contexts, and design programs that are responsive to their audiences. EE's pedagogical approach blends transdisciplinary content with experiential and place-based modalities grounded in connecting people with their environment, making it an ideal vehicle for stimulating environmental science literacy (Kollmus & Agyeman, 2010; Vladova, 2023).

Various ways of knowing are relevant to fostering the connection between people, the environment, and environmental science and there have been significant advances in EE's use of transformative tools to engage people with a diversity of knowledge pathways (Kimmerer, 2012). There is, however, still significant work to be done with regard to EE's capacity to build competency in understanding the science and politics of many of the environmental challenges facing communities today (Hungerford & Volk, 2003). A key element of that capacity is EE's ability to deconstruct the power hierarchies that affect people's ability to engage with environmental science.

Power in Knowledge Production and Collaborative Research

Studies on the effects of power in knowledge production have found that because academic research is a product of the institutions from which it is produced, it is limited by those institutions' hierarchical power structures (Curley et al., 2022). These structures restrict knowledge generation and access and therefore impair people's ability to understand and meaningfully engage with the research (Sarathchandra & Haltinner, 2020). We live in a time when the need for effective environmental education (EE) is more important than ever – climate change, social division, chronic health epidemics caused by extended time sitting indoors – and yet, the objectives of EE are undermined by the exclusivity of knowledge (Meek & Lloro-Bidart, 2017; Lecuyer, et al., 2018). Collaborative science approaches are one way to deconstruct hegemonic knowledge systems and get people positively connected with environmental science (Kindon et al., 2007; Klein et al., 2022).

Much of the examination that has been done on collaborative research has come out of the health services field (e.g., Bodison et. al., 2015; Morales et.al., 2023), which is

logical given the direct effect that medical research has on patients. Within the field of environmental science, the effect of research on individuals and communities is often less overt, but can ultimately be more impactful on the health of individuals, communities, and broader ecosystems than biomedical research (USGCRP, 2016; Pandaya, 2014). Collaborative research models, including interdisciplinary projects, have the ability to challenge longstanding ways of evaluating the impact of a research project based on linear models and instead open up space to reconsider the impact of research as a more sustainable and transformative outcome resulting from relationship building between communities and research institutions (Facer & Enbright, 2016). Therefore, integrating collaborative research approaches into projects addressing a range of environmental issues has the potential to improve outcomes for local communities (K. Williams, et al., 2020).

Notwithstanding the strength of the evidence regarding the benefits of collaborative research, there remains significant resistance to its consideration within research institutions based on the persistent control of dominant science and dominant research paradigms (e.g., Oliver, et al., 2019; O. Williams, et al., 2020). Critics argue that the value gained by incorporating multiple perspectives within the research process does not outweigh the cost to efficiency, credibility, and clarity of outcome (Oliver, et al. 2019). Advocates of collaborative research, however, posit that the additional challenges presented by collaborative research are part of what make both the process and the product of that research more useful and meaningful for both the research institutions as well as the constituent community beneficiaries (O. Williams, et al., 2020).

Within the fields of environmental sciences, ecological services, and environmental education there is particular impetus to move towards a participatory model with a view to furthering education for sustainability in the *process* as well as the *product* of scientific research (Kimmerer, 2012; Kemmis, 2006). Previous research clearly demonstrates that projects in these fields that center inclusivity have significantly increased capacity to generate positive social and ecological outcomes (Miriti, 2019). The research on the power dynamics that affect knowledge production and the compelling work that has been done on the value of community participation on long term human and ecosystem health were guiding factors in the transition of this study from its original proposal to its examination of the project's ability to center transformative participation.

With a baseline of existing research from which to work, Chapter 3 outlines the methodology that was originally proposed to address the original research questions:

1. How do community members identify with and locate themselves in relation to environmental science and the production of knowledge in the SLRW?
 - a. What are people's existing beliefs and attitudes about environmental science in the SLRW?
 - b. What are the underlying considerations that contribute to these beliefs and attitudes?
 - c. What dynamics surface within the community and between the community and the academic researchers during engagement with an interdisciplinary environmental science research project?

Chapter 3 also outlines existing work on the ethics of participatory action research that was used to inform the new research questions aimed at analyzing the ethical

feasibility of the proposed study as it developed within the context of my two-year master's program embedded in dominant research systems:

1. How did the ethics that guide PAR specifically apply to this project?
2. Where were the points of influence for traditional hegemonic power systems to affect the integrity of the process?
3. What were the defining characteristics of those interactions?

Chapter 3: Methodology

Based on the review of the available literature and prior research on people's understanding of science, environmental education in science literacy, and power dynamics in knowledge production, this participatory action research study sought to explore the relationships that people in the St. Louis River watershed (SLRW) area have with the environmental science conducted in the area. The purpose was both to illuminate how the people of this area understand the environmental science happening around them and their place in relation to it as well as to create dialogue and build relationships that would improve the meaningfulness of that science to the local communities.

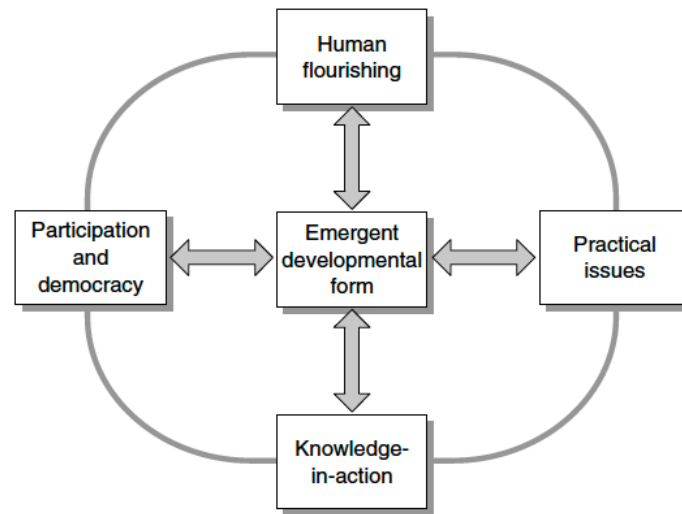
Strategy of Inquiry

This study was intended to be undertaken through participatory action research (PAR). PAR is a methodology that combines philosophies and techniques from both the action research and participatory research fields. It is a collaborative research methodology that advances the democratization of the scientific process by layering in a civic action component (Miller, 2017). The PAR approach has its origins in social justice movements in the early to mid-twentieth century (Dedding et al., 2021). The concept is premised on the rejection of an objective truth in favor of a constructivist worldview centering the collective meaning making of the subjects of the research (Freire, 1982). Participation in research goes beyond methodology and becomes a political process (Lawson, 2015). It is a process premised on action and reflection, grounded in theory and practice, in pursuit of practical knowledge, and aimed at addressing the human needs within a community *as defined by* that community (Reason & Bradbury, 2008). In

synthesizing the diversity of approaches to PAR, Reason and Bradbury (2008) offer a model based on five dimensions common among the approaches.

Figure 2.

Characteristics of Action Research



Note. Reprinted from *The SAGE handbook of action research: Participative inquiry and practice* (2nd ed., p. 5), by Reason, P., & Bradbury, H. (Eds.), 2008, SAGE. Copyright 2008 by Sage Publications.

The roots of PAR are often traced to Kurt Lewin's work in action research in the 1940s as a means to increase the utility of research to its subject populations (Cornish, 2023). Lewin's work led to the development of the iterative action-reflection cycle (Kindon et al., 2007; Reason & Bradbury, 2008). Paulo Freire's work in the 1970s furthered the participation aspect of action research, focusing on the model's potential to deepen the awareness of marginalized groups of the various external forces impacting their lives (Kindon et al., 2007). Similar movements were developing in other colonial and post-colonial regions in South America, Africa, and Asia, as researchers focused on

social change created ways to leverage their work within communities to challenge the colonial institutions and post-colonial political structures (Kindon et al., 2007). PAR has even been used to enable participation of other-than-human co-investigators (Merskin, 2011).

PAR challenges scientific positivism by requiring an ontological position based in the dynamism of human capacity for reflexivity and transformation as well as an epistemological position that welcomes and accommodates that capacity within the research process (Kindon et al., 2007). Only from this ontological and epistemological worldview can researchers create the necessary space for inclusive knowledge production and socio-political action (Kindon et al., 2007). This space is created through the eight principles of PAR as articulated by Lenette (2022):

1. PAR disrupts traditional research approaches and challenges traditional epistemologies.
2. PAR provides for reciprocity by ensuring that co-researchers and academic researchers both benefit from the research process.
3. PAR centers trust through a shared commitment to identifying and addressing problems.
4. PAR seeks deep engagement, especially on the part of the academic researcher to achieve meaningful outcomes for co-researchers.
5. PAR pursues social change by acting as a “tool to re-center lived experience as a source of knowledge,” (Lenette, 2022, p. 5) democratize knowledge production through capacity building, and effect individual, social, and policy change.

6. PAR acknowledges intersectionality by highlighting the “compounded effect of markers of identity that can be at the source of oppression, disadvantage, and marginalization” (Lenette, 2022, p. 5) and pursues critical uses of intersectionality to interrogate systems of oppression.
7. Through elevating the agendas of co-researchers, PAR values local, community, everyday experiences to challenge institutional, political, economic, and social systems.
8. PAR challenges inequitable power dynamics within knowledge production and ownership, requiring that particular attention be paid to prevent tokenism and ensure that PAR meaningfully addresses hierarchies of power (Lenette, 2022).

In a critical assessment of a large-scale PAR project, Fritz (2008) elicited questions that can be used to guide self-reflection on power dynamics in the PAR process to ensure authenticity. A few salient examples that I used to guide this project include:

- Who specifically is defining the research problem and questions?
- Who is deciding which community members to engage and how are those decisions made?
- How are the resources that enable participation distributed?
- In what ways does the design of the process influence the co-researchers’ capacity to voice their concerns and contribute their expertise?
- How well does the process and its outcomes highlight and question common practices in knowledge production?
- How do conflicting values and interests manifest in the process?

- In what ways, if at all, does the process support the capacity of the co-researchers to pursue their goals?
- Are any new discourses, practices, or communities that are emerging through the process?

There has been significant criticism within the broader field of participatory research for failing to achieve meaningful participation (Lenette, 2022) and criticism of PAR projects specifically for failing to uphold the ethical and philosophical principles that ground the practice (Nyemba & Mayer, 2018). Critics argue “participation” is often reduced to a form of tokenism that at best ignores pervasive systemic inequalities and at worst inflicts additional harms on “participants” through manipulative practices that advance the interests of the funding agent at the expense of the integrity of the subject population (Ozkul, 2020; Cooke & Kothari, 2001). In PAR, participation requires a commitment to deconstructing the monopoly of power in knowledge production through centering collaboration with those at the heart of the research subject (Kindon et al., 2007). The viability of this deconstruction requires that academic researchers take time to listen, share the work, and co-develop the process (Klein et al., 2022).

In considering what meaningful participation is, Lenette (2022) offers five principles of deep participation drawn from the available research:

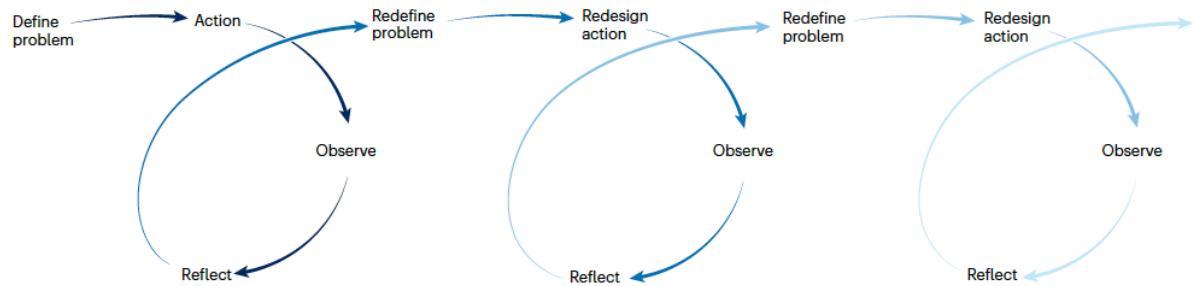
1. Time is necessary to establish trust.
2. Participation as the primary focus of the research from the beginning.
3. Flexibility in response to the dynamic context of co-research teams.

