Volunteer Participation in Ecological Restoration: Motivations, Organizations, and Conviviality

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

The state of ecosystems worldwide are increasingly dire. Ecological restoration is a practice that has the potential to remedy ecosystem degradation. Engaging people in ecological restoration can help ensure project success, increase community acceptance and spread the practice of restoration beyond professionals. Research that focuses on volunteer engagement has revealed varying motivations for volunteering and a preference for well-organized projects. That research has seldom examined community-led ecological restoration (i.e. voluntary activities not organized by a non-profit). Despite extensive research into volunteer motivation, there remains little consensus on what motivates people to participate in ecological restoration and, accordingly, no clear guidance for practitioners who seek to appeal to motivations. Similarly, while project organization has been identified as an important characteristic, it is not clear what constitutes a well-organized project. By filling knowledge gaps around community participation in ecological restoration, the science and practice can have a cultural impact as well as an ecological one. The UN Decade on Ecosystem Restoration (2021-2030) has a stated goal of creating a culture of restoration. A better understanding of participation can help meet that goal.

This dissertation consists of three studies conducted in order to expand knowledge of volunteer participation. First, a systematic map of the literature on volunteer motivation resulted in a typology of the 15 most commonly studied motivations. Second, a survey of volunteers for nature-based non-profits clarifies project organization and its connection to volunteer engagement. Third, a qualitative case study of a community project operationalizes grassroots ecological restoration, specifically exploring the concept of a convivial community tool. Together they reveal the importance of relationships between volunteers and the ability of interconnected groups to overcome barriers to engagement in ecological restoration.

Engagement is a core principle of ecological restoration, and volunteering is a central means by which communities become engaged in ecological restoration projects. This chapter addressed the question: What are the motivations to participate in ecological restoration projects? The systematic

literature map method was used to answer these questions. The research resulted in a typology of motivations examined by the studies that consists of 15 categories. A network analysis of those categories revealed five core and ten additional motivations that co-occur most in the literature: having a positive environmental impact, acquiring and sharing knowledge, caring for the environment, social interactions and community, and human health and wellbeing. Barriers to volunteering and the demographics of volunteers were also mapped in the literature as they appeared frequently alongside motivations. The five core motivations should be taken as a set of widely studied and well-understood motivations which can inform program design. The systematic map also highlights three major areas for future research: extrinsic motivations, demographics of volunteers who participate in ecological restoration and project organization as a motivation.

Project organization is an under-studied but important aspect of motivation to participate in ecological restoration that contributes to long-term engagement in restoration. Early studies on volunteer commitment recognized people are more engaged in well-organized projects, but there is a lack of understanding around what aspects of project organization are tied to volunteer engagement. One framework links performance of community-based initiatives to three aspects: social capital, transformational leadership and organizational capacity. We tested and extended that framework using a survey of volunteers for ecological restoration and conservation projects in Ontario, Canada. Volunteer engagement is a primary goal of many nature organizations. Social capital was most strongly correlated with volunteer engagement. A path analysis of four latent variables resulted in a model that shows transformational leadership ($\beta = 0.37$; $P < 0.001$) and organizational capacity ($\beta = 0.297$; $P < 0.01$) are strongly correlated with social capital, which in turn is correlated with volunteer engagement ($\beta = 0.653$; $P < 0.01$). Practitioners seeking to improve the engagement of their volunteers should emphasize building social capital to enhance volunteer engagement in community-based initiatives.

The majority of restoration research focuses on professional practices rather than community-led initiatives. As a result, there is little understanding of how laypeople engage in ecological restoration.

Native plant gardening is growing in popularity as a means of addressing the degradation in urban landscapes, but it remains in opposition to the norms of wider society, and particularly the horticultural industry. The Ottawa Wildflower Seed Library is an organization that is trying to change the norm by supporting native plant gardeners with free seeds, advice and a supportive community. We expand and adapt Illich's 'convivial community tool' to ecological restoration through a case study of the seed library. A convivial community tool is an approach to providing a tool (e.g. native seeds) that emphasizes accessibility rather than restricting who can access the tool. Through semi-structured interviews, participants discussed themes including accessibility, community and emergence. By focusing on accessibility, the seed library distinguishes itself from other non-profits with similar missions.

This dissertation contributed knowledge on community engagement in ecological restoration, adding to the field's understanding of volunteer motivations, project organization and grassroots action. Taken together, these papers reveal the importance of relationships to restoration outcome and outline a convivial approach to restoration practice. This research will help practitioners engage more people in ecological restoration, which will ultimately result in increased project success.

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Dedication

All of this is for Ollie and his sibling(s) to come, so that they may grow up to know a world rescued from the brink of collapse by community action.

Table of Contents

List of Figures

List of Tables

Chapter 1 Introduction

This chapter introduces the rationale and objectives for the research described in this thesis. I discuss ecological restoration as a community practice, volunteer motivation, project organization and explore a theoretical approach to grassroots restoration associations. This chapter provides detail on the research approach of this thesis, outlining the methodologies and methods used in each research paper. Finally, there is a summary of the organization of this dissertation.

1.1 Rationale and objectives

This research examines community involvement in practice of ecological restoration by investigating the motivations of volunteers, organizational structure and potential for restoration to be a convivial community tool. Ecological restoration itself is defined as the process of assisting the recovery of ecosystems that have been damaged, degraded or destroyed (Gann et al. 2019). The process of ecological restoration involves enhancing the ecological integrity of an area through actions like planting, seeding and invasive species control (Clewell & Aronson 2007). The practice of restoration is based on four principles: 1) that ecological restoration enhances ecological integrity, 2) that it considers the past and future, 3) that it is sustainable and 4) that it benefits and engages people (Suding et al. 2015). Ecological restoration projects can occur over large scales, such as in landscape restoration, or small scales, such as in native garden planting. Community engagement is important to restoration success, and including local communities in restoration projects can address factors that lead to the failure of restoration projects (Fox & Cundill 2018). This thesis reveals the core motivations for people to participate in restoration, the importance of social capital in project organization structure and how restoration can function as a convivial community tool.

1.1.1 Ecological restoration as a profession and community practice

Restoration ecology, the science that underpins the practice of ecological restoration, has focused more on biophysical sciences than on social sciences, prioritizing technical knowledge (Murphy 2018;

Perring et al. 2018). As a result, the literature lacks deep discussion of community engagement, particularly around community-led restoration projects. Past research has examined the emergence of community restoration practices in post-disaster environments (Tidball et al. 2018), the effectiveness of specific practices like community-led trapping (Linley et al. 2017) and the potential for community-based restoration to create long-term stewardship (Kittinger et al. 2016). The outcomes of community-led processes are more likely to be supported by the community (Fleeger & Becker 2008). Community-led restoration has the potential to support long-term monitoring of outcomes from ecological restoration projects – a key goal in the field (Gann et al. 2019; Keenleyside et al. 2012; Parks Canada 2008). However, there is a lack of investigation into what can catalyze community-led restoration efforts and build the will and capacity for restoration. Community involvement in ecological restoration can be characterized as top-down (e.g. an organization plans the restoration and volunteers conduct it) or bottom-up (e.g. a community plans and conducts restoration) (Reed et al. 2018). Participation in restoration is commonly studied as a top-down initiative, with organizations planning the restoration project and involving volunteers in its execution. Within restoration projects, there can be tension between project managers and layperson volunteers (Weng 2015).

There is an active, ongoing debate within ecological restoration around whether it is a profession with standards, certifications and formal institutions (Gann et al. 2018) or a community practice, flexible and open to participation (Light & Higgs 1996; Higgs, Harris, Murphy, Bowers, Hobbs, Jenkins, Kidwell, Nik Lopoukhine, et al. 2018). The profession of ecological restoration has evolved since its inception, with its own professional society and academic journal (*Restoration Ecology*). Restoration is now encoded into the legislation of many countries, with degrading industries such as mining and forestry facing requirements to restore the land they damage. In response to this, there are increasing calls for the professional certification of ecological restoration in order to ensure a standardized practice and ensure all who practice it have a certain level of education (Nelson et al. 2017). Certification of outcomes is a key component of restoration governance (Mansourian 2017). The Society for Ecological Restoration has

implemented a certification process that requires four years of education and experience in order to qualify. However, as the profession continues to grow, countless volunteers are engaging in ecological restoration both in professional organizations and through their own initiative (i.e. grassroots) (Reed et al. 2018). There is a growing recognition that political will is a barrier to restoration, and engaging more people in a 'big tent' interpretation of ecological restoration is one way to build the practice (Murphy 2018). More clearly understanding the factors that lead people to participate in ecological restoration, including motivation and project organization, can expand the capacity of restoration practitioners to engage people in the work.

1.1.2 Volunteer motivation to participate

Volunteer motivation is a core element of participation in ecological restoration projects. The psychological functions that drive people to volunteer their time for causes are studied largely in order to understand how to attract more volunteers (Clary & Snyder 1999; Einolf 2018). The psychological perspective on volunteering focuses on intrinsic and extrinsic factors that motivate individuals to engage in voluntary activity and characterizes those factors as rooted in the mind of the volunteer (Hustinx et al. 2010). However, the sociological approach argues that volunteering is a community activity which should be examined by analyzing inward and outward-facing motivations (Yeung 2004). While there is a wide body of research on motivation to volunteer, there is a lack of consensus on whether motivation is psychological, sociological or some combination of both (Hustinx et al. 2010). Some motivations may be common to all volunteer activity, but can also be specific to the activity (Clary & Snyder 1999). This suggests that studies of ecological restoration and conservation may reveal unique motivations.

Within ecological restoration, motivation to volunteer has been studied through quantitative surveys (Bruyere & Rappe 2007; Asah & Blahna 2013; Miles et al. 1998) and through qualitative interviews and case studies (DiEnno & Thompson 2013; Reid et al. 2011; Weng 2015). While environmental motivations are important, surveys have found that volunteers express social-psychological motivations more frequently, suggesting that making friends and building relationships may be as

important as working for a cause that is important to them (Asah & Blahna 2013). Interviews with volunteers for a nature organization found that they experienced both pleasure-related emotions (e.g. feeling good about restoring degradation) and responsibility-related emotions (e.g. feeling an obligation to reverse degradation) when volunteering (DiEnno & Thompson 2013).

Motivations change over time for nature organization volunteers: helping the environment and learning may get volunteers in the door, but motivations related to social factors and project organization are predictors of long-term commitment to a project (Ryan et al. 2001). However, while there has been wide study on volunteer motivations in ecological restoration, it lacks consensus on what the main motivations may be. This is challenging because motivation acts as a mediating factor between labour's characteristics and satisfaction, meaning that restoration volunteer managers may benefit from a clear understanding of the motivations of volunteers (Millette & Gagné 2008).

Evidence-based management of volunteers requires an understanding of the specific nature of the volunteer task at hand and its idiosyncrasies, such as the nature of the activity and its goal (e.g. physical labour versus knowledge work) (Einolf 2018). In the case of volunteering for ecological restoration, much has been studied but little synthesis has been conducted. Motivations studied in the literature vary widely which presents a challenge for practitioners looking to improve their work. In order for practitioners to make good use of the information, some synthesis is required (Field et al. 2014). While volunteer motivation is not monolithic and varies depending on individuals, an understanding of the most significant motivations can help in the construction of volunteer activities (Asah & Blahna 2013). This thesis addresses the main motivations as studied in the literature and contributes a typology of those motivations, developed through a systematic map.

1.1.3 The appeal of project organization

The organization and management of volunteer projects is connected to their efficacy (Einolf 2018). Organizations have the ability to enable effective restoration, but there is a lack of research into project organization within restoration ecology (Galatowitsch 2023). Organizations driven by volunteer

work are studied under the umbrella of 'voluntaristics' – a field in the social sciences that studies the nature and dynamics of voluntary organizations (Horton Smith 2016). Within voluntaristics, both formal non-profits and informal grassroots associations are studied (Smith 2000). However, despite this research, there is not a unified perspective on the organizational structure of volunteer organizations. A systematic review of community-based initiatives, many of which rely on volunteers, found several factors associated with performance in the research (i.e. whether the initiative achieved its goals): transformational leadership, social capital, organizational capacity and government support (Igalla et al. 2019). Further research validated that framework and connected it to performance using a survey (Igalla et al. 2020). The framework that emerged from this synthesis, and its subsequent validation, illuminate how volunteer-driven organizations like non-profits achieve their goals. However, when volunteer engagement is a part of the goal, it is not clear which of the factors identified affect engagement and in what combination.

While project organization appears frequently in the restoration ecology literature as a primary motivation, it is not clear what defines good project organization from the perspective of volunteers. Project organization has been identified as an important factor in the long-term commitment of volunteers from their perspective, though it is not clear how they are defining it (Ryan et al. 2001). Divers who participate in invasive lionfish control reported that a "well-organized project" was part of their motivation to participate, which suggests that the appearance of organization is significant for motivation (Carballo-Cárdenas & Tobi 2016). Finally, a large survey of volunteers for the Texas Parks and Wildlife Department ranked project organization ahead of social and career motivations for volunteering (Ding & Schuett 2020). Guidance from practitioners on volunteer management recommends identifying and supporting leadership (i.e. transformational leadership), providing the proper tools and knowledge (i.e. organizational capacity) and creating spaces for volunteers to relate to one another (i.e. social capital) (Packard 2017).