4. Reflexivity, transparency, openness, and sensitivity are necessary to the process of addressing power and privilege. This includes ensuring the clarity of the process and research objectives for the co-researchers.
5. PAR research can be messy in both process and outcome due to the nature of the relationships and iterative and reflective processes required to create change.

Close adherence to the fundamental objective of PAR as a mechanism to address social and epistemic injustice ensures that a project remains firmly rooted in true participation. Additionally, reflexivity to the context of the lived experience of the community of participants supports authentic participation despite circumstances in which co-researchers may not be engaged in every step of the research process (Lenette, 2022). In these contexts in particular, achieving meaningful participation within PAR requires establishing an agreement with the community of co-researchers at the outset of the project to articulate the core principles of the project and to delineate the capacities, responsibilities, and expectations of individual co-researchers and the academic co-researcher (Cornish, 2023). This ensures that co-researchers have an opportunity to shape the direction of the project in both substance and form, to avoid exploitation, and to enter the co-research relationship with full transparency (Klein et al., 2022). The process of iterative reflection by the research team throughout the phases of the project, including reflection on the co-researcher agreement, supports authentic participation (Coghlan & Brydon-Miller, 2014; see also Fig. 3).

Figure 3

Participatory Action Research Cycle



Note. From “Participatory action research,” by Cornish, F., Breton, N., Moreno-Tabarez, U., Delgado, J., Rua, M., Aikins, A. d., & Hodgetts, D., 2023, *Natural Reviews Methods Primers*, 3(34),1-14. (<https://doi.org/10.1038/s43586-023-00214-1>). Copyright 2023 by Springer Nature Limited.

Underlying PAR is the assumption that neither participation nor action by themselves are enough and that to make progress toward true epistemic justice local communities must have meaningful opportunities to exercise control over their circumstances and to effect changes in their everyday lived experiences at both the ground level and policy levels (PAR, 2014). By its nature, the PAR process is emergent and must remain responsive to the context of the research, but Cornish et al. (2003) have broadly outlined the key methodological steps of the PAR process, which include:

1. Building relationships
2. Establishing working practices
 - a. Make explicit early on what the working practices will be.
 - b. Identify areas of tension between academic and co-researcher experiences.
3. Establishing a common understanding of the problem
 - a. The research question should be defined with the co-researchers.

- b. The research purpose and questions may be refined during the research process.

4. Generating materials

- a. PAR methodology does not adhere to pre-determined data collection methods
- b. Data collection methods should be engaging for the co-researchers, appropriate for answering the questions, and accessible based on available resources.
- c. Building community capacity for data collection and analysis can be an outcome.

5. Collaborating in data analysis

- a. PAR uses informal collaborative analysis throughout the data collection process
- b. Data collected is used as a point of reflection to identify patterns, causes, and differences or commonalities continuously throughout the PAR process.
- c. Formal data analysis can follow as determined by the research team, but collaboration should continue on key takeaways and messaging.

6. Planning and acting with a *theory of change* involving: (1) an action mechanism (2) directed at an outcome for a (3) target group in a (4) specific context.

Given that an authentic PAR approach is highly contextual and requires constant critical reflection and ethical consideration (Dedding et al. 2021; Gustafson et al., 2019), this study was grounded in a philosophical framework informed by political ecology,

ecofeminism, and grounded normativity. These theories require consideration of Land as a set of relationships between living beings rather than as a resource for exploitation of private property for ownership and control (Curley et al., 2022). This framework shifts the focus to a deconstruction of dualist language and stresses a rejection of the ontological position of geo-spatial categories that “limit land as property and accept the naturalised ideas of nation-states and their borders.” (Curley et al., 2022, pp.1057-1058). It also relies on the concept of “theoretical shoals” representing a metaphorical transition space serving as a point of “reflection, introspection, and productive dialogue” (Curley et al., 2022, p. 1053). The reflection components of the iterative cycles were designed to provide “shoal moments” that centered consideration of relationships.

Ethical Dynamics of Participatory Action Research

As the proposed study unfolded, the mechanisms outlined above which are intended to ensure the authenticity of PAR work, triggered a need to engage in a deeper examination of the ethical dimensions of the project. This ongoing evaluation was supported by research on the conduct of PAR, which highlights the need for special attention be paid to the nuanced ethical dynamics of this kind of research in order to maintain the integrity of the process (Gustafson et al., 2019; Alaimo, 2012). The ethical integrity of research can be compromised by outside agendas that create a barrier to pursuing the research in a manner most consistent with the research purpose. These agendas can be driven by institutional requirements, funding bodies, methodical limitations, non-reflexive research practices, or cultural ignorance (Lenette, 2022). If left unacknowledged and unmitigated, these barriers can cause counter-productive or harmful outcomes for the both the research and the co-researcher community.

Basic Research Ethics

There is a robust institutionalized ethical framework that governs research involving human subjects. This framework originated from concerns that arose following the events of World War II and the exposure of a number of ethically problematic biomedical research studies in the following decades (Columbia University, 2020). The result was the creation of the Declaration of Helsinki internationally and the commissioning of The Belmont Report in the United States. These documents establish the basic ethical principles that govern research involving human subjects (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979).

Under the Belmont framework, institutions that conduct research funded in whole or in part through federal sources are required to establish processes to ensure that their research conforms to the ethical principles prescribed by The Belmont Report (Filing Copies of Campaign Finance Reports and Statements With State Officers, 2024). This process is conducted by an Institutional Review Board (IRB) that determines whether proposed studies qualify as human research and if so, whether the proposals conform to the ethical guidelines established in The Belmont Report. The basic ethical principles provided for in The Belmont Report are (1) respect for persons, (2) beneficence, and (3) justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). As most PAR inherently involves human participants, who may be reduced to “subjects” within the Eurocentric interpretation of the applicable standards, PAR projects are generally considered to fall within this basic ethical framework.

Respect for persons requires that research participants have the opportunity to consent to participation in an informed capacity (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Voluntary, informed consent is not a major concern in PAR because participants are generally intricately involved in the planning and implementation of the study. Respect for persons is also interpreted as requiring measures to protect the privacy and confidentiality of research participants, concepts which are important, but can at times create conflict with some of the underlying principles of PAR, explored in further detail below.

Beneficence requires that the researchers do no harm and maximize the possible benefits of the work while minimizing potential harm (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). In application, beneficence requires an assessment of the nature and scope of the potential risk and benefits to the participants and to the community. In the context of PAR research, this requires researchers to ask the question: Is what I am asking *of* the community commensurate with the value to be gained *by* the community? This is reflected in the consequentialist ethics dimension of PAR, which centers the generation of positive outcomes for co-researchers and their communities. (Davison et. al., 2022).

Justice requires consideration of who should benefit from the research and who should bear the burden of the research (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Traditionally, this manifests most overtly in the selection of research subjects and requires a critical reflection of how the selection processes is designed and in what ways it might be subject to and perpetuating systemic forms of injustice. This principle also manifests in specific

ways within a PAR project. Justice is deeply embedded in the philosophical underpinnings of PAR work and in addition to paying particular attention to how participants are or are not representative of the community, PAR researchers need to also focus on how the entire research process contributes to or alleviates epistemic justice in particular (Abma, 2020).

PAR Specific Research Ethics

The institutionalized ethical principles established in The Belmont report are only the basic starting point, a minimum standard, for what should be a thorough ethical evaluation in research practice. Specifically with regard to PAR research, there are significant additional ethical considerations required by the dual function of knowledge production and community action. The International Collaboration for Participatory Health Research (2013) offers the additional principles of social inclusion, respect (more broadly than the narrow reading of “respect for persons” established by the Belmont framework), democratic decision making, and mutual learning as additional ethical principles to guide PAR work (Abma, 2020; Banks & Brydon-Miller, 2019).

Further ethical considerations arise in PAR where the traditional interpretation and application of the basic ethical principles conflict with the underlying justice-oriented dual objectives of PAR. This occurs where traditional research ethics seek to protect participants in ways that undermine the advancement of community agency and perpetuate epistemic injustice through the reinforcement of marginalizing power dynamics (Lenette, 2022). In addition to areas of substantive dissonance, the biomedical origins of the governing ethical guidelines create procedural challenges in institutional ethical review processes as well. Leibenberg et. al. (2018) found that because these

processes are mostly founded in Eurocentric values, they inherently produce conflicts with the power balancing goals of PAR.

Participants

The original proposal anticipated recruiting a small team of three to five co-researchers, identified by the community of organizers and activists embedded within the neighborhoods and social systems of the SLRW. The objective was to recruit community participants who were interested in, but not already deeply involved with environmental science or community environmental programs in the SLRW. Due to alterations made to the project proposal during the IRB review process, the “co-researcher” role was changed to a “community participant” role.

Initial recruitment efforts began in early February 2024, at which time I reached out to Ecolibrium3, the American Indian Community Housing Organization, the 1854 Treaty Authority, Community Action Duluth, the Twin Ports Walleye Association, and the Twin Ports REKO¹ Ring to request assistance identifying individuals from within these groups’ communities that may be interested in being involved in the project. I received positive communications back from the 1854 Treaty Authority, the Twin Ports REKO Ring, and the Twin Ports Walleye Association. From these contacts, three individuals were identified as potential community participants, two farmers and one angler. I communicated with these potential participants about the scope of the project and proposed hosting an initial meeting with those interested to determine their level of involvement and define roles and responsibilities. The two farmers were geographically located in areas of the watershed which would make an in-person meeting of all potential

¹ REKO is a Finnish acronym meaning “fair consumption” (Growing for Market, 2020).

participants challenging. Additional challenges arose related to the farmer's availability due to the unseasonably warm weather during February and March 2024. For reasons that will be detailed in Chapter 4, I ultimately terminated recruitment efforts in late March 2024.

Other participants in the study as originally proposed were expected to include attendees from at least one community event hosted by the University of Minnesota Duluth-based bioremediation project (Bioremediation Project). These participants would be members of the community that had chosen to attend the event or visit the establishment at which the event was hosted. The specific recruitment of these participants would have depended on the method of data collection decided upon by the team of community participants. Finally, some members of the Bioremediation Project team itself were anticipated to be participants in the study. No recruitment efforts were initiated for these other participants.

Researcher's Role

As an academic researcher partnering with community participants for this PAR project, I was anticipating being predominantly an organizer and an enabler for the community participant team to explore questions related to their community's interaction with environmental science. I anticipated providing the institutional framework (formal research proposal, institutional ethics review, and documentation of the process, data, analysis, and findings) for the team. I had anticipated building relationships with the community participants in order to establish the trust necessary to give meaning to the work. As a relative newcomer to the community in which this project was taking place, I acknowledged that I would have been heavily dependent on the community participants'

expertise regarding their own needs and capacities and of other community members. It was important for me to ensure that the community participants would understand that while I was the organizer of the project, the project would be directed by them. Humility, transparency, and critical self-reflection were necessary hallmarks of my role within the proposed study to avoid reinforcing historic power disparities between academic researchers and research participants; ideals which ultimately led to the transition of focus for the work.

Details about my background and how my worldview has been shaped were relevant to the outcome of the work. I was a masters student seeking to engage in community-centered research in order to do work that is meaningful not just for institutional knowledge creation, but for the lives of the people that make up the community in which I was working. I am a white, cis-gender, heterosexual woman. I had lived in many places, but had a sense of belonging in only a few. I was relatively new to Duluth and located myself as an outsider to the community. Within the context of the diversity of places that I had experienced I believe that Duluth is a very special place and I was honored to be doing the work there.

I have a background in citizen science and in social justice, both in advocacy and in the practice of law. From a position of privilege in my physical abilities and my personal geography I have been able to serve as a team leader for a community of volunteers monitoring wetland health in Burnsville, MN. From a position of educational and social privilege, I have had the opportunity to work towards advancing legislation that protects survivors of human trafficking and holds perpetrators of that heinous crime accountable. I have provided direct legal representation to individuals seeking asylum

from brutality inflicted in foreign countries and to individuals seeking justice for brutality inflicted in the United States. I have also worked to protect civil rights as established by the United States Constitution within the context of procedural protections in both criminal and immigration proceedings.

These practices had given me a lived experience with the way that power dynamics can and do deprive individuals and communities of agency, dignity, and security. I had come to the University of Minnesota Duluth to study environmental education, hoping to transition to a field where I could achieve some distance from the trauma that stems from injustices embedded deep within our social and political structures. What I had found, however, was that even in the field of environmental education and the ostensibly ambivalent work of the natural sciences, the effects of a knowledge production system built on the same exploitative practices that create barriers to legal justice are deep and widespread and the resulting epistemic injustices are only beginning to be acknowledged and understood. On reflection, it was not surprising that this is where I had located myself, since just as my experiences had shaped my worldview, my worldview had also shaped my experiences. This research endeavor was consistent with my personal and professional frame of reference and accordingly, attention to issues of justice and access, a focus on the importance of language and meaning, and a commitment to integrity and truth shaped how I conducted the work.

Data Collection Procedures

Data collection within the PAR methodology is unique in that it requires flexibility and reflexivity (Participatory Action Research, 2014). Utilization of a diverse range of data collection methods and instruments applied in unconventional ways using

non-standard evaluation criteria are necessary to achieving the purposes of authentic PAR. Priority is given to methods that have the highest potential to stimulate knowledge that is useful to the community generated by participants that are representative of the community's needs through their lived experiences (Participatory Action Research, 2014). Some common forms of data collection in PAR include field observations, open-ended interviews and focus groups, storytelling, creative visual arts, historical investigations reliant on personal narrative documents, and mobile methods such as walking interviews (Lenette, 2022; Participatory Action Research, 2014).

Under the original research proposal, I was seeking to use multiple forms of data collection and analysis. Some of the data collection was anticipated to take place within the context of at least one of the community engagement events organized for the ongoing Bioremediation Project. Due to the nature of the emergent and iterative form of the PAR process (as elaborated on above), the specifics of the data collection methods could not be established until the research team was formed and had an opportunity to determine the direction of the research agenda. As a starting place for the research team, the data collection procedures were anticipated to adhere to the following outline:

Cycle 1 (late January 2024): Work with a focus group of three to five community co-researchers to have a conversation about the form and structure of the research and to discuss the proposed research questions:

1. Research Team Agreement: form an agreement with the research team to establish the “intellectual and political heritage and aspirations” (Cornish, 2023, p.2) of the group and to articulate the core principles of the project to protect against extractive research practices.

- a. Come to an agreement about expectations, roles, and responsibilities.
 - b. Clarify co-researcher motivations (Lenette, 2022). Articulate who we are and why we are here.
2. Proposed Research Questions: discuss the appropriateness and specifics of the proposed research direction and questions and discuss plans for cycles 2-4.

Cycles 2-4 (February to March 2024): might have included any of the following based on the direction that the co-researchers decide to take with the project in Cycle 1.

1. Observational data collected by the co-researchers during a creative visual arts event themed around “Beautiful Bacteria.” The event might feature a demonstration Winogradsky column as well as other forms of bacterial and fungi that are integral to our lives. The event may be hosted at a brewery or cidery to underscore the extent of the services provided by microbial communities.
2. Informal, open ended interview data collected *by* the co-researchers through interviews *of* the Bioremediation Project Team members.

Ongoing data collection was also anticipated to occur throughout the PAR cycles in the form of meeting notes from the research team’s planning and follow-up meetings prior to and following each of the events in Cycles 2-4. These notes were anticipated to have been made available to the co-researchers before inclusion for analysis to ensure their accuracy.

Data Analysis

Consistent with the reflective and reflexive nature of the PAR process, data analysis was anticipated to be ongoing throughout the research cycles (Cornish et al., 2003). It would have been conducted by the team of co-researchers through “debriefing”

meetings that were expected to take place following each data collection event (excluding cycle 1). These meetings were also intended to serve as planning sessions for the next cycle. Notes were to be taken during the debriefing sessions by myself and would have been disseminated back out to the research team for verification of accuracy. Additionally, given the centrality of critical reflection in PAR (Dedding, 2021; Gustafson et al., 2019), the co-researchers were to be invited to engage in reflective journaling, shared through a mutually agreeable mechanism as determined by the research team.

Synthesis and recording of the formal data analysis for purposes of the submission of the final thesis paper was to be conducted by myself (the academic co-researcher) and would have been disseminated to the community co-research team prior to final submission. Additional input or critiques from the co-researchers were anticipated to be captured and included as an appendix to the final thesis submission.

Finally, a central metric of validity for PAR projects is whether the research process resulted in actions that addressed a problem and that increased the participation, self-efficacy, and agency of the community (Kindon et al., 2007). Accordingly, the data was going to be analyzed specifically for indications of transformation in participants' self-location in relation to environmental science and in shifts in environmental science researchers' approach to community engagement.

Assumptions

PAR requires that researchers pay careful attention to the project's underlying assumptions, particularly given this method's susceptibility to abuse through tokenized application devoid of a commitment to its foundational principles and philosophy (Dedding, 2021). A significant assumption upon which the proposed study was premised

was that the anticipated timeline of events would proceed smoothly, as allowances for additional time were not able to be built into the project due its positioning within the second year of a two-year masters' degree program. PAR relies heavily on building trust with the community and establishing relationships of mutual reciprocity (Krieg & Roberts, 2007). My plan to limit the risks that this assumption posed, by seeking to build a small team of co-researchers identified by community leaders already taking an active role in advancing positive change in their communities (Armstrong et al., 2012; Johnson et al., 2021), did not account for a delay in the timeline due to other factors, including a longer than anticipated IRB process.

Another assumption was that my position as an outsider to the community and the Place in which the work would happen could be overcome in the given timeframe. To manage this assumption, I had included allowances for my co-researchers to provide feedback towards the end of the project regarding how my positionality potentially impacted the work. This strategy did not account for the effect that my position as a community outsider without a grounded connection to this Place would have on the relational ethics considerations that are fundamental to the integrity of the process itself.

Methodological Shift

Due to circumstances that are discussed at length in the following two chapters, the study as outlined above was not undertaken and instead a reflexivity analysis was employed to determine whether the project was ethically feasible in the context in which it developed. Reflexivity employs critical reflection throughout the research process, including examination of the factors that influence the way that the researcher is constructing knowledge (Guillemin & Gillam, 2004). In the present case, this included

applying a critical lens to the way that the process was shaping how the community participants would be empowered to construct knowledge as well. A primary goal of reflexivity is to improve the quality and validity of the research and to expose the limitations of the knowledge that may be produced (Guillemin & Gillam, 2004; McGowan, 2020). As an inherently subjective process, reflexivity begins with the researcher giving significance to the aspects of the work that they find most crucial (Subramani, 2019). Given the centrality of PAR's dual objectives of knowledge production and community action, epistemic justice was considered crucial to this research and therefore was a driving element of the reflexive work that shifted the focus of the project.

Chapter 4: Outcomes – Reflexivity and Ethical Feasibility

The initial purpose of this study was to use participatory action research to examine how people in the St. Louis River watershed (SLRW) are relating to the environmental science happening in the region. Emerging institutional and epistemological challenges that arose while working towards implementation of the PAR approach necessitated a shift in focus from the initial purpose towards a critical examination of the boundaries of authentic PAR within the context of the traditional academic research process in which this masters' thesis was situated. A reflexive assessment led to a determination that the integrity of the PAR process could not be upheld within the context of the project as it was progressing. Accordingly, no data was collected using the PAR methodology outlined in Chapter 3. Instead, the research focus shifted to a reflexive examination of what it means to engage in an ethical PAR study within the framework of existing academic institutions and dominant research systems. Reflexivity as a research practice is “relational, ethical, and productive” (Olive, 2020, p. 124) and was employed in the present case to expose relational intersectionalities critical to determining the ethical feasibility of the proposed study.

Summary of Relevant Events

Modifications were made to the original proposal during the IRB process as a result of pre-review concerns over the participation of co-researchers in the research process. These concerns were premised on the IRB reviewer's belief that under the proposal as originally written the co-researchers would need to receive institutional ethics training. This created a decision point to either maintain the proposal as originally written and require that the co-researchers be required to take the ethics training, a prospect that

would be likely to meaningfully impair equitable participation in the co-research process, or modify the proposal to eliminate the use of the term co-researcher and reduce the level of ownership that the community participants would have in the project to try to salvage the opportunity for equitable representation. Ultimately the latter course of action was chosen, partly premised on concerns over limiting participation and also partly premised on encroaching timeline pressures. Shortly after the necessary revisions were submitted, the proposal was approved by the IRB. What I did not fully appreciate at the time was how these modifications eroded not only the integrity of the project, but also my own confidence in the project's potential value to the community and as a mechanism to inform the ongoing work of the Bioremediation Project.

It was following the IRB approval and during my recruitment efforts that my reflexivity practice allowed me to fully consider the effects of these modifications on how the project might unfold. The practice of reflexivity allows a researcher to deepen shared understandings and experiences or highlight unique ones by exposing the intersections of the researcher's subjective self with others and with Place. This can lead to insights "which may reproduce, resist and disrupt normative understandings of cultures which are critical to examining relationality" (Olive, 2020, p. 123-124). Reflexivity requires a balancing of the "risk of self-indulgence or self-absorption" with the very real need to include ourselves in the picture in order to get a rich, full, and nuanced perspective on the research (Olive, 2020, p. 126; Carrington, 2008; Couldry, 1996).

I expanded the reflexive work that the recruitment process had catalyzed to include reflection on the work that had informed my original proposal. The feminist lens that informs the theoretical framework for this project prompted additional critical

reflection on the “othering” of research participants and re-centered the critique of scientific objectivity (and its mechanisms of distancing and authority), in order to create new avenues for knowledge generation (Alaimo 2012; Gustafson et al., 2019). In grounding my reflexivity in the action element of PAR and seeking out additional bodies of work on the ethics of authentically engaging with communities in PAR, I began to question the ability of this project, done in the context that was unfolding, to meet the standards that are required for the level of participatory action research that I envisioned and proposed.

Reflexivity and Ethical Feasibility Examination

The questions that guided the new examination prompted by the events include:

1. How did the ethics that guide PAR specifically apply to this project?
2. Where were the points of influence for traditional hegemonic power systems to affect the integrity of the process?
3. What were the defining characteristics of those interactions?

The inputs that emerged during this process and guided these reflexive questions are summarized in Table 3.

Table 3

Research Events – Reflexivity

Event	Reflexive practice
Research topic selection	Consideration of Place (geographic, cultural, temporal) Am I in the right place to do this work?

Event	Reflexive practice
Colloquium presentation and notes	Integration of humility, accountability, and collectivity as grounding principles
IRB clarification requests and responses	Personal reflections during the IRB review process grounded in emerging research in spirituality as a resilience tool
Modification to proposal	Reviewing of authentic PAR metrics; rereading of philosophical underpinnings of PAR; expanding my understanding of ethical research (including research ethics broadly and the ethics specific to PAR)
Recruitment (emails and zoom calls with prospective participants)	Am I upholding my ethical obligation of beneficence? Am I asking for more than I am able to give back?
Bioremediation project activities (Teen Science Café and St. Louis River Summit)	Am I making a meaningful contribution? To the field? To the project? Emergence of concerns for compromising the integrity of the Bioremediation Project.
Passing of all data collection target dates	What does a timeline of trust look like? What are my personal responsibilities?