Given the similarities between practical experience in ecological restoration volunteer management and the community-based initiatives framework developed by Igalla (2019), I argue that the framework should be applied to restoration organizations. Volunteer engagement fulfills one of the four proposed principles of restoration put forth by Suding et al. (2015) – that restoration is engaging. Participation by local volunteers can lower costs for restoration projects and increase acceptance by the surrounding community (Daniels et al. 2014; Baker 2017). A successful application of the community-based initiatives framework can provide a new understanding of the essential elements that condition the performance of such initiatives, including both volunteer engagement and project success (Edelenbos et al. 2020).

1.1.4 Restoration as a convivial community tool

Participation in restoration is typically studied as a top-down endeavour, with relatively little attention given to grassroots, community-led ecological restoration projects (Reed et al. 2018). This parallels research in voluntaristics, where formal non-profit volunteering tends to be heavily researched and grassroots, informal efforts less so (Smith 2018). However, grassroots associations can bring a measure of creativity and innovation to practices like restoration and can be a counterweight to professionalization. This thesis does not attempt to compare the qualifications or practices of volunteers with those of professional restoration ecologists (i.e. individuals who make their income full-time from the practice). Alternatives to professional practices have been described by the term "convivial community tools" (Bradley 2018; Kozubaev & DiSalvo 2020; Illich 1973). Illich (1973) described convivial community tools as: "… those which give each person who uses them the greatest opportunity to enrich the environment with the fruits of his or her vision. Industrial tools deny this possibility to those who use them, and they allow their designers to determine the meaning and expectations of others," (p. 34). Illich's ideas have been mobilized by community service organizations to provide access to tools and knowledges that are otherwise delivered by industrial capitalism – for example, free bicycle repair workshop space, computer repair, audio recording studio space as implemented by The Working Centre

in Kitchener, Ontario (Mancini & Mancini 2015). While The Working Centre has applied the idea of a convivial community tool across many domains, it has not engaged in ecological restoration. The convivial community tools approach holds the potential to increase social engagement and capacity for restoration which can enhance restoration success (Covelli Metcalf et al. 2017). This continues a long debate in ecological restoration over whether it is a closed definition practice, strictly guided by standards and regulations, or an open practice, flexible in its interpretation and implementation (Light & Higgs 1996).

Illich's notion of conviviality as applied to restoration aligns with Higgs (2003), who outlined a vision of restoration as a processed-based 'focal practice' as opposed to a technocratic device with rigid prescriptions that produces restored ecosystems like widgets on a factory line. Higgs writes:

> "Repairing damage by designing interventions that reconstitute ecological and cultural integrity requires treating ecosystems as things rather than devices. For the ecological restorationist, this entails focal restoration: practices that create a stronger relationship between people and natural process, a bond reinforced by communal experience. A focal restoration is one that centers the world of the restorationist, expresses the commanding presence of nature, and demonstrates continuity between that particular act of restoration and other activities on the landscape. Focal restoration is mindful restoration." (Higgs 2003, p. 242)

While biophysical science is undoubtedly necessary to the techniques used in ecological restoration, in practice a more fluid approach that considers values and local cultural practices may have broader applicability (Cabin 2007). The heterogeneity of ecosystems and cultures means that there may be multiple motivations for engaging in ecological restoration projects (Wyborn et al. 2012). Restoration as a focal practice provides a means for integrating multiple motivations into ecological restoration goals. Upscaling the use of social practices in restoration requires attention to knowledge dissemination, effective techniques and educational capacity (Perring et al. 2018). Under Illich's philosophical

framework, focal restoration is an aligned choice. A rigid, device-centric conception of restoration would be incompatible with Illich's guidance that a convivial tool should allow people to enrich their lives with the fullness of their vision. However, while the philosophical precepts are well-explored, there remains a lack of understanding around how the idea of a convivial community tool is operationalized broadly.

If native plant gardening is considered the tool, can it be made into a "convivial community tool" and what would be required to do so? The answer to this question is key to expanding engagement with restoration and empowering more people to undertake the practice. While there are practical examples of community tools and principles on designing technology with that framework, there is a gap in operationalizing the concept in community-based work like native plant gardening (Mancini & Mancini 2015; Vetter 2018; Voinea 2018). Illich explicitly provided the philosophical underpinnings of the idea rather than a prescriptive guide on how to create such a tool (Illich 1973).

Preliminary studies have highlighted the importance of an organization that supports the use of a tool, particularly by providing space for people to use the tool (Bradley 2018). The idea is still nascent – there is no association of convivial community tools, and little public recognition of the term. As such, preliminary research should focus on examining the phenomenon as it occurs naturally. Conviviality is not only a quality of the tool itself, but also something that must be practiced by spaces or organizations that govern access (Mehra & Rioux 2016). Libraries have been referred to as a 'prototypical community tool' because of their commitment to access to what was once a resource available to the wealthy (i.e. books) (Kozubaev & DiSalvo 2020). An understanding of how an ecological restoration library functions will provide the starting point for a generalized understanding of how a convivial community tool operates and specifically how the concept can be used to more deeply engage people in restoration.

1.2 Research approach

1.2.1 Systematic map of volunteer motivation

Volunteer motivation is widely studied in the ecological restoration literature – so much so that a diversity of findings have emerged. However, not all studies use the same definitions or frameworks to measure the motivations of volunteers. Some researchers take a quantitative approach and survey volunteers, while others use qualitative research methods such as interviews and focus groups. Synthesis of these diverse studies could provide a better understanding of motivation to volunteer in ecological restoration. Knowledge synthesis is a key step in the knowledge-to-action framework, which outlines an approach to make research findings applicable by practitioners (Graham et al. 2006). Knowledge synthesis within the environmental sciences is typically conducted using a systematic map, systematic review or meta-analysis (Pullin et al. 2016). Each technique is capable of synthesizing a selection of literature, and each has benefits and drawbacks depending on the situation.

A systematic map is capable of describing and cataloguing a wide, heterogenous body of literature that uses multiple measurement types or study methods (James et al. 2016). Also known as a systematic scoping review, this type of knowledge synthesis can provide meaningful insights and the basis for further studies. Systematic reviews are more specified and focus on extracting synthesized results from the data rather than cataloging the studies (Macura et al. 2019). Mixing quantitative and qualitative data, and ambiguous definitions, can be challenging for systematic reviews. Meta-analysis is a type of systematic review that relies on statistical analysis and is predominantly used for synthesizing quantitative research (Gurevitch et al. 2018). We selected a systematic map to approach the challenge of synthesizing volunteer motivation since there are varied definitions of motivation, a variety of volunteer scenarios, as well as qualitative, quantitative and mixed-methods studies. A systematic map can extract meaningful insights from heterogenous literature and will highlight productive future directions for research, including future systematic reviews.

1.2.2 Survey on the relationship between project organization and volunteer engagement

Survey research is an effective method for investigating the beliefs and opinions of a group of people and connections between those (Groves 2004). Surveys are used widely in the voluntaristics literature to study motivation to volunteer (Einolf 2018), volunteer commitment (Ding & Schuett 2020), the benefits of volunteering (Asah et al. 2014), and other dimensions of the volunteer experience. The research done in Chapter 3 is concerned with volunteers' perception of what a "well-organized" project entails and how that relates to their engagement. A survey was chosen because this is a subjective question – if a project is well-organized, but the volunteer does not believe it is, their belief would be more likely to affect other interior characteristics like their engagement. Surveys are effective tools to measure the perception of abstract concepts such as social capital, organizational capacity and transformational leadership (Fowler 2014). A web-based survey was chosen because the population being surveyed is dispersed across the province of Ontario, and web surveys allow for rapid deployment and effective response-gathering (Rea & Parker 2014).

Surveys are relied upon to draw conclusions for a larger population because they yield results that can be studied using inferential statistical methods. Likert scales are frequently used to measure latent concepts – things for which there is no objective measure, but are present within the mind of the respondent (Rea & Parker 2014). A Likert scale consists of a statement, and a level of agreement with that statement (e.g. from 1 – strongly disagree to 7 – strongly agree). The data that results from Likert scales is discrete, but statistical methods tend to require continuous data. However, such methods have successfully been validated using ordinal data (Barendse et al. 2015; Robitzsch 2020). Methods like exploratory factor analysis are widely used to analyze survey data in a variety of disciplines (Swierzy et al. 2018; Steele et al. 2006; Gargoum & El-Basyouny 2016). Finally, while individual Likert items are discrete, the latent concepts they measure become continuous when an aggregate score is calculated (Boone & Boone 2012).

1.2.3 Qualitative case study of the Ottawa Wildflower Seed Library

The notion of conviviality and the idea of convivial community tools is still early and has not yet resulted in testable theories. Qualitative case study research is an approach that can yield theoretical insights and develop theory (Løkke & Sørensen 2014). Case study research is appropriate for research questions that contain "how?" or "why?", contemporary events and research that does not require control over behaviour (Yin 2018, p. 38). This approach yields insights applicable to theoretical development rather than knowledge generalizable to a given population. Once several case studies have explored a phenomenon, synthesis of those case studies may be employed to build a comprehensive theory (Hoon 2013). In the case of convivial community tools, there is a lack of widespread awareness and no central repository for such tools, limiting the availability of multiple cases to compare. We conducted a cross-temporal case study to develop the theoretical basis for a convivial community tool.

Research data were gathered through semi-structured interviews. The strategy-as-practice framework asserts that an organization's strategy is made visible through its practices (Jarzabkowski & Paul Spee 2009). Grassroots organizations may not have codified policies, procedures and strategy documents like more formal structured organizations (Smith 2000). The work of participants in a grassroots organization constitutes its 'practices' and contributes to the overall strategy. Semi-structured, one-on-one interviews combined with qualitative coding are an effective way to gather information and extract meaningful insights (Yin 2018; Saldaña 2013). A semi-structured interview uses a list of pre-developed questions but also allows for deviation from that list to explore follow-up questions and delve deeper into the topic being discussed.

1.3 Organization of this dissertation

This dissertation is manuscript-based and contains five chapters. The first chapter is an introduction which outlines the rationale, objectives and research approach for the Chapters 2, 3 and 4. Chapter 2 contains the first research paper and is titled "Motivations for volunteers to participate in ecological restoration: A systematic map." This study is a systematic map of studies that investigated the

motivations of volunteers who participate in ecological restoration projects and reveals five main motivations documented in the literature. Chapter 3 contains the second research paper and is titled "Community-based initiatives and people: Which aspects of project organization affect volunteer engagement?" This research paper reports the results of a survey that investigates the connection between project organization and volunteer engagement. Chapter 4 contains the third research paper and is titled "What makes a convivial community tool? Investigating grassroots ecological restoration." This study reports the results of a qualitative case study of the Ottawa Wildflower Seed Library, a grassroots organization, in order to understand what factors contribute to the operation of a convivial community tool. Chapter 5 is the conclusion to this dissertation. It synthesizes the results of the preceding chapter, discusses limitations and opportunities for future research, and outlines the contributions to knowledge and expected impact made by this dissertation.

Chapter 2 Motivations for volunteers to participate in ecological restoration: A systematic map

2.1 Introduction

Increased participation in ecological restoration by community members can generate interest in and acceptance of restoration, which is needed to increase the scale of restoration work and ensure positive outcomes (Perring et al. 2018). By understanding the motivations of participants, restoration practitioners can conduct restoration that engages the community. Opportunities to participate in restoration can involve communities in the planning and implementation of restoration, increasing engagement with the project and fulfilling one of the four principles proposed to guide the practice (Suding et al. 2015). While it is important to pay staff adequately and support restoration professionals, widespread volunteer participation in ecological restoration alongside paid professionals can offset costs (Daniels et al. 2014). There is a need increase community engagement to support upscaling the practice ecological restoration to confront the scope of biodiversity loss and meet the ambitious goal of the United Nations (UN) Decade on Ecosystem Restoration to create a "culture of restoration" (United Nations 2019).

Community engagement is important to restoration success, and including local communities in restoration projects can prevent projects from proceeding based on untested assumptions about the local community, a factor that can lead to the failure of restoration projects (Fox & Cundill 2018). While there have been some syntheses of biophysical restoration practices (Shackelford et al. 2018; Borkhataria et al. 2017; Follstad Shah et al. 2007), there has not yet been synthesis of the multiple studies which investigate motivation to participate in ecological restoration despite calls to better understand the social dimensions of restoration (Jones et al. 2018; Wortley et al. 2013). Practitioners are encouraged to maximize engagement, and a map of the peer-reviewed knowledge on the motivations that lead people to participate in ecological restoration voluntarily can help achieve that goal.

Motivation is studied in the broader volunteering literature by analyzing the psychological functions served by volunteer activities (Clary & Snyder 1999; Einolf 2018). This approach is consistent with the psychological perspective on volunteering, which focuses on what moves individuals to participate (Hustinx et al. 2010). However the sociological approach characterizes volunteering as a community activity, which demands examination of both inward and outward-facing motivations (Yeung 2004). Volunteering appeals to both intrinsic and extrinsic motivations – participants have some intrinsic motivation to contribute to a public good, but also seek something for themselves, often education or experience (Hustinx et al. 2010). This means that a person may volunteer both out of a desire to do good and for personal advancement. Barriers are often studied alongside motivations as what prevents people from volunteering may be related to what enables it. While broad categories of motivation have been outlined in the Volunteer Functions Inventory (VFI), including values, understanding, enhancement, career, social and protective (Clary & Snyder 1999), motivation is activity-specific. In the case of ecological restoration, motivations studied in the literature vary widely, which presents a challenge for practitioners looking to improve their work. In order for practitioners to make good use of the information, some synthesis is required (Field et al. 2014). This review addresses the following research questions: What are the motivations for volunteers to participate in ecological restoration and how are they interconnected? What are the barriers that prevent volunteers from participating in ecological restoration? What are the demographics (i.e. age, gender, ethnicity, income) of volunteer populations studied in the literature?

2.2 Methods

The goal of a systematic map is to catalog a body of evidence, building a database of information about studies on a given subject (James et al. 2016). Evidence synthesis in environmental studies is frustrated by heterogeneity of methods and measurements (Macura et al. 2019). A systematic map, in contrast to a systematic review, is capable of analyzing evidence that uses different methodologies, populations and evaluations of outcomes (Levac et al. 2010). A systematic map can identify trends in the

literature, knowledge clusters and gaps, but does not synthesize results. The output of a systematic map — the systematic map database — can provide both actionable insights and directions for future research, but does not synthesize findings as a systematic review would (James et al. 2016).

2.2.1 Literature search

The following four databases were searched February 2021: Web of Science, Scopus, Google Scholar and ProQuest Dissertations and Theses Global. The search string was identical for three of the databases (Web of Science, Scopus and ProQuest Dissertations) but modified for Google Scholar due to shorter length requirements.

Search terms were generated through a review of the literature and refined in consultation with an environment research librarian at the University of Waterloo. The following search terms were applied to the title, abstract and keyword search fields in each database:

("restoration ecology" OR "eco* restoration" OR "environment* restoration" OR "habitat restoration" OR "eco* remediation" OR "environment* remediation" OR "habitat remediation" OR "eco* reclamation" OR "environment* reclamation" OR "habitat reclamation" OR "eco* rehabilitation" OR "environment* rehabilitation" OR "habitat rehabilitation" OR "rewild*" OR "re-wild*" OR "reforest*" OR "re-forest*" OR "conservation") **AND** "motiv*" **AND** ("participation" OR "volunt*" OR "engagement" OR "citizen")

These searches yielded 2,058 records after the removal of duplicates.

2.2.2 Screening

Screening criteria focused on studies that can answer the research question and eliminate extraneous studies, such as those that mention volunteering but do not study volunteers (Levac et al.

2010). Studies were included if they met the following criteria, which were selected to ensure that research captured studied the motivations of volunteers:

1) Peer reviewed research or published dissertation.
2) Primary data was gathered.
3) English language.
4) Study subjects are volunteers in active ecological restoration, conservation or citizen science projects.
5) Study specifically examined motivation of those volunteers.

The title and abstracts were manually screened and 1,643 of 2,058 records were excluded for not meeting the inclusion criteria. If there was uncertainty, studies were moved forward to full-text screening. For instance, if an abstract mentioned volunteers but not necessarily motivation, the study moved forward to the full-text screening. The inclusion criteria were applied in the full-text screening of the 415 records that made it through the first stage. During the full-text stage, 331 records were excluded. The most common reason for exclusion was that the studies did not focus on volunteer motivations, but simply included volunteers among the study. A total of 84 records moved forward to the final analysis (Appendix A).

All screening and data extraction was completed using CADIMA, a software platform for systematic reviews and maps. The steps taken were documented according to the RepOrting standards for Systematic Evidence Syntheses in environmental research (ROSES) protocol – an approach to documenting systematic reviews that is tailored to environmental research (Haddaway et al. 2018). This was chosen over PRISMA, which is common in medical research, because ROSES supports multiple methods of analysis while PRISMA is tailored towards quantitative analysis (Haddaway et al. 2018; Moher et al. 2009).

2.2.3 Coding and analysis

Two cycles of coding were applied to the 84 studies identified in the literature search. The first level used initial coding to identify the motivations, barriers and demographics (Saldaña 2013). Initial coding is an open-ended approach to coding that was used to inform preliminary categorization of the motivations, barriers and demographics in the studies. The second cycle employed axial coding, which groups codes around common themes, in order to group the motivations and barriers into categories (Charmaz 2006; Saldaña 2013). Axial coding involved grouping the initial codes around categories that emerged from the data itself. All coding was conducted by the lead researcher using Atlas.ti. Further interpretation was done using Gephi, R and Microsoft Excel.

A network analysis was used to visualize the relationships between the second cycle motivation codes. Network analysis is a technique for visualizing the strength of relationships between items. In this case, it is employed to visualize the strength of relationships between the categories of motivations using a force-directed algorithm. Nodes represent categories and those that co-occur more frequently have edges with greater resistance, pulling the nodes closer together. Force-directed analysis was applied to re-orient the nodes using the Fruchterman-Reingold algorithm (Fruchterman & Reingold 1991). This analysis causes the edges to mimic springs, pulling more strongly-related nodes together and pushing weaker relations to the outside.

2.3 Results

The records contained studies that were quantitative (n = 39), qualitative (n = 20) and mixed methods (n = 25). The most common lead author affiliation was United States (n = 31), followed by United Kingdom (n = 13), Australia (n = 11) and Canada (n = 7). Other countries included the Netherlands (n = 3), South Africa (n = 3), Spain (n = 3), Austria (n = 2), Japan (n = 2), Chile, China, Finland, Germany, Indonesia, Italy, Macedonia, Malaysia and Thailand (all n = 1).

The studies commonly used surveys (n = 61) and interviews (n = 42) (or both (n = 22)) to study volunteer motivation. Less commonly used were focus groups (n = 12) and participant observation (n = 11). Just one study used document analysis. About one third of studies used multiple tools to gather data (n = 30), though the majority relied on just one data collection tool.

2.3.1 Motivations

Table 2-1: A list of 15 motivations studied in the literature.

Code group name	Description	N of studies	Examples
Having a positive environmental impact	Volunteers are motivated by contributing to conservation and science, having a visible impact on the environment and feelings about their need to give back to nature.	61 (72.6%)	Akin et al. 2013; Caissie & Halpenny 2003; Asah et al. 2014
Acquiring and sharing knowledge	Volunteers are motivated by learning about the natural world broadly, gaining specific skills and knowledge, and teaching others.	58 (69%)	Sharma et al. 2019; Currie et al. 2016; Krasny et al. 2014
Care for the environment	Volunteers are motivated by pro-environmental values that they already hold, as well as social norms in the form of traditions or cultural practices.	58 (69%)	Larson et al. 2020; Sakurai et al. 2015; Dunkley 2019
Social interactions and community	Volunteers are motivated by social interactions, being part of a group and engaging with a community.	52 (61.9%)	Currie et al. 2016; Asah & Blahna 2012; Toomey et al. 2020

Health and well-being	Volunteers are motivated by the chance to improve their physical fitness, positive emotions from volunteering and personal growth.	41 (48.8%)	Guiney 2009; Asah & Blahna 2012; DiEnno 2009
Time in nature	Volunteers are motivated by the opportunity to spend time in nature, enhance their connection to the natural world and escape the demands of everyday life.	37 (44%)	Douglas & Rollins 2007; Guiney 2009; Van Den Berg et al. 2009
Career	Volunteers are motivated by enhancing their current careers or gaining skills and experience to switch careers.	25 (29.8%)	Bruyere & Rappe 2007; Dunkley 2019; Pages et al. 2018
Perceived need for action	Volunteers are motivated by being asked to volunteer, perceived threats to the environment and the desire to protect valued natural features.	25 (29.8%)	Ai Lin et al. 2020; DiEnno & Thompson 2013; Hennessey & Beazley 2014
Place-related	Volunteers are motivated by a pre-existing connection to place and can develop a sense of attachment that serves as further motivation for volunteering.	22 (26.2%)	Currie et al. 2016; Measham & Barnett 2008; Mumaw 2017
Recreation and access to special places	Volunteers are motivated by experiences that align with recreational hobbies like birding, provide new opportunities for recreation	20 (23.8%)	DiEnno & Thompson 2013; Thomas et al. 2021; Wright et al. 2015

	and facilitate access to special places.		
Perks and recognition	Volunteers are motivated by perks like access to special places, recognition from the community and staff, and other non-monetary benefits they receive from volunteering.	17 (20.2%)	Caissie & Halpenny 2003; Guiney 2009; Khatimah et al. 2019
Specific species or organism	Volunteers are motivated by caring for a particular species or organism, sometimes as a result of cultural or personal significance.	16 (19%)	Pages et al. 2018; Sharma et al. 2019; Toomey et al. 2020
Activity-specific	Volunteers are motivated by activities that provide immediate gratification, are hands-on and affect organisms or ecosystems they care about.	15 (17.9%)	Pages et al. 2018; Thomas et al. 2021; Weston et al. 2003
Future generations	Volunteers are motivated by the idea of caring for future generations who will inhabit this Earth.	11 (13.1%)	Asah et al. 2014; Ding & Schuett 2020; Ganzevoort & van den Born 2020
Project organization	Volunteers are motivated by projects that are well-organized and use their time effectively.	8 (9.5%)	Bruyere & Rappe 2007; Ding & Schuett 2020; He et al. 2019

The most common motivation in the literature was captured by the code group "having a positive environmental impact" (n = 61). This code group was applied to papers that referred to volunteers being motivated by having a visible impact such as making a contribution to conservation or science, or

physically altering the environment. This code group applied when volunteers were motivated by the outcome of their work rather than describing a feeling. For example, volunteers cutting invasive tree mallow (*Malva arborea*) in Scotland reported satisfaction from the act of removing plants (Pages et al. 2018). In comparison, the motivation group “care for the environment” was used when papers referred to pro-environmental values in the motivation of volunteers, but not necessarily the outcome of their actions (n = 58). Motivations in this category often took the form of personal values or community norms. For instance, volunteers in Japan who felt caring for greenspace was the responsibility of the community were more likely to volunteer (Sakurai et al. 2015). While the two categories are clearly related, “having a positive environmental impact” emphasizes the motivational potential of an immediate visible impact, such as that provided by engaging in ecological work, while “caring for the environment” is more diffuse.

Acquiring and sharing knowledge was used when volunteers reported being motivated both by gaining knowledge and by teaching others (n = 58). These motivations ranged from a general desire for knowledge to a desire to learn about a specific species or ecosystem. For instance, participants in a digital community science platform tracking bumblebees were motivated by improving their bumblebee identification skills (Sharma et al. 2019).

The group "social interactions and community” was applied to studies where volunteers reported being motivated by social interactions, by being a part of a group and engaging with the community (n = 52). For example, volunteers who wanted to build community were more likely to be committed to a conservation project (Asah & Blahna 2013). The code group “personal health and well-being” was used when volunteers reported being driven by their own physical fitness, general positive motivations and personal growth (n = 41). For example, volunteers with the Minnesota Master Naturalist program reported stress reduction, relaxation and exercise as motivators for getting involved (Guiney 2009).

In many studies, spending time in nature was reported as a motivation in and of itself, as volunteers saw the activity as a reason to be outdoors (n = 37). A smaller set of papers reported career-centric motivations from volunteers (n = 25). This code group was applied when volunteers discussed

enhancing or gaining skills relevant to their careers or making a career change. Place-related motivations (n = 22) include a pre-existing connection to the place where restoration and conservation are occurring. Recreation and access to special places was used when volunteers enjoyed the activity as a recreational hobby (e.g. birders who participate in bird surveys) (n = 20). Studies that included recreation as a motivation also mentioned the opportunity to access special places that was afforded by participation in the volunteer activity. Some volunteers were motivated by perks and recognition received as part of volunteering (n = 17). The code group "specific species or organism" was applied to studies where volunteers were motivated by care for a particular species or organism (n = 16). In some cases, this species was of particular cultural or personal significance. The activity-specific motivation code group (n = 15) included codes applied when volunteers reported being motivated by the activity itself, such as those that provided immediate gratification. The code group "future generations" was applied when volunteers reported being motivated by care for children or the world they will inherit. Finally, the project organization motivation code group was applied when volunteers reported that the project being well-organized was a factor in their participation (n = 8).

The co-occurrence matrix shows the number of papers in which two categories occurred together (Figure 2-1). This allows for further analysis that investigates which motivations tend to appear alongside one another in the research.