Event	Reflexive practice
	Centering the building of sustainable relationships between academia and the community.

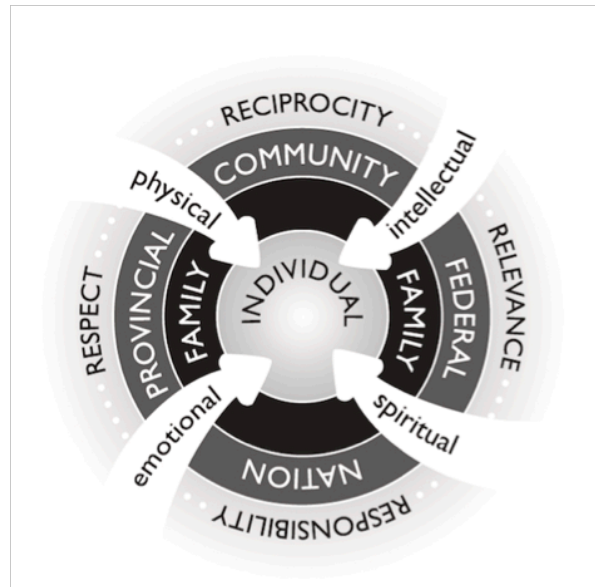
Through the unfolding of these events, the question that kept recurring was: How can I ask my prospective participants for their time and input, perspectives, experiences, personal stories, mental energy, and other things that I might not even know I am asking for, when I myself don't trust that the process as I am able to undertake it, is going to return adequate value to them and their communities? This question relates specifically to the basic ethical principle of beneficence, which in the context of PAR, requires researchers to ask the question: Is what I am asking *of* the community commensurate with the value to be gained *by* the community?

Expanding on the ethics work I was doing alongside this process, I used the themes of the four R's – respect, relevance, reciprocity, and responsibility – adapted from Pidgeon and Riley's (2021) Indigenous Wholistic Framework (IWF) to critically reflect on these developments. The Indigenous Wholistic Framework is visualized in Figure 4. It's applicability to my reflexive examination of the developments of the PAR study is based in the framework's ability to capture the *totality of the circumstances*, a legal concept, which is used to make a finding based on all of the available information rather than through application of a strict, pre-established bright-line rule. This type of analysis seemed appropriate for the present situation given that no single variable alone

necessitated a decision to forego the proposed research, but when taken in total, or as a whole, they collectively undermined the project's integrity.

Figure 4

Indigenous Wholistic Framework



Note. From Pidgeon, M. & Riley, T. (2021). Understanding the application and use of Indigenous research methodologies in the social sciences by Indigenous and non-Indigenous scholars. *International Journal of Education Policy Leadership*, 17(8), p. 6. <http://journals.sfu.ca/ijepl/index.php/ijepl/article/view/1065>

The IWF calls out *respect* for Indigenous, and other non-dominant Ways of Knowing, including providing for the space necessary to accommodate those forms of knowing throughout the process (Pidgeon & Riley, 2021). It requires that the anticipated work be *relevant* to the community in which it is conducted. It necessitates embedding *reciprocal* obligation in the research process. And it centers the *responsibility* inherent in the relationship between the researcher and the community (Pidgeon & Riley, 2021, p. 3)

I then overlaid Lenette's (2022) five principles of deep participation from Chapter 3 to these reflexive questions. Out of this work came three main themes that, when taken as a whole, undercut the project's integrity and eroded its capacity to achieve authentic PAR: (1) epistemic injustice embedded in the ethics review process, (2) challenges to relational ethics manifested in a risk of exploitation, accountability concerns, and a lack of Place relations, and (3) insufficient time.

Chapter 5: Discussion

While this study was designed to examine how people are interacting with environmental science in the St. Louis River watershed, it transformed into a critical reflection on conducting participatory action research (PAR) within a traditional academic context. The finding that the anticipated PAR cycles could not be undertaken ethically and the resulting reflexive analysis produced a set of insights that can be used to consider the ethical and logistical landscape of using participatory modes of research in settings grounded in dominant research frameworks.

As established in Chapter 1, PAR is a democratic research process premised on action and reflection, grounded in theory and practice, in pursuit of practical knowledge, and aimed at addressing the human needs within a community *as defined by* that community (Reason & Bradbury, 2008). It is intended to be a “counterhegemonic approach to knowledge production” (Kindon et al., 2007, p. 9). Furthermore, as noted throughout Chapters 1, 2, and 3, this study specifically anticipated affording particular consideration for the centrality of existing power dynamics, the transcendence of dualism, and relational accountability. Underlying PAR is the assumption that neither participation nor action by themselves are enough and that to make progress toward true epistemic justice local communities must have meaningful opportunities to exercise control over their circumstances and to effect changes in their everyday lived experiences at both the ground level and policy levels (PAR, 2014).

To maintain the integrity of this process, PAR requires ethics work, which involves both reflexive work on the part of the researcher as well as reflection on the institutional norms and processes that may perpetuate epistemic injustice (Abma, 2020).

The dominant paradigm of qualitative research is “so disciplined, so normalized, so centered ... that it has become conventional, reductionist, hegemonic, and sometimes oppressive and has lost its radical possibilities” reinforced by volumes of work that repeat the dogmatized structure and create a belief that *this* is what qualitative research looks like and that anything that looks different is inherently *not* (St. Pierre, 2011, p. 613).

Power Dynamics and the IRB Process

As highlighted by the literature review in Chapter 2, academic research is a product of the institutions from which it is produced and is therefore limited by those institutions’ hierarchical power structures (Curley et al., 2022). The knowledge output requirement of academic research, increasingly measured with efficiency-focused quantitative metrics, “obscures power differentials, political differences, and cultural values” by relying on epistemological structure that divides the research subject from the research object, separating the knower from the known (Alaimo, 2012, p. 560).

Institutional ethical frameworks, implemented through the IRB process, that were designed for and exist within such systems of hegemonic power disparity often serve to perpetuate those very systems in their pursuit of ethical ideals (Lenette 2022). There are two primary issues with the way that the IRB process functions with regard to PAR that are highlighted by the results of this study. First, the formulaic approach of the process places inapplicable standards on PAR proposals that curtail their efficacy and integrity. Second, the process fails to include consideration of the additional ethical issues specific to the PAR process that are necessary to a meaningful evaluation of the ethical posture of a PAR study. In practice, IRB processes are at the same time overly protective *and* insufficient to provide meaningful review to ensure ethical and authentic PAR (Wood,

2017). This means that there are aspects of the ethical review process that are (1) overemphasizing some ethical standards and (2) overlooking the meaningful consideration of others.

What is the process overemphasizing?

Where the underlying PAR principle of advancing community agency is undermined by traditional research ethics' drive to protect research participants, it can serve to perpetuate the very power imbalances that the PAR process should be disrupting (Lenette, 2022). In these cases, researchers need to have the flexibility to prioritize the principles that are most consistent with achieving the community action element of PAR (Freire, 1982). Epistemic justice cannot be achieved by modeling co-researcher participation in the image of institutional research procedures (Voronka, 2016).

The experience of moving this proposal through the IRB process developed consistently with the insights provided by the research in this area: application of standardized, "one-size-fits-all" guidelines resulting in modifications to meet the IRB's protocols, which undermined the integrity of the project. Requiring that co-researchers flex themselves to fit the form of the academic research process is antithetical to the underlying principles and ethics of PAR and will compromise both PAR objectives: less robust and less useful knowledge will be created and community action will be impaired. In the present case, the IRB's application of ethical standards based in dominant research paradigms led to the determination that the co-researchers would likely need to take the ethics training required for academic researchers engaged in research involving human subjects. This would have undermined the authenticity of the PAR project in two ways.

First, it would require prospective co-researchers to have access to a computer, internet connection, email address, and a degree of technological literacy and to create an account for the University of Minnesota Duluth's Citi program, which hosts the ethics training. Blanket application of this requirement is premised on assumptions about co-researchers existing means and levels of comfort with engaging with the academic system. This requirement would be at best an unnecessary frustration for co-researchers and at worst a prohibitive barrier to participation based on prospective participants' past experiences with extractive research practices (Miriti, 2019).

Second, the training requirement fails to account for the technical literacy of the prospective co-researchers. The ethics trainings are written for professional researchers and contain a significant degree of technical language that could make the trainings difficult to understand or even alienating for prospective co-researchers. Shifting from "co-researchers" to "community participants" as a means of avoiding the ethics training requirements, however, salvages the potential for inclusivity of participation only at the expense of the participants' agency. In removing the participants from critical phases of the project, including research design, data analysis, and dissemination, the project loses its capacity to fill the dual function of knowledge generation and community action (see Frtiz, 2008).

Application of the Indigenous Wholistic Framework (IWF) to the reflexive analysis done as the project progressed counters the inflexible "checklist" approach of the existing ethical review process. Consistent with an authentic PAR process, the IWF supports academic researchers in finding ways to instead flex the structure of the research to fit the needs of the co-researchers. This means meeting the co-researchers where they

are, physically, temporally, and cognitively. In the present case, a wholistic alternative the ethical training requirement could have been the development of an ethics briefing that could have been provided by the academic co-researcher at the first co-researcher team meeting. This would eliminate the need for the co-researchers to engage with the University's technical system, allow for the use of plain-language, and provide an opportunity for the co-researchers to ask questions. In this way, the structure of the dominant research requirements could be flexed to meet the needs of the co-researchers without compromising the purpose of the ethics requirements *or* the authenticity of the PAR.

What is the process overlooking?

The ethical considerations that are specific to PAR and that go beyond the basic principles established in the Belmont report outlined in Chapter 2 are not reviewed by the IRB. In the present case, that meant missing out on a comprehensive review of the ethical considerations that should be taken into account to ensure ethical integrity in this type of study. Meaningful consideration of the research ethics that go beyond the “procedural ethics” framework central to IRB review requires constant critical reflection throughout the research process. This reflexive practice is grounded primarily in the ethical dimensions of the relational aspects of the research through which “the process of informed consent really occurs—not on the pieces of paper that an ethics committee peruses” (Guillemin & Gillman, 2004, p. 275).

Where a study meets the IRB standardized review process, but fails to internally account for these additional considerations, the IRB process can serve as a rubber stamp for PAR studies that should otherwise be revised or reconsidered and can provide a false

sense of ethical security to researchers and participants. Based on the findings from the reflexivity practice applied here, the areas of significant concern that also needed weighing include a review of relational ethics and the time necessary to fulfill the dual function of PAR work.

Relational Ethics

The outcome of this attempted study indicates that in order to avoid repeating cycles of research design and practice that perpetuate epistemic injustice, relational ethics need to be taken into account in reviewing, and also continuously while undertaking, a PAR study. Ethical relationality is grounded in reciprocity of thought, which requires awareness of those that are “speaking alongside us” (Todd, 2016, p. 19). Reciprocity of thinking positions us in dynamic systems within which we have a myriad of duties and responsibilities to various elements of the worlds we inhabit. This positionality, in turn, informs the ethics of how we do our work.

This PAR study as originally proposed was intended to offer an alternative strategy of building coalitions that transcend academic institutional knowledge production to create a “politically engaged and informed resistance” or “reflexive scientific knowledge production” (Neimark et al., 2019, p. 615). Relational ethics are central to these objectives and are considered a critical component of the integrity of this project. As the reflexivity work of this project progressed, three key relational ethics elements arose that presented significant challenges: the risk of exploitation of the research subject, concerns over accountability, and considerations of Place relationships.