Figure 2-1: Co-occurrence of motivations matrix

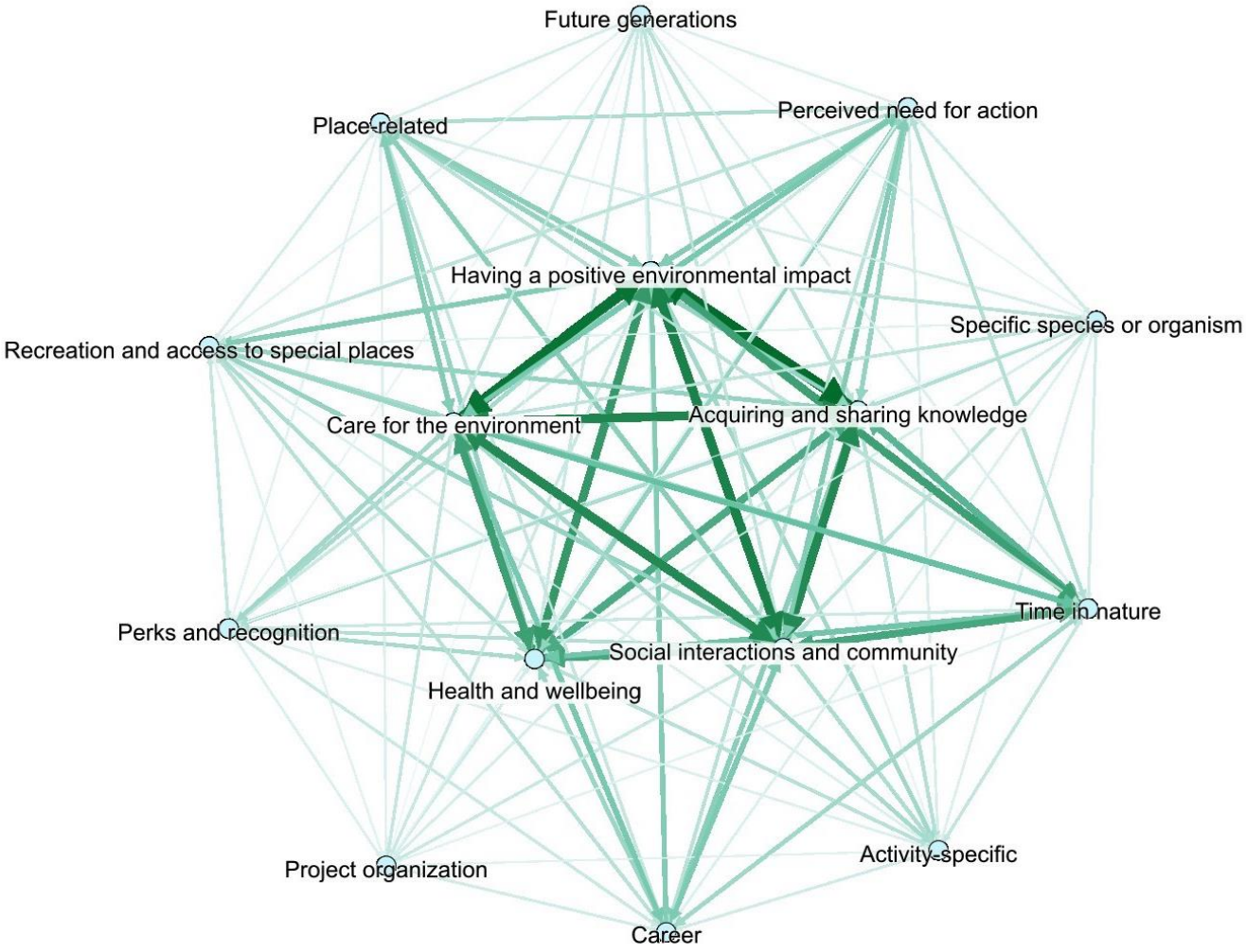
	Acquiring and sharing knowledge	Activity-specific	Career	Future generations	Having a positive environmental impact	Health and wellbeing	Perceived need for action	Perks and recognition	Place-related	Project organization	Recreation and access to special places	Social interactions and community	Specific species or organism	Time in nature	Care for the environment
Acquiring and sharing knowledge	X	11	18	10	47	30	16	12	16	5	16	39	11	27	40
Activity-specific	11	X	6	2	14	10	5	4	5	3	4	12	4	8	13
Career	18	6	X	3	19	15	10	7	8	6	10	20	4	14	21
Future generations	10	2	3	X	7	7	4	2	5	1	3	9	2	4	8
Having a positive environmental impact	47	14	19	7	X	35	19	13	18	7	19	41	10	33	45
Health and wellbeing	30	10	15	7	35	X	16	13	16	6	12	31	5	22	33
Perceived need for action	16	5	10	4	19	16	X	7	12	3	9	19	6	11	21
Perks and recognition	12	4	7	2	13	13	7	X	3	4	8	11	1	7	14
Place-related	16	5	8	5	18	16	12	3	X	4	5	18	5	10	19
Project organization	5	3	6	1	7	6	3	4	4	X	3	7	0	3	8
Recreation and access to special places	16	4	10	3	19	12	9	8	5	3	X	16	3	13	15
Social interactions and community	39	12	20	9	41	31	19	11	18	7	16	X	9	31	39
Specific species or organism	11	4	4	2	10	5	6	1	5	0	3	9	X	6	9
Time in nature	27	8	14	4	33	22	11	7	10	3	13	31	6	X	24
Care for the environment	40	13	21	8	45	33	21	14	19	8	15	39	9	24	X

This table shows the co-occurrence of motivational categories. The number of papers is shown in each square. Squares that are a darker green show higher co-occurrence values.

Visual analysis was used to further analyze the co-occurrence table. We modeled the co-occurrence of motivations using a Fruchterman-Reingold rotation (Figure 2-2), which clusters factors that tend to co-occur more frequently by modelling the relationship between them based on the number of co-occurrences. Motivations that co-occur more frequently have a higher stiffness value, meaning they will be closer together when the modeled force is applied. Nodes that are closer together have a higher number of co-occurrences as reflected in Figure 2-1. The visual analysis revealed five motivational categories with a high degree of co-occurrence between one another: having a positive environmental impact, care

for the environment, acquiring and sharing knowledge, health and wellbeing and social interactions and community. These motivations are frequently studied together and so form a core group of commonly studied motivations, while the remaining 10 motivational categories are less frequently studied together.

Figure 2-2: Co-occurrence of motivations diagram



This diagram uses a Fruchterman-Reingold rotation to show the relationship between motivational categories. The nodes represent the categories and have a repulsive force and edges are modeled as springs, with their resistance calculated based on the number of co-occurrences. The equation for Hooke's Law, F = kx, is used to determine stiffness, where F equals the force required, k is equal to the number of occurrences and x is the distance the spring is deformed. Categories that co-occur less frequently have a lower stiffness measurement and thus are pushed further apart.

2.3.2 Barriers to volunteering

Table 2-2: Barriers to volunteering studied in the literature.

Code group name	Description	N of studies	Examples
Lack of time and energy	Personal and work conflicts around time were one reason for not volunteering.	19 (22.6%)	Hunter 2010; Kaeser et al. 2018; Merenlender et al. 2016
Difficult and costly work	The work of ecological restoration can be physically difficult.	15 (17.9%)	Richter et al. 2018; Miller 2020; O'Brien et al. 2010
Unaware of volunteer opportunity	Potential volunteers reported not being aware that they could volunteer for a particular project.	11 (13.1%)	Hobbs 2012; Pages et al. 2018; O'Brien et al. 2010
Difficulty reaching site	Remote or difficult to reach sites presented a barrier.	7 (8.3%)	Rinkus et al. 2017; Miller 2020; DiEnno 2009
Poor management	Communications problems between management and volunteers.	6 (7.1%)	Miller 2020; Hennessey & Beazley 2014; Higgins & Shackleton 2015
Implicit or explicit exclusion	Potential volunteers reported being left out of communications or feeling excluded.	5 (6%)	Méndez-López et al. 2015; Hobbs 2012; Rinkus et al. 2017

The barriers to volunteering were reported by some, but not all, papers that were a part of this review. The main barrier to participation reported in the research was a lack of time and energy (n = 19). This code group was applied when volunteers or potential volunteers reported time conflicts that interfered with their volunteering. In some papers, volunteers cited the difficult nature of restoration work as a barrier (n = 15). Some studies found that a lack of awareness of opportunities was a barrier to

volunteering (n = 11). Remote sites or those that were outside of urban areas could present a transportation barrier (n = 7). Poor communication between managers and volunteers was identified as a barrier (n = 6). Potential volunteers reported feeling excluded from projects because of factors like lack of education or their gender (n = 5).

2.3.3 Demographics of study populations

Table 2-3: Demographics studied in the literature.

Code group name	Description	N of studies	Examples
Age	The age of participants was reported.	53 (63.1%)	MacPhail et al. 2020; Athihirunwong et al. 2017; Douglas and Rollins 2007
Gender	The gender of participants was reported.	52 (61.9%)	Domroese & Johnson 2016; Ganzevoort & van den Born 2020; Lucrezi et al. 2018
Economic status	The economic status (e.g. income or employment status) was reported.	42 (50%)	Maund et al. 2020; Wright et al. 2015; Sharma et al. 2019
Race	The race of participants was reported.	18 (21.4%)	Jones et al. 2021; Larson et al. 2020; Van Den Berg et al. 2009
Urban or rural	Whether the participants were from urban or rural areas was reported.	5 (6%)	Sarvilinna et al. 2018; Broun et al. 2009; Hvenegaard & Perkins 2019
Nationality	The nationality of participants was reported.	2 (2.4%)	Atchison et al. 2017; Lucrezi et al. 2018
Place duration	How long participants lived in a place was reported.	2 (2.4%)	Sakurai et al. 2015; Hennessy and Beazley 2014
Politics	The political alignment of participants was reported.	2 (2.4%)	Weston et al. 2003; Larson et al. 2020

The demographics reported in studies included age (n = 53), gender (n = 52), economic status (n = 42), race (n = 18), whether the participant was from an urban or rural area (n = 5), nationality (n = 2), how long participants lived in a place (n = 2) and political alignment (n = 2).

2.3.4 Systematic map database

The systematic map search and screening process resulted in a list of 84 journal articles that discuss the motivation for volunteers to participate in ecological restoration and conservation. That list has been included in Appendix A.

2.4 Discussion

This research mapped the literature on volunteer motivation to answer the following questions: What are the motivations for volunteers to participate in ecological restoration and how are they interconnected? What are the barriers that prevent volunteers from participating in ecological restoration? What are the demographics (i.e. age, gender, ethnicity, income) of volunteer populations studied in the literature? We found that the literature focuses on five core motivations that are both commonly studied and highly interrelated (Figure 2-2): having a positive environmental impact; acquiring and sharing knowledge; care for the environment; social interactions and community; and health and well-being. There were ten motivations less commonly studied and less interrelated. Six barriers emerged from the map: lack of time and energy, difficult and costly work, unaware of volunteer opportunity, difficulty reaching site, poor management, and implicit or explicit exclusion. The demographics categories that tended to be reported were age, gender, economic status, race, urban or rural, nationality, duration lived in a place, and political alignment.

2.4.1 A typology of motivation

The 15 motivations documented by this systematic map form a typology of volunteer motivation for ecological restoration and conservation. The typology contains motivations in four broad groups: environmental, personal growth, obligation and enjoyment. Environmental motivations include place-

based motivations, spending time in nature, having a positive environmental impact, caring for the environment and attachment to a species or organism. These motivations are connected to the environmental nature of the work of restoration and conservation volunteering, while personal growth motivations may be satisfied by non-environmental volunteering. That distinction can be further broken down into intrinsic (i.e. the volunteer is rewarded by internal feelings) and extrinsic (i.e. the volunteer is rewarded by the external world) motivations (Bénabou & Tirole 2003).

Table 2-4: A typology of environmental volunteer motivations

	Intrinsic	**Extrinsic**
Environmental	Time in nature	Having a positive environmental impact
	Care for the environment	Place-related
	Specific species or organism	
Personal growth	Acquiring and sharing knowledge	Career
	Health and well-being	Social interactions and community
Obligation	Future generations	Perceived need for action
Enjoyment	Activity-specific	Recreation and access to special places
		Perks and recognition

Typologies such as the one proposed in this paper can be valuable analytical tools in the social sciences which can enable conceptual creativity and analytical rigour (Collier et al. 2012). Two-dimensional typologies (Table 2-4) provides 8 unique combinations (e.g. Intrinsic-Environmental) that can be further explored using the individual motivations (e.g. time in nature). While the intrinsic-extrinsic dichotomy has been criticized for being too simplistic, the addition of the categories of environmental, personal growth, obligation and enjoyment motivations creates a matrix which deepens the description (Reiss 2012).

Many of the motivations revealed by this map are served directly by the activities typically involved in ecological restoration. For example, removing invasive species has a visible positive environmental impact, can be an outlet for care for the environment, involves acquiring and sharing knowledge and is physical work that contributes to health and wellbeing (Pages et al. 2018). Some, particularly those that are described as extrinsic motivation, require facilitation to implement. For instance, program managers must decide to offer access to special places for volunteers.

Five motivations form a set for which there is abundant evidence in the literature: having a positive environmental impact, care for the environment, health and wellbeing, acquiring and sharing knowledge, and social interactions and community. The interconnectedness of all motivations was analyzed by constructing a co-occurrence matrix and conducting network analysis on the code categories. Co-occurrence means that these motivations are often studied together, which may signal that they are connected in some way, or can be served by one activity.

2.4.2 Barriers to volunteering

A set of barriers was also uncovered that includes six categories of barriers: difficult and costly work; unaware of volunteer opportunity; difficulty reaching site; poor management; implicit or explicit exclusion. Barriers are things that prevent people from volunteering, and as such can be difficult to study since those who experience the greatest barriers are unlikely to volunteer. Barriers are often case specific and may be imposed by project leaders – for example, a study of local populations in six communities in southern Mexico reported some people felt excluded because of a lack of education and some sectors were deliberately excluded from participation by project managers (Méndez-López et al. 2015).

Three of the reported barriers – lack of time and energy, difficult and costly work, difficulty reaching site – are likely to be present in restoration and conservation projects regardless of the quality of management. The work is often physical and may require an investment of tools or time, and sites may be distant from urban centres. The broader volunteer engagement literature revealed three common barriers based on data from a national survey: lack of time, lack of interest and ill health (Sundeen et al. 2007).

While this systematic map did not uncover ill health as a barrier, it is clear that someone's personal health and capabilities would have some bearing on whether the work and difficulty reaching the site are major barriers to participation. One approach to studying barriers captured by our systematic map interviewed people who participated in naturalist training programs but did not progress to volunteering. Interviewees said the primary barrier was lack of time (Merenlender et al. 2016). Future research into barriers may require novel methods to survey or interview people who have not volunteered.

2.4.3 Demographics of volunteers

There were eight demographic categories commonly studied: age, economic status, gender, nationality, politics, race, urban or rural. 71.4% (n = 64) of the papers included discussed demographics in some way. Where the race of volunteers was surveyed and reported on, volunteers tended to be mainly white (e.g. M. S. Jones et al., 2021; Larson et al., 2020; Van Den Berg et al., 2009). One paper surveyed 3,041 citizen science volunteers across the United States and found that 97 per cent identified as white (Larson et al. 2020). Gender was among the more frequently reported categories of demographics, and it may be possible to do a meta-analysis of the gender of volunteers in a future study. There were papers where the majority of volunteers were women (Domroese & Johnson 2016; Markus & Blackshaw 1998; Martin & Greig 2019) and ones were the majority of volunteers were men (Ganzevoort & van den Born 2020; Lucrezi et al. 2018; McSkimming & Berg 2008). While some papers reported a higher incomes among their volunteers earners (Domroese & Johnson 2016; Maund et al. 2020; Wright et al. 2015) others reported a wide spread of incomes (Guiney 2009; Niemiec et al. 2018; Sharma et al. 2019), or even lower incomes (Rinkus et al. 2017) than the general population. These findings suggest a future direction for research which could examine the demographics of volunteers and barriers preventing unrepresented populations from participating in volunteer ecological restoration activities.

2.4.4 Directions for future research

While the systematic map can provide an overview of the findings in terms of motivation, it should not be taken as a commentary on which motivations are most significant. Volunteers almost never have a singular motivation, but rather are acting on multiple motivations simultaneously (Athihirunwong et al. 2018; Ganzevoort & van den Born 2020; Jones et al. 2021). A systematic map is not designed to provide such a synthesis, but instead to catalog the available evidence and point the way for future research (James et al. 2016).

The findings of this systematic map also matched up with the Volunteer Functions Inventory (VFI), which postulates that motivations to volunteer serve six psychological functions: values, understanding, social, career, protective and enhancement (Clary & Snyder 1999). A meta-analysis of studies that use the Volunteer Functions Inventory may yield a clearer picture of the prevalence of motivations among environmental volunteers.

One motivation did not fit into the typology: project organization. Project organization is important because it has been identified as a key component of volunteer commitment to projects (Ryan et al., 2001). Volunteers who experience this motivation report that they like to be part of a program that uses their time well (Bruyere & Rappe 2007). Established projects that have experienced leadership and well-developed goals can serve this motivation (Ding & Schuett 2020). Contrary to this background and our expectations, project organization only appeared in eight studies, despite being highlighted as a key component for volunteer commitment. The lack of representation of studies that look at project organization as a motivation suggests that future research into volunteer motivation in ecological restoration should closely consider project organization. While some papers surfaced a general understanding of project organization, there is an opportunity to explore, in detail, how project organization is connected to volunteer engagement.

2.5 Conclusion

Motivation is a key area of knowledge to enable the upscaling of ecological restoration through participation. A deeper understanding of the motivations that drive volunteers can help practitioners understand how to attract and retain volunteers for ecological restoration projects. This systematic map documented a typology of fifteen motivations for participating in ecological restoration and highlighted five among those that co-occur most frequently. This typology provides an answer to the question of what motivates volunteers to participate in ecological restoration projects. By embracing the typology when developing, marketing and executing volunteer ecological restoration projects, practitioners can enhance the engagement of volunteers in those projects.

Chapter 3 Community-based initiatives and people: Which aspects of project organization affect volunteer engagement?

3.1 Introduction

Volunteer participation in ecological restoration and conservation is both a means of accomplishing stewardship goals and enhancing nature engagement, but research into volunteering tends to focus on motivation rather than other factors that may condition engagement (Molsher & Townsend 2016). Volunteer engagement in particular is a core goal of ecological restoration as it has the potential to reduce the cost and increase the impact of restoration (Suding et al. 2015). Increasing participation is essential in order to increase restoration and achieve the goals of the UN Decade on Ecosystem Restoration (Fischer et al. 2020). Volunteer participation in restoration results in restoration projects that are seen as more legitimate and experience reduced conflict (Baker 2017).

Volunteers who are committed to projects cite project organization as a core motivation, which suggests that organizational factors are important to volunteer engagement (Ryan et al. 2001). However, despite project organization being cited as a significant motivation, what constitutes good project organization in the eyes of volunteers has not yet been explored in the literature. Knowledge of how organizational function affects ecological restoration has been described as a key determinant in restoration as a viable strategy to improve ecosystem services (Galatowitsch 2023). For example, interviews with divers who participate in invasive lionfish control found that a "well-organized project" formed part of their motivation to participate (Carballo-Cárdenas & Tobi 2016). A survey of volunteers for the Texas Parks and Wildlife Department ranked project organization ahead of social and career motivations for volunteering (Ding & Schuett 2020). These two cases show the appeal of local project organization but to determine if this is a generally important motivation, we need to determine what constitutes a "well-organized project" from a volunteer perspective.

Community-based initiatives – like environmental organizations that conduct restoration – arise from the self-organization of community members trying to solve problems (Chaskin 2001; Edelenbos et

al. 2018). Many initiatives, including those doing ecological restoration, receive funding and support from governments. Research into the performance of these initiatives, defined as the organization meeting their stated goals, has found that three factors are important for meeting their intended objectives: social capital, transformational leadership and organizational capacity (Igalla et al. 2020) (See Table 3-1 for definitions).

Table 3-1: Definitions of the components of community-based initiatives.

Feature	Definition
Social capital	Social capital refers to networks, norms and trust between volunteers within the organization, with others outside the organization and between the organization and formal institutions. (Igalla et al. 2019; Putnam 2001)
Transformational leadership	Transformational leadership is a leadership style that focuses on making connections between individuals or groups, prioritizing organizational values and directing and inspiring people. (Igalla et al. 2019; Wright et al. 2012)
Organizational capacity	Organizational capacity refers to the ability for the organization to provide the knowledge and resources (e.g. tools, supplies, equipment) volunteers need to accomplish their tasks. (Igalla et al. 2020)

In the case of nature organizations, volunteer engagement itself is often the goal of volunteer programs, therefore the factors that have been found to affect performance should affect volunteer engagement. We conducted a survey to test the relationship between three components of community-based initiatives and volunteer engagement. We surveyed 182 volunteers in community-based ecological restoration initiatives in order to answer the question: What is the relationship between the three factors of community-based initiative performance – social capital, transformational leadership and organizational capacity – and volunteer engagement?

3.2 Methods

A survey was created to answer this research question because surveys are an effective method for discovering linkages between concepts through sampling a large portion of a particular population.

Surveys are effective tools to measure the perception of abstract concepts such as social capital, organizational capacity and transformational leadership (Fowler 2014). A web-based survey was chosen because the population being surveyed is dispersed across the province of Ontario, and web-based surveys allow for rapid deployment and effective response-gathering (Rea & Parker 2014).

3.2.1 Recruitment

A non-exhaustive list of environmental organizations was created through internet searching, by reviewing recipients of grants (e.g. Canada's EcoAction Community Funding Program, TD Friends of the Environment Foundation, Ontario Community Environment Fund), and through consultation with area experts. The survey was sent to environmental organizations across Ontario, a geographic limitation that was chosen in order to standardize the governance context organizations are working in because government assistance has been shown to have an effect on community-based initiatives (Edelenbos et al. 2020). Organizations that had a website and used the word "community" in their mission and vision were included in the distribution list. The organizations contacted were provided with a paragraph of text and an image to include in their volunteer newsletter or to email to their volunteers. Each organization was emailed once, then received a follow-up email two weeks after the initial email. The survey was administered using the online survey platform Qualtrics. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 43278).

3.2.2 Survey development

3.2.2.1 Descriptive questions

Participants were asked which organization they mainly volunteer for, how frequently they volunteer for that organization and how long they have been volunteering there. They were asked which activities they perform, whether they have prior environmental education and whether they have work experience in restoration and conservation. See Appendix B for a full version of the survey.

Participants were asked demographics questions including their gender identity, ethnicity and age in order to more clearly understand the composition of the sample. They were not asked about their household income or employment status as the primary purpose of this survey was not to analyze the demographics of volunteers and excessive questioning about demographic factors may have reduced response rates.

3.2.2.2 Volunteer engagement

Volunteer engagement is a contributor to the performance of community-based initiatives (Edelenbos et al. 2020). A systematic review of volunteer management literature recommends the use of the Utrecht Work Engagement Scale as a common measurement to evaluate the engagement of volunteers (Einolf 2018). Volunteer engagement is defined as the degree to which volunteers report feeling connected to the project's goals and engaged by its activities (Vecina et al. 2012). The success of projects lies in the ecosystems restored; but there is often an emphasis on the goal of participation in ecological restoration to engage people (Suding et al. 2015) and an important desirable outcome of community-led ecological restoration is that people are engaged in the restoration of ecosystems. The Utrecht Work Engagement Scale was adapted for this focus on participation and engagement. Hypotheses that pertain to volunteer engagement are grouped with the elements they relate to below.

<u>Questions that measure volunteer engagement adapted from Schaufeli et al. (2006):</u>

1 to 7 scale of how frequently you feel this way (1 = never, 2 = almost never, 3 = rarely, 4 = sometimes, 5 = often, 6 = very often, 7 = always)

1. During my volunteer work, I feel bursting with energy.
2. During my volunteer work, I feel strong and vigorous.
3. I am enthusiastic about my volunteer work.
4. My volunteer work inspires me.

5. When I get up in the morning, I feel like going to my volunteer work.
6. I feel happy when I am volunteering intensely.
7. I am proud of the volunteer work that I do.
8. I am immersed in my volunteer work.
9. I get carried away when I am volunteering.

3.2.2.3 Community-Based Initiatives questions

Community capacity has emerged in the literature as a way of talking about both community- and organization-scale capacities that enable collective action. Community-based restoration initiatives possess elements of community capacity that enable their actions. The definition of community capacity from Chaskin (2001) is "the interaction of human capital, organizational resources, and social capital existing within a given community that can be leveraged to solve collective problems and improve or maintain the well-being of a given community." This definition underpins later work to develop surveys of community-based initiatives which explore the interactions between human capital, organizational resources and social capital.

Community-based initiatives are emerging in places where citizens organize to solve problems collectively (Igalla et al. 2019). Community-based initiatives are an instance of co-production, the highest rung on Arnstein's ladder of participation (Arnstein 1969). A literature review of community-based initiatives found that the four key components were leadership, social capital, organizational resources and government support (Igalla et al. 2019). Community capacity itself is not a homogenous measurement but a combination of factors (Lempa et al. 2008). In order for this research to be of use to practitioners, it is important to measure components which can be influenced by organizations seeking to build community capacity. Therefore, this study focuses on leadership, social capital and organizational capacity as they can be influenced through workshops and training. Government support, motivation and demographics are fixed within the community and generally out of the hands of organizations trying to

build community capacity, though they remain important factors. By understanding the relationship between community capacity and volunteer engagement, organizations can more effectively advise groups on how to build volunteer engagement.

3.2.2.3.1 Transformational leadership

Leadership may refer to the board of directors of an initiative or to volunteers who perform leadership activities like planning, fundraising and coordination. Leadership style has been found to be related to the performance of community-based initiatives (Edelenbos et al. 2020). Transformational and boundary-spanning leadership in particular were found to be necessary conditions for the success of community-based initiatives in a Qualitative Comparative Analysis of 17 cases (Edelenbos et al. 2020).