Exploitation

The question that continued to recur for me: “Is what I was asking *of* the community commensurate with the value to be gained *by* the community?” informs the relational ethics question by requiring a direct examination of exploitation. Extractive research practices are unfortunately common-place in dominant research structures and are a violation of relational ethics. In answering the above question in the negative, an acknowledgement must be made that the project cannot sustain the necessary respect for relational ethics due to an inability to meet the requirements of the four Rs and satisfy a wholistic ethical inquiry.

In the present case, the risk of exploitation was heightened by all four Rs. First, with regard to respect, the space that is necessary to accommodate non-dominant Ways of Knowing *throughout* the process (Pidgeon & Riley, 2021) was eroded by both the reduction in agency created by changing the “co-researchers” to “community participants” and by the shortened time frame that resulted from the original context of the two-year master’s program in which the study was situated as well as the extended IRB review process. Second, the potential for the work to be relevant to the community was impaired by the removal of the community participants from parts of the research design phase, as including the community in the design is necessary to ensure the relevance of the work. Third, the reduction to community participant agency undermined the reciprocity of obligation between the community and the academic researcher by placing the community participants in a more passive role, closer to the role of a research subject in a dominant research paradigm. Fourth, my own reflexive questioning exposed foundational deficiencies in my own ability to uphold the responsibility inherent in my

relationship with the community specifically related to my relationship with Place, examined further below (Pidgeon & Riley, 2021).

As demonstrated by the present case, in reflecting on the risk of exploitation, researchers must create space to engage with the “the political situation, agency, legal orders and relationality” of the research subject, particularly when that subject involves voices that have been systemically excluded (Todd, 2016, p. 18). Failure to do so can risk the perpetuation of epistemic injustice. A commitment to avoiding the perpetuation of exploitative research practices also requires integrity not just in practice, but also in the language that we use to define that practice. An abandonment of accurate participatory terminology in the interests of overcoming institutional requirements may achieve approval for an individual project, but it will not move the system towards systemic justice and ultimately such a tactic undermines the ability to strive for wholistic epistemology. PAR can and should center relational ethics in order to reorient towards research in which “the ultimate aim is not explaining an objectified universe, but rather learning about and understanding responsibilities and relationships and celebrating those that humans establish with the world” (Cajete, 2004, p. 55).

Accountability

Ethics is grounded in entanglement, is inherently and inextricably relational, and requires a recalibration of how we think about accountability, which derives from commitment and connection (Springgay & Truman, 2018). Accountability work in regard to relational ethics requires reconsideration of the impact of research, and a reorientation of the work towards more sustainable and transformative outcomes resulting from relationship building between communities and research institutions (Facer & Enbright,

2016). A significant point of reflection in my reflexivity practice exposed concerns that proceeding with the proposed study could compromise the integrity of the bioremediation project and undermine the work of the bioremediation project team, which triggers questions of the accountability of the work.

As discussed in Chapter 2, authentic community participation in environmental science projects centering inclusivity have significantly increased capacity to generate positive social and ecological outcomes (Miriti, 2019). This is a primary objective of the bioremediation project in which the proposed PAR study was conceptualized. My reflexive practice and critical reflection led to the exposure of the very real risk that proceeding with the proposed PAR work in an unethical way would not only be counterproductive and inauthentic to the study itself, but could have longer term negative consequences for the ability of the Bioremediation Project to engage meaningfully with the community. This new understanding of the intersectionality of my work in a broader context bore significant weight in the wholistic evaluation of the ethical feasibility of the study.

Place

The reflexivity practice employed here exposed a deep concern for my own relationship with Place that created a crisis of confidence and undermined my capacity to uphold relational ethics. This understanding allowed me to lean into that intersection of my subjective self with the others, both individuals and Place, that I was seeking to engage in the proposed study and provided the insight necessary for examining the “embodied and relational nature of geographies, communities, cultures, histories, experiences and relationships” (Olive, 2020, p. 123-124). It was this examination and

reflection on myself as an outsider, both geographically and culturally, that allowed me to situate my relationship with Place as a challenge to the deep reciprocity necessary for this work. In a grounded normativity framework, “deep reciprocity” and place-based ontology are essential to authenticity in research practice (Coulthard & Simpson, 2016, p. 254).

Reflexive questioning of Place-related ethical concerns is directly relevant to PAR practice and in this case was an important factor in the wholistic evaluation of ethical feasibility.

Reconsidering Time

Eurocentric perspectives on time and current academic research frameworks emphasize scholarly productivity in a way that directly conflicts with the consideration of time necessary to engage in PAR. Relationship building, reflexive research, and inclusive publishing processes are incompatible with existing dominant research paradigms (Pidgeon & Riley, 2021). The findings of my reflexive work on this process support the need to reconsider time as an ethical component of a PAR research process. In the present case, based on the outcomes of my own reflexive analysis and application of the Indigenous Wholistic Framework, I would argue that a review of my initial proposal should have raised ethical questions regarding my proposed timeframe. At no point during the review process, however, was the element of what should be considered an ethical timeframe addressed.

Critical political ecology, which constitutes part of the theoretical framework for this study, challenges researchers to produce knowledge by harnessing resources traditionally excluded from the scientific process (Neimark, 2019). I would offer that in this context, as with many (if not most) PAR projects, the most relevant of those

excluded resources is time. Specifically, the time that is required to build trust, to establish good relationships, and to allow for the kinds of reflexivity necessary to continually re-evaluate the ethical foundations of the project. The results of my reflexive analysis support incorporating additional time, or a concept of “slowness” into PAR work, which can make space for “a process of unlearning and unsettling what has come before” (Springgay & Truman, 2018, p. 18). Slowness can be a defining feature in the ability of PAR work to move systems towards epistemic justice. For most PAR projects, anticipated timelines should be measured in years rather than months.

Implications

The implications of this study are consistent with much of the research that has been done on relational ethics and the challenges of conducting authentic and ethical PAR research in a traditional academic setting. The findings here, that this work could not be done ethically in the given context, should provide an opportunity for reflection on how the University of Minnesota Duluth’s IRB process incorporates expertise or training on participatory methods of research and epistemic justice. Failure to undertake critical reflection in this area poses a risk of perpetuating systemic marginalization of traditionally underrepresented epistemologies as well as stifling innovation in research practice (Honan & Bright, 2016).

The findings here can also inform future PAR projects with regard to the timelines necessary to achieve the dual function of knowledge production and community action. In determining a project timeline, researchers should allocate extra time in the project to:

1. Work with and educate as necessary the IRB reviewers in order to be able to maintain the integrity of the project.
2. Ensure an ability to be responsive to the seasonal availability of co-researchers in order to ensure participation from a diverse range of community members.
3. Provide for multiple PAR cycles, allowing for authentic co-researcher involvement and opportunity for sustainable and transformative community action.

Finally, the inability of this study to undertake the original research regarding people and environmental science in the SLRW means that these related research questions remain unanswered. Their relevance persists for all of the reasons originally outlined. This is work that is worth doing, but needs to be done right, which means more time, deeper relationships, and more meaningful opportunities for reciprocity with Place.

Recommendations

My first recommendation would be for an evaluation to be done on how UMD's institutional research structures could be more conducive to PAR work. Ironically, an ideal mechanism for this would likely be a participatory evaluation process, given that it would have an action element embedded in its objective. This would ensure that any insights gained could be immediately useful in remediating the frameworks that hinder epistemic justice in this setting. Developing a protocol that allows for academic researchers to develop alternative ethics training options for co-researchers that meet institutional requirements while also delivering the flexibility necessary to maintain the integrity of PAR would be a tangible step in the direction of epistemic justice. Another localized recommendation would be to undertake the initial research study proposed here,

but with a substantially longer timeline and with additional allowances for building relationships with not only the prospective co-researchers, but also the IRB reviewers and with the Place at the heart of the project.

More generally, future research on the ethical considerations necessary to undertake PAR within traditional academic settings could explore whether there are other universities or other dominant research institutions that are more adept at navigating the complex dynamics of epistemological power deconstruction. Whether there are better models and what we might be able to learn from them would be a worthwhile examination.

Finally, the outcomes of the reflexive and wholistic evaluation that resulted from this process highlight a need for the academic community to be building relationships with community partners outside of singular research projects. A sustained presence *within* the community established prior to the materialization of a research agenda can build trust in ways that can never be fully realized when community partnerships are sought primarily as a means to an end. This requires a shift in how many academic researchers position themselves in relation to the communities in which they live and work. The work that unfolded for the interdisciplinary researchers on the Bioremediation Project team demonstrates an example of what this could look like. It involves reconsidering timelines, grounding oneself in Place, and centering relationships over research agendas. While at times uncomfortable for those trained in dominate research systems and in many cases contradictory to metrics of professional advancement and academic funding cycles, the Bioremediation Team's work has shown the value that emerges when academic researchers engage with the community for the sake of the

engagement, rather than to advance a particular research objective. It is the difference between saying “we are here to do this thing or get that result” and saying “we are here to be in relationship with you.” This level of trust has the power to lead to wholistic, sustainable knowledge production *and* the advancement of community priorities.

Conclusion

What began as a qualitative participatory action research study transformed into an examination of the ethics of attempting to undertake participatory action research within the context of a two-year master’s program embedded in a traditional academic institution. While the initial research question persists as an important area for exploration to inform ongoing environmental science activities in the area, adherence to the underlying principles and ethics of PAR necessitated the conclusion that this work could not be done authentically or ethically in the particular context and that given these constraints, the most appropriate course of action was not to make an attempt that would reinforce systems of epistemic injustice. The reflexive process that informed this determination, however, provides useful insights that will hopefully guide future PAR work in similar contexts and can inform researchers seeking to build sustainable community relationships.

References

- Abma, T. (2020). Ethics work for good participatory action research, *Beleidsonderzoek Online*. <https://doi.org/10.5553/BO/221335502020000006001>
- About the Lake Superior Reserve* (n.d.). Lake Superior National Estuarine Research Reserve. Retrieved November 6, 2023, from <https://lakesuperiornerr.org/about-the-lake-superior-reserve/>
- Alaimo, S. (2012). Sustainable this, sustainable that: New materialisms, posthumanism, and unknown futures. *Publications of the modern language association of America*, 127(3), 558-564. <https://doi.org/10.1632/pmla.2012.127.3.558>
- Allen, S., Allen, D., Phoenix, V.R., Le Roux, G., Jiménez, P. D., Simonneau, A., Binet, S., & Galop, D. (2019). Atmospheric transport and deposition of microplastics in a remote mountain catchment. *Nature Geoscience*, 12, 339–344 (2019). <https://doi.org/10.1038/s41561-019-0335-5>
- American Rivers (n.d.). *St. Louis River*. Retrieved October 31, 2023, from <https://www.americanrivers.org/river/st-louis-river/>
- Armstrong, L., Loomis, C., & Mairena-Torres, E. (2012). Is participatory research compatible with graduate research? Reflections from three stakeholders. *Global Journal of Community Psychology Practice*, 3(3), 1-10. <https://www.gjcpp.org/pdfs/2011-0009-final-20120515.pdf>
- Bauer, M. W. (2009). The evolution of public understanding of science—Discourse and comparative evidence. *Science, Technology and Society* 14(2), 221–240. <https://doi.org/10.1177/097172180901400202>
- Bodison, S.C., Sankaré, I., Anaya, H., Booker-Vaughns, J., Miller, A., Williams, P., Norris, K. and (2015), Engaging the community in the dissemination, implementation, and improvement of health-related research. *Clinical And Translational Science*, 8, 814-819. <https://doi-org.libpdb.d.umn.edu/2443/10.1111/cts.12342>
- Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science (Bristol, England)*, 25(1), 2–16. <https://doi.org/10.1177/0963662515607406>
- Broto, V.C., *et.al.* (2022). Co-production outcomes for urban equality: Learning from different trajectories of citizens' involvement in urban change, *Current Research in Environmental Sustainability*, 4. <https://doi.org/10.1016/j.crsust.2022.100179>
- Bruine de Bruin, W., Rabinovich, L., Weber, K., Babboni, M., Dean, M., & Lance Ignon (2021). Public understanding of climate change terminology. *Climatic change*, 167(37). <https://doi.org/10.1007/s10584-021-03183-0>