Leadership emerged as a significant factor in the development of survey scales for the measurement of community capacity in community-based institutions (Lempa et al. 2008). The scales developed by Lempa et al (2008) measure leadership with questions for both volunteers and leaders. Transformational leadership is defined as leadership that motivates people by appealing to their ideals and values and brings them together for a shared mission (Tucker & Russell 2004). This leadership style has been tied to increased creativity in the workplace (Bin Saeed et al. 2019). This is in contrast to transactional leadership, where leaders focus on bureaucratic standards (Tucker & Russell 2004). Leadership was measured by asking questions of the volunteers in order to gauge their perception of the leadership style.

Hypothesis 1 (H1): Transformational leadership is positively associated with social capital.

Hypothesis 2 (H2): Transformational leadership is positively associated with volunteer engagement.

Questions that measure leadership adapted from Lempa et al. (2008):

1 to 7 scale of agreement (1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree nor disagree, 5 = somewhat agree, 6 = Agree, 7 = Strongly agree)

1. The leadership is motivated by helping others.
2. Volunteers involved with the project trust the leadership.
3. The leadership shows compassion for people.
4. The people involved with the project support the principles or values of the leadership.
5. People involved with the project agree with the leadership's vision.
6. The leadership tries to develop agreement in group decision making.
7. The leadership's vision is clear to people involved with the project.
8. The leadership spells out its principles or values clearly.
9. The leadership follows through on their commitments.

3.2.2.3.2 Social capital

Edelenbos et al (2020) identifies three aspects to social capital, which they refer to as "network structure:" bonding, bridging and linking. Bonding social capital occurs within the organization, while bridging social capital is present between one organization and another and linking social capital is present between an organization and those above it. Studies of meso-scale social capital (e.g. within an organization) have focused instead on three dimensions to social capital: structural, relational, cognitive (Pastoriza & Ariño 2013). Structural social capital refers to the information and resource sharing among volunteers, while relational social capital measures generalized trust among volunteers. Cognitive social capital measures collective goal orientation and the shared vision among volunteers (Pastoriza & Ariño 2013).

Hypothesis 3 (H3): Social capital is positively associated with volunteer engagement.

Questions that measure social capital adapted from Pastoriza & Ariño (2013)

1 to 7 scale of agreement (1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree nor disagree, 5 = somewhat agree, 6 = Agree, 7 = Strongly agree)

1. In our group volunteers engage in open and honest communication with one another.
2. In our group volunteers share and accept constructive criticism without making it personal.
3. In our group volunteers keep each other informed at all times.
4. I can rely on the volunteers I work with.
5. Volunteers in this group show a great deal of integrity.
6. Volunteers have confidence in one another in this group.
7. Volunteers share the same ambitions and vision for this group.
8. There is a commonality of purpose among volunteers in this group.
9. Volunteers view themselves as partners in charting the group's direction.

3.2.2.3.3 Organizational capacity

Organizational capacity is a latent variable that, for the purposes of this survey, includes technical knowledge, access to tools and financial support. The scale developed by Lempa et al (2008) focuses on office space, equipment and funding. The scale used by Igalla et al (2020) includes the number of volunteers and the number of revenue sources as elements of organizational capacity. Questions asked here attempt to capture the volunteers' perception of the adequacy of the training, tools and other resources they need to complete their task.

Hypothesis 4 (H4): Organizational capacity is positively associated with volunteer engagement.

Hypothesis 5 (H5): Organizational capacity is positively associated with social capital.

<u>Questions to measure organizational capacity:</u>

1 to 7 scale of agreement (1 = Strongly disagree, 2 = Disagree, 3 = Somewhat disagree, 4 = Neither agree nor disagree, 5 = somewhat agree, 6 = Agree, 7 = Strongly agree)

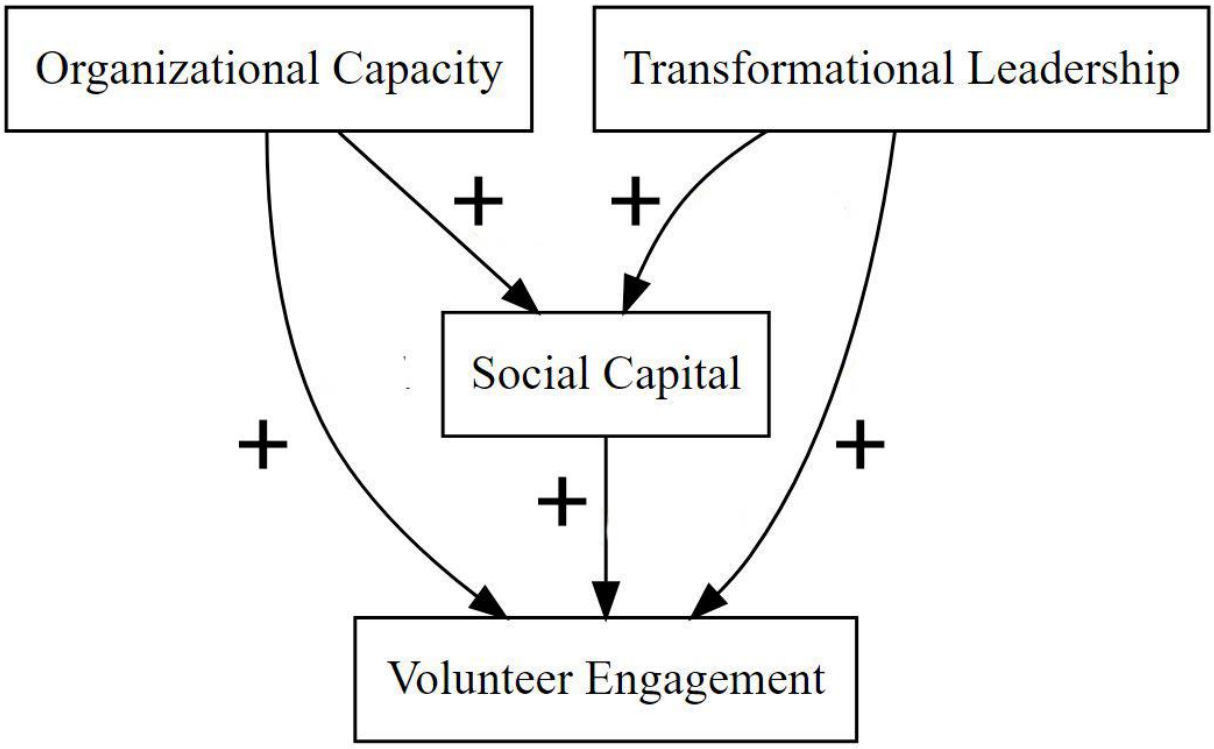
1. I have the technical knowledge needed to complete my volunteer tasks.
2. There is someone I can ask for help if there is something I do not know how to do.
3. I feel confident in my ability to complete volunteer tasks.
4. I always have the tools needed to do my volunteer tasks.
5. There are enough supplies for all the volunteers to complete their tasks.
6. We have an adequate number of tools for the projects we take on.
7. The project knows where it can go for funding.
8. As a volunteer I feel confident the organization will continue receiving funding.
9. I feel confident that my projects will continue to be funded.

3.2.3 Model hypotheses

Our hypothesized model (Figure 3-1) portrays a positive relationship between transformational leadership, organizational capacity and social capital, as well as between transformational leadership, organizational capacity and volunteer engagement. This model shows social capital plays a mediating relationship between organizational capacity and transformational leadership, and volunteer engagement.

> *Hypothesis 6 (H6): Organizational capacity and transformational leadership are positively associated with social capital, which positively affects volunteer engagement.*

Figure 3-1: Hypothesized path model



This diagram shows the hypothesized relationships between the three components of community-based initiatives and volunteer engagement. The plus sign indicates that a positive correlation is hypothesized between the concepts. While arrows are used in the diagram, this study does not claim a directional causality.

3.2.4 Model analysis

Multiple linear regression was used to assess direct relationships between the latent variables. Path analysis, a method of structural equation modeling that identifies the effects of variables on one another through a series of causal pathways, was used to test the model hypothesis (Stage et al. 2004). The technique is a variant of multiple regression that allows for the analysis of correlations between not just two variables but chains of variables linked through a path diagram and equations (Streiner 2005).

The model uses contingent linear regression and can be expressed with the following equations, where *b* is equal to the regression coefficients:

Social Capital = $b_0 + b_1$ (Organizational Capacity) + b_2 (Transformational Leadership)

Volunteer Engagement = $b_{02} + b_3$ (Social Capital)

3.3 Results

3.3.1 Sample size and reliability

There were 182 responses to the survey. Sample size calculations based on the population were not appropriate because the sample frame was limited to a population that fluctuates and is of an unknown size (Hill 1998). When determining an appropriate sample size for an unknown population, the guidance is to allow analysis to determine the minimum sample required (Bartlett et al. 2001).

We performed an exploratory factor analysis and path analysis. There is a wide range of appropriate sample sizes reported in the structural equation modeling literature, from 30 to 460 observations (Wolf et al. 2013). There are two main schools of thought: that the sample ought to be based off the number of parameters (e.g. Kline 2023), and that the sample size ought to be based on the number of latent variables and their indicators (e.g. De Winter et al., 2009). Kline (2023) recommends a guideline of a minimum of 10 cases per parameter, with 20 cases per parameter being an ideal ratio. Our hypothesized model contains 10 parameters, making the sample range 100 to 200 based on Kline's rule of thumb. While the rule of thumb is popular, simulation studies have raised doubts about its efficacy, but such simulation studies result in recommendations for specific models and are not easily generalizable (Kyriazos 2018). Sample size in factor analysis can be determined by the number of factors, variables per factor and factor loadings (De Winter et al. 2009). In the case of this study, we have four factors, a high number of variables per factor (9/*f*), and high average factor loadings (TFL = 0.73; ENG = 0.71; SCAP = 0.61; OCAP = 0.62). The sub-sampling study reported by De Winter et al. (2009) found a sample of 94

cases was sufficient to generate reliable factors with a four factor model. Our sample is sufficient to conduct factor analysis and path analysis.

3.3.2 Descriptive questions

The sample consisted of 93 people who identified as female (51%), 49 who identified as male (27%) and 1 who identified as non-binary. A total of 38 people either left the question blank or indicated they preferred not to say (20.8%). The sample tended to be older, with 73% of respondents (n = 106) reporting they were 56 years old or older.

More than half of respondents (54.1%) reported having some environmental education prior to volunteering (n = 79). However, most respondents (60.9%) reported having no environmental work experience prior to volunteering (n = 89). Respondents performed a variety of activities including administrative work such as fundraising (n = 36), outreach (n = 66) and project planning (n = 62); trail maintenance (n = 58) and ecological monitoring (n = 46); as well as ecological interventions like invasive species management (n = 66), planting seeds (n = 41) and planting nursery stock (n = 53).

Table 3-2: Descriptive question results.

Question #	Question	Results
4	Which organization do you mainly volunteer for?	N = 47
5	How frequently do you volunteer with that organization?	A few times a year: 34 Once a month: 12 2-3 times a month: 19 4-6 times a month: 10 Once a week: 16 2-3 times a week: 28 4-6 times a week: 16 Daily: 12
6	How many years have you been volunteering with that organization?	11 or more years: 39 6-10 years: 29 2-5 years: 55 Less than one year: 23
7	How old are you?	65+: 57 56 to 65: 49 46 to 55: 10 36 to 45: 17 26 to 35: 10 18 to 25: 3
8	What is your gender?	No answer: 27 Male: 44 Female: 84 Non-binary: 1 Captain: 1

9	Which of the following best describes your ethnic background? Please check all that apply.	Indigenous: 1 Other: 7 South Asian: 1 Southeast Asian: 3 West Asian: 1 White: 135 Other responses included: "Prefer not to say", "White Canadian", "Canadian", "West Indian", "Naval academy", "Can you not be black European? Or Asian European?", "mixed black and white"
10	Which activities do you do while volunteering?	Fundraising: 36 Invasive species management: 66 Monitoring (e.g. bird counts, plant surveys, etc.): 46 Outreach: 66 Planting (seeds): 41 Planting (nursery stock): 53 Project management: 51 Project planning: 62 Trail maintenance: 58
11	Did you have environmental education prior to joining this project?	None: 67 Yes, some: 43 Yes, lots: 36
12	Do you have work experience in ecological restoration or conservation?	None: 89 Yes, some: 39 Yes, lots: 18

Respondents reported their frequency and duration of volunteering. Most volunteers reported being involved for more than one year (n = 123) and volunteering on a weekly (n = 60) or monthly (n = 41) basis.

3.3.3 Community-based initiative model analysis

We used a two-step modeling approach to analyze the core questions in the survey (Kline 2023). The two-step modeling approach involves creating a measurement model to verify that the statements load onto the latent variables, then creating a path analysis model to analyze correlations between the latent variables.

Table 3-3: Descriptive statistics for community-based initiatives questions.