- Cajete, G. (2004). Philosophy of native science. In A. Waters (Ed.), *American Indian thought* (45-57). Malden, MA: Blackwell Publishing Ltd.
- Carrington, B. (2008). “What’s the footballer doing here?”: Racialized performativity, reflexivity, and identity. *Cultural studies ⇔ Critical methodologies*, 8(4), 423–452.
- Castree, N., Chatterton, P. A., & Heynen, N. (Eds.) (2010). *The point is to change it: Geographies of hope and survival in an age of crisis*. Oxford, UK: Wiley.
- Christie, I., Gunton, R. M., & Hejnowicz, A.P. (2019). Sustainability and the common good: Catholic Social Teaching and ‘Integral Ecology’ as contributions to a framework of social values for sustainability transitions. *Sustainability Science*, 14, 1343–1354. <https://doi.org/10.1007/s11625-019-00691-y>
- Coghlan, D., & Brydon-Miller, M. (2014). Introduction. In D. Coghlan & M. Brydon-Miller (Eds.), *The SAGE Encyclopedia of Action Research*. SAGE Publications Ltd. <https://doi.org/10.4135/9781446294406>
- Columbia University (2020). *Ethics and the IRB*, August 3, 2020. Teachers College, Columbia University, <https://www.tc.columbia.edu/institutional-review-board/irb-blog/2020/the-history-of-the-belmont-report/>
- Cooper, R., & Lilyea, B. (2022). I’m interested in autoethnography, but how do I do it? *Qualitative Report*, 27(1), 197–208. <https://doi.org/10.46743/2160-3715/2022.5288>
- Cornish, F., Breton, N., Moreno-Tabarez, U., Delgado, J., Rua, M., Aikins, A. d., & Hodgetts, D. (2023). Participatory action research. *Natural Reviews Methods Primers* 3(34), 1-14. <https://doi.org/10.1038/s43586-023-00214-1>
- Couldry, N. (1996). Speaking about others and speaking personally: Reflections after Elspeth Probyn’s Sexing the self. *Cultural Studies*, 10(2), 315– 333
- Coulthard, G., & Simpson, L. B. (2016). Grounded Normativity / Place-based solidarity. *American Quarterly*, 68(2), 249–255. <https://doi.org/10.1353/aq.2016.0038>
- Creswell, J. W. & Creswell, J. D. (2022). *Research design: Qualitative, quantitative, and mixed methods approaches* (Sixth edition). SAGE Publications, Inc.
- Curley, A., Gupta, P., Lookabaugh, L., Neubert, C., & Smith, S. (2022). Decolonisation is a political project: Overcoming impasses between Indigenous sovereignty and abolition. *Antipode*, 54(4), 1043-1062. <https://doi.org/10.1111/anti.12830>

- Davison, R. M., Martinsons, M. G., & Wong, L. H. M. (2022). The ethics of action research participation. *Information Systems Journal (Oxford, England)*, 32(3), 573–594. <https://doi.org/10.1111/isj.12363>
- Dedding, C., Goedhart, N. S., Broerse, J. E. W., & Abma, T. A. (2021). Exploring the boundaries of ‘good’ Participatory Action Research in times of increasing popularity: Dealing with constraints in local policy for digital inclusion, *Educational Action Research*, 29(1), 20-36. <https://doi.org/10.1080/09650792.2020.1743733>
- Durose, C., Perry, B., & Richardson, L. (2022). Is co-production a ‘good’ concept? Three responses, *Futures*, 142. <https://doi.org/10.1016/j.futures.2022.102999>
- Egan, P. J. & Mullin, M. (2017). Climate change: US public Opinion. *Annual Review of Political Science*, 20, 209-227. <https://doi.org/10.1146/annurev-polisci-051215-022857>
- Environmental Education, NAEF*. (n.d.). National Association of Environmental Education. Retrived October 28, 2023, from <https://naaee.org/about/ee>.
- Esbjorn-Hargens, S. (2005) Integral ecology: The what, who, and how of environmental phenomena. *World Futures*, 61(1-2), 5-49. <https://doi.org/10.1080/02604020590902344>
- Facer, K., & Enright, B. (2016). Creating living knowledge: The Connected Communities Programme, community-university partnerships and the participatory turn in the production of knowledge. *Arts and Humanities Research Council*. <https://connected-communities.org/index.php/creating-living-knowledge-report/>
- Fletcher, A. & Christin, Z. (2015). *The value of nature’s benefits in the St. Louis River Watershed*. Earth Economics, Tacoma, WA. <http://www.fdlrez.com/%5C/RM/downloads/Earth%20Economics%20St%20Louis%20River%20Project%20Report.pdf>
- Filing Copies of Campaign Finance Reports and Statements With State Officers, Duties of State Officers, 45 C.F.R. § 46 (2024). <https://www.ecfr.gov/current/title-45/subtitle-A/subchapter-A/part-46>
- Fond du Lac Environmental Program (2021). *Fond du Lac Reservation nonpoint source assessment*. <http://www.fdlrez.com/%5C/RM/downloads/NPSAssessmentReport2021.pdf>
- Freire, P. (1982). Creating Alternative Research Methods: Learning to Do It by Doing It. In B. Hall, A. Gillette, & R. Tandon (Eds.), *Creating Knowledge: A Monopoly? Participatory Research in Development* (pp. 29–37). Participatory Research Network.

- Fritz, L., & Meinherz, F. (2020). Tracing power in transdisciplinary sustainability research: An exploration. *GAIA - Ecological Perspectives for Science and Society*, 29(1), 41-51. <https://doi.org/10.14512/gaia.29.1.9>
- Given, L. M. (Ed.) (2008). *The SAGE Encyclopedia of Qualitative Research Methods*. (Vols. 1-0). SAGE Publications, Inc. <https://doi.org/10.4135/9781412963909>
- Goldfarb, J. L., & Kriner, D. L. (2017). Building public support for science spending: Misinformation, motivated reasoning, and the power of corrections. *Science Communication*, 39(1), 77-100. <https://doi.org/10.1177/1075547016688325>
- González-Pleiter, M., Edo, C., Velázquez, D., Casero-Chamorro, M. C., Leganés, F., Quesada, A., ... & Rosal, R. (2020). First detection of microplastics in the freshwater of an Antarctic Specially Protected Area. *Marine Pollution Bulletin*, 161(B), <https://doi.org/10.1016/j.marpolbul.2020.111811>
- Growing for Market, 2020. *REKO ring: A new way to pre-sell online*, June 1, 2020. [https://growingformarket.com/articles/reko-ring-new-way-presell-online#:~:text=What%20is%20a%20REKO%20ring,\(you%20get%20the%20idea\).](https://growingformarket.com/articles/reko-ring-new-way-presell-online#:~:text=What%20is%20a%20REKO%20ring,(you%20get%20the%20idea).)
- Guarino, MV., Sime, L.C., Schröder, D., Malmierca-Vallet, I., Rosenblum, E., Ringer, M., Ridley, J., Feltham, D., Bitz, C., Steig, E.J., Wolff, E., Stroeve, J., & Sellar, A. (2020). Sea-ice-free Arctic during the last interglacial supports fast future loss. *Natural Climate Change*, 10, 928–932. <https://doi.org/10.1038/s41558-020-0865-2>
- Guillemin, M., & Gillam, L. (2004). Ethics, Reflexivity, and “Ethically Important Moments” in Research. *Qualitative Inquiry*, 10(2), 261-280. <https://doi-org.libpdb.d.umn.edu:2443/10.1177/1077800403262360>
- Gustafson, D. L., Parsons, J. E., & Gillingham, B. (2019). Writing to transgress: Knowledge production in participatory action research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 20(2), 1-25. <https://doi.org/10.17169/fqs-20.2.3164>
- Harcourt, W., & Nelson, L. L. (Eds.) (2015). *Practicing feminist political ecologies: Moving beyond the “green economy.”* London: Zed.
- Harvey, Chelsea (2022 February 15). Western ‘Megadrought’ is the worst in 1,200 years. E&E News. <https://www.scientificamerican.com/article/western-megadrought-is-the-worst-in-1-200-years/#:~:text=The%20searing%20“megadrought”%20that%20has,to%20new%20research%20published%20yesterday.>
- Honan, E. & Bright, D. (2016). Writing a thesis differently. *International Journal of Qualitative Studies in Education*. <https://dx.doi.org/10.1080/09518398.2016.1145280>

- Hungerford, H. R. & Volk, T. R. (2003). Notes from Harold Hungerford and Trudi Volk. *The Journal of Environmental Education*, 34(2), 4-6.
<https://doi.org/10.1080/00958960309603493>
- International Collaboration for Participatory Health Research (2013). *Participatory Health Research: A guide to ethical principals and practice. Position Paper No. 2*. Berlin: International Collaboration for Participatory Health Research.
http://www.icphr.org/uploads/2/0/3/9/20399575/ichpr_position_paper_2_ethics_-_version_october_2013.pdf
- IPCC 2021, *Climate Change 2021: The Physical Science Basis, the Working Group I contribution to the Sixth Assessment Report*, Cambridge University Press, Cambridge, UK.
- Jansen, B., Reehorst, E., & Delhaas, R. (1995). Action research networking and environmental education in the Netherlands: A challenging and successful action research strategy for educational reform, *Educational Action Research*, 3(2), 195-209. <https://doi-org.libpdb.d.umn.edu:2443/10.1080/0965079950030206>
- Jenkins, E. (2003). Environmental education and the public understanding of science. *Frontiers in Ecology and the environment*, 1(8), 437-443.
[https://doi.org/10.1890/1540-9295\(2003\)001\[0437:EEATPU\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2003)001[0437:EEATPU]2.0.CO;2)
- Johnson, M. T., Gallagher, V., & Appleton, R. (2021). Teaching participatory action research: Fostering impact. *Journal of Political Science Education*, 17(2), 191-212. <https://doi.org/10.1080/15512169.2019.1616551>
- Kemmis, S. (2006). Participatory action research and the public sphere. *Educational Action Research*, 14(4), 459-476, <https://doi.org/10.1080/09650790600975593>
- Kemmis, S., McTaggart, R., & Nixon, R. (2014). Introducing critical participatory action research. In *The Action Research Planner*. Springer, Singapore. https://doi-org.libpdb.d.umn.edu:2443/10.1007/978-981-4560-67-2_1
- Khan, I., Hou, F., & Le, H. P. (2021). The impact of natural resources, energy consumption, and population growth on environmental quality: Fresh evidence from the United States of America. *Science of the total environment*, 754, 1-13.
<https://doi.org/10.1016/j.scitotenv.2020.142222>
- Kimmerer, R. W. (2012). Searching for synergy: Integrating traditional and scientific ecological knowledge in environmental science education. *Journal of Environmental Studies and Sciences*, 2(4), 317-323.
<https://doi.org/10.1007/s13412-012-0091-y>
- Kindon, S., Pain, R., & Kesby, M. (2007). Participatory action research: Origins, approaches and methods. In S. Kindon, R. Pain, & M. Kesby (Eds.) *Participatory*

Action Research Approaches and Methods: Connecting People, Participation and Place. Routledge.