Concept	#	Statement	Median	SD
Volunteer engagement	1	During my volunteer work, I feel bursting with energy.	5.29	1.16
	2	During my volunteer work, I feel strong and vigorous.	5.29	1.06
	3	I am enthusiastic about my volunteer work.	6.01	0.93
	4	My volunteer work inspires me.	5.93	1.05
	5	When I get up in the morning, I feel like going to my volunteer work.	5.21	1.36
	6	I feel happy when I am volunteering intensely.	5.67	1.09
	7	I am proud of the volunteer work that I do.	6.31	0.96
	8	I am immersed in my volunteer work.	5.23	1.29
	9	I get carried away when I am volunteering.	4.35	1.64
Transformational leadership	1	The project leadership is motivated by helping others.	5.8	1.00
	2	Volunteers involved with the project trust the leadership.	5.94	1.02
	3	The leadership shows compassion for people.	6.03	1.03
	4	The volunteers involved with the project support the principles or values of the leadership.	6.05	0.86
	5	Volunteers involved with the project agree with the leadership's vision.	5.91	0.98
	6	The leadership tries to develop agreement in group decision-making.	5.62	1.17
	7	The leadership's vision is clear to people involved with the project.	5.85	1.13
	8	The leadership spells out its principles or values clearly.	5.92	1.01
	9	The leadership follows through on their commitments.	6	0.98

Social capital	1	In our group, volunteers engage in open and honest communication with one another.	6.05	0.91
	2	In our group, volunteers share and accept constructive criticism without making it personal.	5.66	1.00
	3	In our organization, volunteers keep each other informed at all times.	5.38	1.18
	4	I can rely on the volunteers I work with.	6.08	0.80
	5	Volunteers in our group show a great deal of integrity.	6.29	0.81
	6	Volunteers have confidence in one another in this group.	6.04	0.89
	7	Volunteers share the same ambitions and vision for this group.	5.96	0.92
	8	There is a commonality of purpose among volunteers in this group.	6.31	0.62
	9	Volunteers view themselves as partners in charting this group's direction.	5.81	1.06
Organizational capacity	1	I have the technical knowledge needed to complete my volunteer tasks.	5.96	0.96
	2	There is someone I can ask for help if there is something I do not know how to do.	6.32	0.86
	3	I feel confident in my ability to complete volunteer tasks.	6.35	0.73
	4	I always have the tools needed to do my volunteer tasks.	5.97	0.99
	5	There are enough supplies for all the volunteers to complete their tasks.	6	0.88
	6	We have an adequate number of tools for the projects we take on.	5.88	0.98
	7	The group knows where it can go for funding.	5.3	1.33
	8	I feel confident that our group will continue to receive funding.	5.53	1.30

	9	Before the pandemic, I had many chances to work with government officials on projects.	3.53	1.56

The data were cleaned prior to analysis by removing responses where none of the questions were answered (n = 39). The remaining dataset had 163 missing values, which were imputed with the mode of the statement response (Boone & Boone 2012; Downey & King 1998). The analysis proceeded with 143 responses.

3.3.3.1 Step 1: Measurement model

Exploratory factor analysis (EFA) was used to analyze the dataset. EFA was used since our scales and statements were derived from the literature and there was not a confirmed direct relationship between those statements and the latent variables (Beaujean 2013, 2014). Factor analysis has been tested on discrete (e.g. Likert item) data using the weighted least squares estimator (Barendse et al. 2015). EFA was used as opposed to Principal Components Analysis (PCA) because the statements and factors are reflective of the concepts they describe, rather than formative (Alavi et al. 2020).

Bartlett's test of sphericity was significant ($p = 2.22 \times 10^{-16}$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was above the threshold of 0.7 (0.82), indicating that the sample was adequate for factor analysis (Shrestha 2021). A correlation matrix (Table 3-4) was generated for the individual Likert statements, revealing clusters of higher correlations among the statements grouped by anticipated factors.

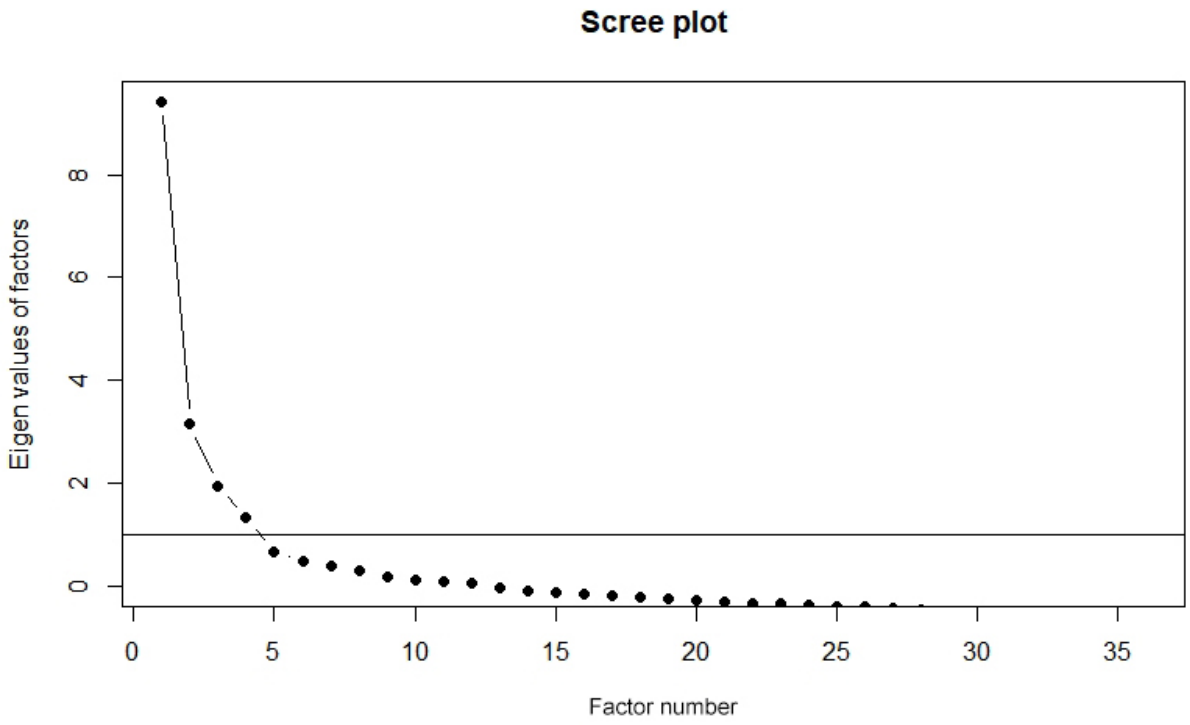
Table 3-4: Correlation matrix for Likert statements.