- Klein, S., Lee, J. S., Courtney, S., Morehead-Hillman, L., Lau, S., Lewis-Smith, B., Sarna-Wojcicki, D., & Woelfle-Hazard, C. (2022). Transforming restoration science: Multiple knowledges and community research cogeneration in the Klamath and Duwamish Rivers. *The American Naturalist*, 200(1). <https://doi.org/10.1086/720153>
- Klemmer, C.L., & McNamara, K. A. (2020). Deep ecology and ecofeminism: Social work to address global environmental crises. *Journal of Women and Social Work*, 35(4), 503-515. <https://doi.org/10.1177/0886109919894650>
- Kolka, R. K., Haight, R. G., Chun, C. L., Berens, M. J., Rogers, E. R., Vinhal, R. A., Zalesny, R. S., Jr., Nislow, K. H., Perry, C. H., & Connolly, S. J. (2022). Mercury sulfur initiative: Suggested program of research for the Upper Great Lakes States. *General Technical Report, NRS-206. U.S. Department of Agriculture, Forest Service, Northern Research Station*, 25. <https://doi.org/10.2737/NRS-GTR-206>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. <https://doi.org/10.1080/13504620220145401>
- Krieg, B., & Roberts, L. (2007). In S. Kindon, R. Pain, & M. Kesby (Eds.) *Participatory Action Research Approaches and Methods: Connecting People, Participation and Place*. Routledge.
- Lake Superior National Estuarine Research Reserve (2023). *St. Louis River Summit 2023 Full Agenda with Abstracts*. <https://lakesuperiornerr.org/wp-content/uploads/sites/319/2023/07/Full-Abstract-Agenda-Summit-2023.pdf>
- Lawson, H. A. (2015). Introduction. In H. A. Lawson, J. Caringi, L. Pyles, J. Jurkowski, & C. Bozlak (Eds). *Participatory action research*. Oxford University Press.
- Lecuyer, L., White, R. M., Schmook, B., Lemay, V., & Calmé, S. (2018). The construction of feelings of justice in environmental management: An empirical study of multiple biodiversity conflicts in Calakmul, Mexico. *Journal of Environmental Management*, 213, 363-373. <https://doi.org/10.1016/j.jenvman.2018.02.050>
- Liebenberg, L. (2018). Thinking Critically About Photovoice: Achieving Empowerment and Social Change. *International Journal of Qualitative Methods*, 17(1). <https://doi.org/10.1177/1609406918757631>
- Lenette, C. (2022). *Participatory Action Research: Ethics and Decolonization*. Oxford University Press.
- Liboiron, M. (2021). *Pollution is colonialism*. Duke University Press.

- Macaulay, A. C. (2017). Participatory research: What is the history? Has the purpose changed? *Family Practice*, 34(3), 256–258. <https://doi.org/10.1093/fampra/cmw117>
- Maiter, S., Simich, L., Jacobson, N., & Wise, J. (2008). Reciprocity: An ethic for community-based participatory action research. *Action Research*, 6(3), 305-325. <https://doi-org.libpdb.d.umn.edu:2443/10.1177/1476750307083720>
- Matson, et. al. (2020). Transforming research and relationships through collaborative tribal-university partnerships on Manoomin (wild rice). *Environmental Science and Policy*, 115, 108-115. <https://doi.org/10.1016/j.envsci.2020.10.010>
- McGowan, W. (2020). ‘If you didn’t laugh, you’d cry’: Emotional labour, reflexivity and ethics-as-practice in a qualitative fieldwork context. *Methodological Innovations*, 13(2). <https://doi.org/10.1177/2059799120926086>
- Meek, D. & Lloro-Bidart, T. (2017). Introduction: Synthesizing a political ecology of education. *The Journal of Environmental Education*, 48(4), 213-225. <https://doi.org/10.1080/00958964.2017.1340054>
- Menken, S., & Kestra, M. (2016). *An Introduction to Interdisciplinary Research: Theory and Practice*. Amsterdam University Press.
- Merskin, D. (2011). Hearing voices: The promise of participatory action research for animals. *Action Research*, 9(2), 144-161. <https://doi-org.libpdb.d.umn.edu:2443/10.1177/1476750310388050>
- Miller, J. L. (2017.) Neo-positivist intrusions, post-qualitative challenges, and PAR’S generative indeterminacies. *International Journal of Qualitative Studies in Education*, 30(5), 488-503. <https://doi.org/10.1080/09518398.2017.1303215>
- Minnesota Scientific and Natural Areas: Patterned Peatland*. (n.d.). Minnesota Department of Natural Resources. Retrieved November 5, 2023, from <https://www.dnr.state.mn.us/snas/peatlands.html>
- Miriti, M. N. (2019). Nature in the eye of the beholder: A case study for cultural humility as a strategy to broaden participation in STEM. *Education Sciences*, 9(4), 291-300. <https://doi.org/10.3390/educsci9040291>
- Morales, S., Gore, D., Cua, G., Segovia, D., Rusch, D., Mehta, T., & Atkins, M. (2023). 190 filling the gap: Perspectives from a long-standing Community Engagement Advisory Board on conducting community-engaged research that emphasizes the needs of communities. *Journal of Clinical and Translational Science*, 7(s1), 58–58. <https://doi.org/10.1017/cts.2023.266>
- National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. (1979). *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research*. U.S. Department of

Health and Human Services. <https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/read-the-belmont-report/index.html>

- Neimark, B., Childs, J., Nightingale, A. J., Cavanagh, C. J., Sullivan, S., Benjaminsen, T. A., Batterbury, S., Koot, S., & Harcourt, W. (2019). Speaking power to “post-truth”: Critical political ecology and the new authoritarianism. *Annals of the American Association of Geographers*, 109(2), 613–623. <https://doi.org/10.1080/24694452.2018.1547567>
- Nguyen, V. M., Young, N., Brownscombe, J. W., & Cooke, S. J. (2019). Collaboration and engagement produce more actionable science: quantitatively analyzing uptake of fish tracking studies. *Ecological application*, 29(6). <https://doi.org/10.1002/eap.1943>
- Noy, S., & O’Brien, T. L. (2019). Science for good? The effects of education and national context on perceptions of science. *Public Understanding of Science*, 28(8), 897-916. <https://doi.org/10.1177/0963662519863575>
- Nyemba, F., & Mayer, M. (2018). Exploring the roots of participatory action research: An interview with Dr Marja-Liisa Swantz. *Action Research*, 16(3), 319-338. <https://doi.org/10.1177/1476750316684003>
- Olive, R. (2020). Thinking the social through myself: Reflexivity in research practice. In *Research Methods in Outdoor Studies* (1st ed., Vol. 1, pp. 121–129). Routledge. <https://doi.org/10.4324/9780429199004-12>
- Oliver, K., Kothari, A., & Mays, N. (2019) The dark side of coproduction: Do the costs outweigh the benefits for health research? *Health Research Policy and Systems*, 17(33). <https://doi.org/10.1186/s12961-019-0432-3>
- Pandya, R.E. (2014). Community-driven research in the anthropocene. In D. Dalbotten, G. Roehrig & P. Hamilton (Eds.), *Future Earth—Advancing Civic Understanding of the Anthropocene* (pp. 53-66). <https://doi.org/10.1002/9781118854280.ch6>
- Participatory Action Research. (2014). In D. Coghlan & M. Brydon-Miller (Eds.), *The SAGE Encyclopedia of Action Research*. SAGE Publications Ltd. <https://doi.org/10.4135/9781446294406>
- Past Projects*. (n.d.). St. Louis River Alliance. Retrieved November 6, 2023, from <https://www.stlouisriver.org/past-projects>
- Pidgeon, M. & Riley, T. (2021). Understanding the application and use of Indigenous research methodologies in the social sciences by Indigenous and non-Indigenous scholars. *International Journal of Education Policy Leadership*, 17(8). <https://journals.sfu.ca/ijepl/index.php/ijepl/article/view/1065>
- Poto, M.P., & Porrone, A. A. (2021). Co-created methodological approach to address the relational dimension of environmental challenges: When critical legal analysis

- meets illustrated storytelling. *Sustainability*, 13, 1-10.
<https://doi.org/10.3390/su132313212>
- Projects*. (n.d.). National Estuarine Research Reserve. Retrieved November 5, 2023, from <https://nerrsciencecollaborative.org/projects>
- Reason, P., & Bradbury, H. (Eds.). (2008). *The SAGE handbook of action research: Participative inquiry and practice* (2nd ed.). SAGE.
- Research and Monitoring Program*. (n.d.) Lake Superior National Estuarine Research Reserve. Retrieved November 5, 2023, from <https://lakesuperiornerr.org/research-and-monitoring/>
- Richardson, L. & St. Pierre, E.A. (2005). *Writing: A method of inquiry*. In N.K. Denzin & Y.S. Lincoln (Eds.) *The SAGE handbook of qualitative research* (pp. 959– 978). Thousand Oaks, CA: SAGE. <https://doi-org.libpdb.d.umn.edu:2443/10.1177/1556264616650>
- River talks: Harmful algae blooms in the estuary with Euan Revie*. (n.d.). Friends of the Lake Superior National Estuarine Research Reserve. Retrieved November 6, 2023 from <https://folsr.org/events/lx6drnncbxi969yzfhndftkayzwrgrf>
- Roy, D. (2008). Asking different questions: Feminist practices for the natural Sciences. *Hypatia*, 23(4), 134–156. <https://doi.org/10.1111/j.1527-2001.2008.tb01437.x>
- Sarathchandra, D., & Haltinner, K. (2020). Trust/distrust judgments and perceptions of climate science: A research note on skeptics’ rationalizations. *Public Understanding of Science*, 29(1), 53-90.
<https://doi.org/10.1177/0963662519886089>
- Savolainen, J., Casey, P. J., McBrayer, J. P., & Schwerdtle, P. N. (2023). Positionality and its problems: Questioning the value of reflexivity statements in research. *Perspectives on Psychological Science*, 1-10.
<https://doi.org/10.1177/17456916221144988>
- Sea Grant: University of Minnesota*. (n.d.) University of Minnesota. Retrieved November 4, 2023, from <https://seagrants.umn.edu>
- Sea Grant: University of Wisconsin*. (n.d.). University of Wisconsin. Retrieved November 4, 2023, from <https://www.seagrants.wisc.edu>
- Somani R. (2023). Global Warming in Pakistan and its impact on public health as viewed through a health equity lens. *International Journal of Social Determinants of Health and Health Services*, 53(2):154-157.
<https://doi.org/10.1177/27551938231154467>

- South St. Louis Soil and Water Conservation District (n.d.). *St. Louis River, One Watershed, One Plan*. Retrieved October 31, 2023, from <https://www.southstlouisswcd.org/1w1p/>
- Springgay, S. & Truman, S. (2018). *Walking methodologies in a more than human world: Walking-lab*. Routledge.
- Stack, S. (2013). Science education, integral inquiry, transformation and possibility. *Cultural Studies of Science Education* 8, 521–527. <https://doi.org/10.1007/s11422-013-9525-4>
- St. Louis River AOC. (2023, September 21). U.S. Environmental Protection Agency. <https://www.epa.gov/great-lakes-aocs/st-louis-river-aoc>
- St. Pierre, E. A. (2011). Post qualitative research: The critique and the coming after. *The Sage handbook of qualitative research*. 611-625.
- Subramani, S. (2019). Practising reflexivity: Ethics, methodology and theory construction. *Methodological Innovations*, 12(2). <https://doi.org/10.1177/2059799119863276>
- Svarstad, H., & Benjaminsen, T. A. (2020). Reading radical environmental justice through a political ecology lens. *Geoforum*, 108, 1-11. <https://doi.org/10.1016/j.geoforum.2019.11.007>
- The stories and the science*. (n.d.). St. Louis River Estuary. Retrieved November 5, 2023, from <https://www.stlouisriverestuary.org/about.php>
- Tilbury, D., & Wortman, D. (2008). How is community education contributing to sustainability in practice? *Applied Environmental Education & Communication*, 7(3), 83-93. <https://doi-org.libpdb.d.umn.edu:2443/10.1080/15330150802502171>
- Todd, Z. (2016). An Indigenous feminist's take on the ontological turn: 'Ontology' is just another word for colonialism. *Journal of Historical Sociology* 29(1). <https://doi.org/10.1111/johs.12124>
- Tuana, N. (2001). Preface. In N. J. Holland & P. J. Huntington (eds.). *Feminist interpretations of Martin Heidegger*. Pennsylvania State University Press.
- Tuck, E., & Yang, K.W. (2012). Decolonization is not a metaphor. *Decolonization: Indigeneity, education, and Society*, 1(1), 1-40. <https://jps.library.utoronto.ca/index.php/des/article/view/18630>
- U.S. Fish and Wildlife Service. (2023, October 16). *Fish and Wildlife Service Delists 21 Species from the Endangered Species Act due to Extinction* [Press Release]. <https://www.fws.gov/press-release/2023-10/21-species-delisted-endangered-species-act-due-extinction>

- USGCRP, 2016. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312. <http://dx.doi.org/10.7930/J0R49NQX>
- Voronka, J. (2016). The politics of ‘people with lived experience’ experiential authority and the risks of strategic essentialism. *Philosophy, Psychiatry & Psychology*, 23(3), 189–201. <https://doi.org/10.1353/ppp.2016.0017>
- van Swol, L. M., Bloomfield, E. F., Chang, C., & Willes, S. (2022) Fostering climate change consensus: The role of intimacy in group discussions. *Public Understanding of Science*, 31(1), 103-118). <https://doi.org/10.1177/09636625211020661>
- Vladova, I. (2023). Towards a more sustainable future: The importance of environmental education in developing attitudes towards environmental protection. *SHS Web of Conferences*, 176, 1009-1016. <https://doi.org/10.1051/shsconf/202317601009>
- Williams, A. P., John T. Abatzoglou, Alexander Gershunov, Janin Guzman-Morales, Daniel A. Bishop, Jennifer K. Balch, Dennis P. Lettenmaier (2019). Observed impacts of anthropogenic climate change on wildfire in california. *Earth's Future*, 7(8), 892-910
- Williams, K. J. H., Ford, R. M., & Rawluk, A. (2020). The role of collaborative research in learning to incorporate values of the public in social ecological system governance: case study of bushfire risk planning. *Ecology and Society*, 25(4), 31–43. <https://doi.org/10.5751/ES-11987-250431>
- Williams, O., Sarre, S., Papoulias, S.C. *et al.* (2020). Lost in the shadows: Reflections on the dark side of co-production. *Health Research Policy and Systems*, 18(43), 1-10. <https://doi.org/10.1186/s12961-020-00558-0>
- Wood, L. (2017). The ethical implications of community- based research: A call to rethink current review board requirements. *International Journal of Qualitative Methods*, 16, 1– 7. <https://doi.org/10.1177/160940691774827>
- Yanar, Z.M., Fazli, M., Rahman, J., & Farthing, R. (2016). Research ethics committees and participatory action research with young people: The politics of voice. *Journal of Empirical Research on Human Research Ethics*, 11(2), 122-128. <https://doi-org.libpdb.d.umn.edu/2443/10.1177/1556264616650>

Appendix A: Recruitment Materials

Email soliciting referrals for community participants

Hello, _____

I hope that you are doing well! As you may remember from our previous conversations about the UMD based community-engaged Bioremediation Project, I am looking to explore how people in this area are relating to the environmental science that is happening around them. In pursuit of this aim, I am recruiting a small group of community participants that can help with this project and I am hoping that there might be someone in your community that you think would be a good fit.

If anyone comes to mind that might be interested, please let me know. And if so, can you please share the best way of contacting them?

Also, definitely let me know if you have any questions about this project either before referring anyone or at any point.

Thank You!
Caitlin

Email to (or phone script for) the potential community participants

Hello, _____

I am a UMD graduate student exploring how science works in and for your community. I was referred to you by [Name] from [Name of community organization].

I am hoping to find a few people who would be willing and available to provide insight on science in their community. Specifically, I am hoping to explore what the community knows about the science happening in your area, how people feel about that science and the way that it is being done, and what people's thoughts are about what scientists are focusing on, how the scientific process and results are communicated, and the effect that any of this might have on you personally or on your community.

You do not need to have any pre-existing knowledge of any science or science activities. An underlying objective of this project is to make science work better for the people of this area, so even if you have no idea what science is going on here, that is helpful as well!

If this is something that you are interested in, please let me know. I am hoping to host a lunch or dinner for folks that want to participate and I am looking to get it scheduled sometime in the next couple of weeks.

Thank You,
Caitlin

Email to (or phone script for) the Bioremediation Project team participants

Hello, _____

My research examining people and environmental science in the St. Louis River watershed is underway. I have [# of] community participants that I am working with and am reaching out to see whether you might be interested in being interviewed for the project by one of these community members.

These interviews will give the community participants the opportunity to learn about the researchers working in their community and experience how research works themselves. The community participants will use a set of questions that I have prepared to guide a semi-structured, informal interview. As the researcher on this project, I will be in attendance during the interviews and will record the interview either through a transcription application or through written notes. The information gathered during the interviews will be part of the data used for my thesis.

I expect the interviews will last between 30 and 60 minutes and will be arranged either in-person or virtually depending participant availability.

Please let me know if you are interested and available to participate. I am hoping to get these interviews scheduled during the week of [target dates for interviews].

Thank You!
Caitlin

Appendix B: Information Sheet – Community Participants
INFORMATION SHEET FOR RESEARCH

People and Environmental Science in the St. Louis River Watershed
Community Participants

You are invited to be in a research study of People and Environmental Science in the St. Louis River Watershed. You were selected as a potential participant because you were identified by a community leader and expressed an interest in participating. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Caitlin Hughes-Parry, Environmental Education Masters Candidate, under the supervision of Dr. Elizabeth Boileau, Assistant Professor, College of Education and Human Service Professions, University of MN Duluth.

Procedures:

If you agree to be in this study, we would ask you to do the following things:

- (1) Participate in a focus-group style meeting at which you, the researcher (Caitlin), and 1-4 other participants will discuss your relationship with environmental science in the St. Louis River Watershed. The conversation will involve ways that it might be useful to further explore this issue as well and we will discuss whether you would want to participate in this ongoing inquiry and if so, in what capacity.
 - a. This meeting will likely take 1-2 hours.
 - b. This meeting will be transcribed using audio-recording software.
- (2) Participate in conducting an interview of a pre-identified scientist working on an active environmental science project in the St. Louis River Watershed. You will be given an opportunity to provide input on the interview questions and will be accompanied by the researcher (Caitlin) for the interview.
 - a. This interview will likely take 30-60 minutes and could be conducted in-person, via telephone, or virtually.
 - b. This interview will either be transcribed using audio-recording software or recorded via notes taken by either yourself if you would like or by the researcher (Caitlin).
- (3) Possibly participate in a community event at which a team of scientist will be discussing their work with the public. You would assist with observational data collection at the direction of Caitlin. If you choose to participate in this event, you will be provided with the tools and information necessary to make the observations during the event.
 - a. This event would likely be 1-2 hours.
 - b. Your notes regarding your observations will be collected and retained.

Confidentiality:

During the project, information from this study will be kept private and will be stored securely. Only the research team will have access to information that identifies you. Your identifying information will not be shared with others outside of this research study. However, organizations that may inspect and copy your information include the Institutional Review Board (IRB), the committee that provides ethical and regulatory oversight of research, and other representatives of this institution, including those that have responsibilities for monitoring or ensuring compliance (such as the Quality Assurance Program of the Human Research Protection Program (HRPP)).

Unless otherwise requested, any personal information that could identify you will be removed or changed before we publish any report or share the results or data from this study. Any audio recordings made will be accessible to the researchers (Caitlin and Dr. Boileau) and will be erased once a transcript has been created from the recording.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or with any organization from which you were referred. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researcher(s) conducting this study is (are): Caitlin Hughes-Parry and Dr. Elizabeth Boileau. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Caitlin at the University of MN Duluth, 651-245-0935 or mcnam101@d.umn.edu or Dr. Boileau at (218) 726-8277 or eboileau@d.umn.edu.

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

You will be given a copy of this information to keep for your records.

Appendix C: Information Sheet – Bioremediation Project Team Participants

INFORMATION SHEET FOR RESEARCH

People and Environmental Science in the St. Louis River Watershed
Bioremediation Project Team Participants

You are invited to be in a research study of People and Environmental Science in the St. Louis River Watershed. You were selected as a potential participant because you are a member of the Bioremediation Project team at the University of Minnesota Duluth. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Caitlin Hughes-Parry, Environmental Education Masters Candidate, under the supervision of Dr. Elizabeth Boileau, Assistant Professor, College of Education and Human Service Professions, University of MN Duluth.

Procedures:

If you agree to be in this study, we would ask you to do the following things:

- (1) Participate in an interview conducted by a community member participating in this study. The community participant will use list of questions generated by the researcher to guide the semi-structured, informal interview. The researcher (Caitlin) will be present during the interview.
 - a. This interview will likely take 30-60 minutes and could be conducted in-person, via telephone, or virtually.
 - b. This interview will either be transcribed using audio-recording software or recorded via notes taken by either yourself if you would like or by the researcher (Caitlin).

Confidentiality:

During the project, information from this study will be kept private and will be stored securely. Only the research team will have access to information that identifies you. Your identifying information will not be shared with others outside of this research study. However, organizations that may inspect and copy your information include the Institutional Review Board (IRB), the committee that provides ethical and regulatory oversight of research, and other representatives of this institution, including those that have responsibilities for monitoring or ensuring compliance (such as the Quality Assurance Program of the Human Research Protection Program (HRPP)).

Unless otherwise requested, any personal information that could identify you will be removed or changed before we publish any report or share the results or data from this study. Any audio recordings made will be accessible to the researchers (Caitlin and Dr. Boileau) and will be erased once a transcript has been created from the recording.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota or with any organization from which you were referred. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researcher(s) conducting this study is (are): Caitlin Hughes-Parry and Dr. Elizabeth Boileau. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact Caitlin at the University of MN Duluth, 651-245-0935 or mcnam101@d.umn.edu or Dr. Boileau at (218) 726-8277 or eboileau@d.umn.edu.

This research has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to z.umn.edu/participants. You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

You will be given a copy of this information to keep for your records.

Appendix D: Data Collection Tools

Focus Group Style Meeting - Guiding Questions

1. Tell us a little bit about yourself and why you are interested in participating in this project.
2. What is your personal experience with science?
3. Are you aware of any environmental science happening in your community?
4. Do you think there are any environmental issues that scientist should be looking at in the area?
5. Where would you expect to get information about science projects that are ongoing or their results?
6. Do you think there are better places or platforms for scientists to engage with the public?
7. In your experience, would you or others in your community be interested in learning more about or engaging with environmental science projects in your area?
8. What do you think the benefits could be of more community engagement with science?
9. What do you think some of the challenges might be?
10. Are you interested in being a community participant to help researchers continue exploring this issue?

Interview Questions for Community Participants to Ask Bioremediation Scientists

1. Tell me a little bit about yourself and how you got into science.
2. What does “being a scientist” mean to you?
3. What are some of your main goals in the science that you do?
4. What are some of the biggest challenges you face?
5. Have there been times in your career when you have worked with community members or communicated directly with the community about your work and if so, did you find it valuable and how so?
6. What do you wish the community knew about your work that they might not know?
7. What is one of your favorite projects that you have worked on?
8. If you could have one superpower, what would it be and why?

Observational Data Collection Guide for Community Bioremediation Event

Sometimes we observe things differently and see things we might not have seen if we are asked to present our observations in a particular way. As community observers at the upcoming Bioremediation Project event, based on your observations throughout the evening either draw a picture (or pictures) or write a short story about the evening’s events.

Alternatively, write a short reflective journal entry about your personal experience attending the event as a member of the community. Some guiding questions could be:

Did you feel that the audience represented your community?

Did you feel a sense of belonging or did you feel out of place during the event?

Did you feel heard or that the panelists and other attendees were receptive to your input?

Did the event make you more curious about how science works for and in your community?