	ENG1	ENG2	ENG3	ENG4	ENG5	ENG6	ENG7	ENG8	ENG9	TFL1	TFL2	TFL3	TFL4	TFL5	TFL6	TFL7	TFL8	TFL9	SCAP1	SCAP2	SCAP3	SCAP4	SCAP5	SCAP6	SCAP7	SCAP8	SCAP9	OCAP1	OCAP2	OCAP3	OCAP4	OCAP5	OCAP6	OCAP7	OCAP8	OCAP9
ENG1	1.00	0.81	0.52	0.57	0.50	0.53	0.41	0.35	0.28	0.14	0.13	0.11	0.11	0.21	0.10	0.19	0.16	0.16	0.17	0.07	0.10	0.20	0.17	0.17	0.19	0.15	0.13	0.11	0.15	0.27	0.17	0.06	0.10	0.03	0.09	-0.04
ENG2	0.81	1.00	0.52	0.56	0.52	0.58	0.41	0.39	0.31	0.20	0.15	0.15	0.09	0.20	0.08	0.15	0.12	0.16	0.18	0.09	0.11	0.31	0.23	0.22	0.20	0.25	0.16	0.14	0.17	0.22	0.17	0.03	0.08	0.03	0.08	0.03
ENG3	0.52	0.52	1.00	0.75	0.54	0.63	0.62	0.44	0.29	0.18	0.12	0.14	0.17	0.26	0.09	0.14	0.05	0.19	0.22	0.11	0.09	0.31	0.27	0.26	0.27	0.27	0.17	0.12	0.18	0.28	0.19	0.16	0.20	0.07	0.08	0.04
ENG4	0.57	0.56	0.75	1.00	0.61	0.66	0.60	0.48	0.39	0.27	0.23	0.21	0.17	0.31	0.21	0.20	0.14	0.22	0.23	0.15	0.14	0.31	0.23	0.26	0.28	0.27	0.26	0.06	0.19	0.27	0.20	0.09	0.13	0.09	0.08	0.11
ENG5	0.50	0.52	0.54	0.61	1.00	0.67	0.41	0.45	0.29	0.16	0.17	0.09	0.10	0.22	0.06	0.07	0.06	0.15	0.16	0.14	0.08	0.20	0.21	0.18	0.24	0.28	0.20	0.14	0.16	0.30	0.18	0.10	0.18	0.13	0.15	0.08
ENG6	0.53	0.58	0.63	0.66	0.67	1.00	0.53	0.50	0.34	0.17	0.21	0.14	0.16	0.24	0.08	0.16	0.10	0.18	0.24	0.14	0.12	0.37	0.27	0.29	0.26	0.29	0.18	0.14	0.18	0.27	0.23	0.08	0.18	0.14	0.13	0.11
ENG7	0.41	0.41	0.62	0.60	0.41	0.53	1.00	0.49	0.30	0.15	0.20	0.19	0.15	0.22	0.12	0.20	0.11	0.22	0.24	0.18	0.19	0.28	0.36	0.29	0.26	0.37	0.21	0.16	0.16	0.36	0.17	0.13	0.17	0.03	0.08	0.07
ENG8	0.35	0.39	0.44	0.48	0.45	0.50	0.49	1.00	0.51	0.21	0.25	0.23	0.30	0.32	0.25	0.16	0.20	0.26	0.22	0.26	0.18	0.16	0.23	0.24	0.28	0.29	0.27	0.11	0.10	0.19	0.06	0.11	0.16	0.13	0.09	0.10
ENG9	0.28	0.31	0.29	0.39	0.29	0.34	0.30	0.51	1.00	0.18	0.08	0.17	0.11	0.18	0.12	-0.01	0.06	0.09	0.14	0.14	0.11	0.09	0.15	0.08	0.20	0.04	0.02	0.07	0.06	0.11	-0.03	-0.02	0.00	0.05	-0.01	0.04
TFL1	0.14	0.20	0.18	0.27	0.16	0.17	0.15	0.21	0.18	1.00	0.47	0.42	0.40	0.43	0.39	0.36	0.26	0.40	0.27	0.20	0.17	0.22	0.15	0.22	0.18	0.30	0.26	0.07	0.15	0.20	0.18	0.09	0.10	0.07	0.08	0.02
TFL2	0.13	0.15	0.12	0.23	0.17	0.21	0.20	0.25	0.08	0.47	1.00	0.60	0.51	0.58	0.46	0.50	0.46	0.65	0.36	0.23	0.27	0.30	0.29	0.35	0.36	0.43	0.36	0.09	0.31	0.19	0.13	0.14	0.12	0.20	0.19	0.09
TFL3	0.11	0.15	0.14	0.21	0.09	0.14	0.19	0.23	0.17	0.42	0.60	1.00	0.48	0.38	0.42	0.44	0.33	0.66	0.34	0.25	0.30	0.27	0.37	0.31	0.28	0.44	0.33	0.17	0.27	0.24	0.17	0.18	0.16	0.14	0.10	0.04
TFL4	0.11	0.09	0.17	0.17	0.10	0.16	0.15	0.30	0.11	0.40	0.51	0.48	1.00	0.60	0.49	0.53	0.51	0.58	0.32	0.30	0.33	0.28	0.30	0.37	0.37	0.44	0.42	0.05	0.22	0.20	0.26	0.31	0.33	0.15	0.16	-0.03
TFL5	0.21	0.20	0.26	0.31	0.22	0.24	0.22	0.32	0.18	0.43	0.58	0.38	0.60	1.00	0.49	0.55	0.51	0.56	0.35	0.20	0.31	0.30	0.25	0.36	0.41	0.35	0.31	0.11	0.27	0.20	0.25	0.21	0.21	0.21	0.27	0.01
TFL6	0.10	0.08	0.09	0.21	0.06	0.08	0.12	0.25	0.12	0.39	0.46	0.42	0.49	0.49	1.00	0.45	0.48	0.53	0.32	0.35	0.45	0.25	0.27	0.31	0.33	0.34	0.46	-0.04	0.23	0.08	0.14	0.19	0.17	0.28	0.19	0.11
TFL7	0.19	0.15	0.14	0.20	0.07	0.16	0.20	0.16	-0.01	0.36	0.50	0.44	0.53	0.55	0.45	1.00	0.68	0.56	0.36	0.23	0.35	0.27	0.25	0.33	0.34	0.34	0.30	0.04	0.34	0.22	0.22	0.16	0.19	0.10	0.17	0.06
TFL8	0.16	0.12	0.05	0.14	0.06	0.10	0.11	0.20	0.06	0.26	0.46	0.33	0.51	0.51	0.48	0.68	1.00	0.56	0.28	0.23	0.34	0.17	0.18	0.26	0.29	0.32	0.26	0.02	0.30	0.13	0.13	0.10	0.14	0.16	0.16	-0.01
TFL9	0.16	0.16	0.19	0.22	0.15	0.18	0.22	0.26	0.09	0.40	0.65	0.66	0.58	0.56	0.53	0.56	0.56	1.00	0.40	0.26	0.39	0.27	0.26	0.33	0.36	0.47	0.38	0.19	0.34	0.29	0.27	0.25	0.32	0.26	0.20	0.00
SCAP1	0.17	0.18	0.22	0.23	0.16	0.24	0.24	0.22	0.14	0.27	0.36	0.34	0.32	0.35	0.32	0.36	0.28	0.40	1.00	0.60	0.46	0.47	0.53	0.51	0.38	0.42	0.34	0.24	0.29	0.36	0.22	0.24	0.30	0.31	0.30	0.09
SCAP2	0.07	0.09	0.11	0.15	0.14	0.14	0.18	0.26	0.14	0.20	0.23	0.25	0.30	0.20	0.35	0.23	0.23	0.26	0.60	1.00	0.37	0.33	0.43	0.40	0.39	0.33	0.39	0.07	0.18	0.18	0.07	0.12	0.16	0.21	0.14	0.04
SCAP3	0.10	0.11	0.09	0.14	0.08	0.12	0.19	0.18	0.11	0.17	0.27	0.30	0.33	0.31	0.45	0.35	0.34	0.39	0.46	0.37	1.00	0.37	0.38	0.37	0.29	0.28	0.32	0.09	0.25	0.23	0.34	0.33	0.35	0.27	0.29	0.11
SCAP4	0.20	0.31	0.31	0.31	0.20	0.37	0.28	0.16	0.09	0.22	0.30	0.27	0.28	0.30	0.25	0.27	0.17	0.27	0.47	0.33	0.37	1.00	0.63	0.68	0.51	0.50	0.43	0.09	0.36	0.29	0.31	0.32	0.29	0.22	0.22	0.04
SCAP5	0.17	0.23	0.27	0.23	0.21	0.27	0.36	0.23	0.15	0.15	0.29	0.37	0.30	0.25	0.27	0.25	0.18	0.26	0.53	0.43	0.38	0.63	1.00	0.69	0.47	0.61	0.45	0.13	0.34	0.33	0.15	0.29	0.20	0.15	0.20	0.04
SCAP6	0.17	0.22	0.26	0.26	0.18	0.29	0.29	0.24	0.08	0.22	0.35	0.31	0.37	0.36	0.31	0.33	0.26	0.33	0.51	0.40	0.37	0.68	0.69	1.00	0.52	0.61	0.44	0.15	0.35	0.41	0.21	0.27	0.27	0.21	0.14	-0.01
SCAP7	0.19	0.20	0.27	0.28	0.24	0.26	0.26	0.28	0.20	0.18	0.36	0.28	0.37	0.41	0.33	0.34	0.29	0.36	0.38	0.39	0.29	0.51	0.47	0.52	1.00	0.53	0.47	0.06	0.39	0.27	0.16	0.23	0.21	0.22	0.17	0.04
SCAP8	0.15	0.25	0.27	0.27	0.28	0.29	0.37	0.29	0.04	0.30	0.43	0.44	0.44	0.35	0.34	0.34	0.32	0.47	0.42	0.33	0.28	0.50	0.61	0.61	0.53	1.00	0.56	0.13	0.39	0.34	0.19	0.28	0.26	0.16	0.18	-0.02
SCAP9	0.13	0.16	0.17	0.26	0.20	0.18	0.21	0.27	0.02	0.26	0.36	0.33	0.42	0.31	0.46	0.30	0.26	0.38	0.34	0.39	0.32	0.43	0.45	0.44	0.47	0.56	1.00	-0.02	0.25	0.20	0.25	0.29	0.26	0.20	0.24	-0.01
OCAP1	0.11	0.14	0.12	0.06	0.14	0.14	0.16	0.11	0.07	0.07	0.09	0.17	0.05	0.11	-0.04	0.04	0.02	0.19	0.24	0.07	0.09	0.09	0.13	0.15	0.06	0.13	-0.02	1.00	0.26	0.48	0.33	0.24	0.26	0.14	0.14	0.12
OCAP2	0.15	0.17	0.18	0.19	0.16	0.18	0.16	0.10	0.06	0.15	0.31	0.27	0.22	0.27	0.23	0.34	0.30	0.34	0.29	0.18	0.25	0.36	0.34	0.35	0.39	0.39	0.25	0.26	1.00	0.37	0.40	0.41	0.30	0.32	0.29	0.06
OCAP3	0.27	0.22	0.28	0.27	0.30	0.27	0.36	0.19	0.11	0.20	0.19	0.24	0.20	0.20	0.08	0.22	0.13	0.29	0.36	0.18	0.23	0.29	0.33	0.41	0.27	0.34	0.20	0.48	0.37	1.00	0.45	0.35	0.41	0.19	0.24	-0.01
OCAP4	0.17	0.17	0.19	0.20	0.18	0.23	0.17	0.06	-0.03	0.18	0.13	0.17	0.26	0.25	0.14	0.22	0.13	0.27	0.22	0.07	0.34	0.31	0.15	0.21	0.16	0.19	0.25	0.33	0.40	0.45	1.00	0.57	0.60	0.12	0.26	0.04
OCAP5	0.06	0.03	0.16	0.09	0.10	0.08	0.13	0.11	-0.02	0.09	0.14	0.18	0.31	0.21	0.19	0.16	0.10	0.25	0.24	0.12	0.33	0.32	0.29	0.27	0.23	0.28	0.29	0.24	0.41	0.35	0.57	1.00	0.76	0.23	0.31	-0.03
OCAP6	0.10	0.08	0.20	0.13	0.18	0.18	0.17	0.16	0.00	0.10	0.12	0.16	0.33	0.21	0.17	0.19	0.14	0.32	0.30	0.16	0.35	0.29	0.20	0.27	0.21	0.26	0.26	0.26	0.30	0.41	0.60	0.76	1.00	0.34	0.40	-0.03
OCAP7	0.03	0.03	0.07	0.09	0.13	0.14	0.03	0.13	0.05	0.07	0.20	0.14	0.15	0.21	0.28	0.10	0.16	0.26	0.31	0.21	0.27	0.22	0.15	0.21	0.22	0.16	0.20	0.14	0.32	0.19	0.12	0.23	0.34	1.00	0.56	0.17
OCAP8	0.09	0.08	0.08	0.08	0.15	0.13	0.08	0.09	-0.01	0.08	0.19	0.10	0.16	0.27	0.19	0.17	0.16	0.20	0.30	0.14	0.29	0.22	0.20	0.14	0.17	0.18	0.24	0.14	0.29	0.24	0.26	0.31	0.40	0.56	1.00	0.12
OCAP9	-0.04	0.03	0.04	0.11	0.08	0.11	0.07	0.10	0.04	0.02	0.09	0.04	-0.03	0.01	0.11	0.06	-0.01	0.00	0.09	0.04	0.11	0.04	0.04	-0.01	0.04	-0.02	-0.01	0.12	0.06	-0.01	0.04	-0.03	-0.03	0.17	0.12	1.00

The table above shows a correlation matrix for all of the individual Likert statements. A darker shade of green indicates higher correlation between the statements.

A scree plot (Figure 3-2) confirmed that four factors is suitable for this dataset because any further factors have an eigenvalue lower than 1, meaning they explain less than 10% of the variation in the data.

Figure 3-2: Scree plot of factors



The Scree plot above shows the proportion of variance explained by each of the factors. The horizontal line indicates a validity cutoff, where factors with an Eigenvalue less than 1 do not provide sufficient information on the data.

Factor loadings are reported in Table 3-5. An oblique rotation was used rather than orthogonal because oblique rotations permit correlations among factors, and this study is looking for such correlations (Fabrigar et al. 1999; Osborne 2015). Statements that had a factor loading ≥0.4 were included in the composite variable (Cutillo 2019). Cronbach's alpha measure of internal consistency was acceptable for each of the identified factors (Volunteer engagement $\alpha = 0.906$; Organizational capacity $\alpha = 0.786$; Transformational leadership $\alpha = 0.918$; Social capital $\alpha = 0.869$). Composite variables for path analysis were created by summing the response values (Boone & Boone 2012).

Table 3-5: Factor loadings for composite variables.

	compTransfLdr	compEngage	compSocialCap	compOrgCap
ENG1	0.04	0.81	-0.12	0.07
ENG2	0.01	0.8	-0.02	0.02
ENG3	-0.06	0.82	0.01	0.07
ENG4	0.09	0.86	0	-0.08
ENG5	-0.04	0.78	0.03	0.02
ENG6	-0.02	0.8	0.12	0.02
ENG7	-0.04	0.54	0.28	0.06
ENG8	0.15	0.58	0.16	-0.1
ENG9	0.08	0.45	0.06	-0.18
TFL1	0.6	0.08	-0.02	-0.11
TFL2	0.8	0.03	0.07	-0.08
TFL3	0.72	0.01	0.05	-0.09
TFL4	0.78	-0.06	-0.04	0.04
TFL5	0.79	0.16	-0.08	0.03
TFL6	0.7	-0.08	0.2	-0.04
TFL7	0.8	0.03	-0.03	0.06
TFL8	0.69	-0.01	0.03	0.02
TFL9	0.7	-0.04	0.01	0.21
SCAP1	0.15	0.01	0.52	0.17
SCAP2	0.06	-0.06	0.59	-0.06
SCAP3	0.24	-0.1	0.34	0.3
SCAP4	-0.04	0.08	0.65	0.16

SCAP5	-0.09	0.13	0.78	-0.07
SCAP6	0.05	0.06	0.72	0.03
SCAP7	0.12	0.05	0.51	0.05
SCAP8	0.13	0.03	0.6	0.04
SCAP9	0.24	-0.08	0.51	0.08
OCAP1	-0.02	0.21	-0.12	0.49
OCAP2	0.2	0.05	0.19	0.39
OCAP3	-0.01	0.24	0.07	0.56
OCAP4	0.05	0.08	-0.06	0.75
OCAP5	-0.02	-0.11	0.13	0.68
OCAP6	-0.02	-0.02	0.03	0.8
OCAP7	0.22	-0.11	0.17	0.36
OCAP8	0.19	-0.04	0.05	0.42
OCAP9	0.06	0.09	-0.01	0.07

3.3.3.2 Step 2: Path model

Prior to generating the path model, we ran a multiple linear regression analysis on the four composite variables to assess their relationships (Appendix C). Organizational capacity and transformational leadership did not have a significant effect on volunteer engagement, so the direct paths between those variables were removed from the model.

We generated a path model using the R package Lavaan (Rosseel 2012) with the following specified path model:

```
# Directional relations (path)

compSocialCap ~  compOrgCap + compTransfLdr
```

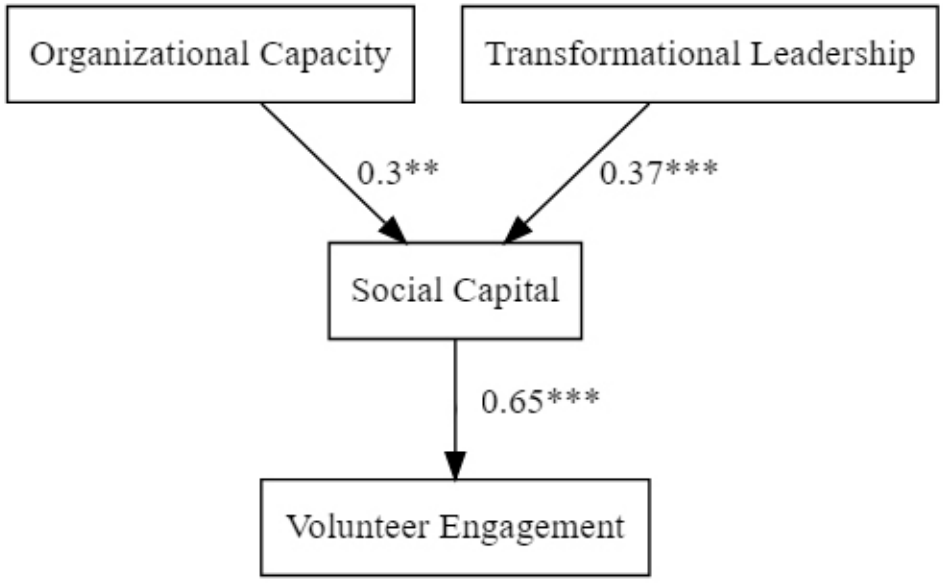
compEngage ~ compSocialCap

Covariances

compOrgCap ~~ compTransfLdr

The goodness-of-fit statistics indicated good model fit: Comparative Fit Index (CFI): 1.000 (>=1); Tucker-Lewis Index (TLI): 1.056 (>= 1); RMSEA: 0 (<0.08); SRMR: 0.030 (<0.05) (Hooper et al. 2008) (Appendix D). Figure 3-3 contains a hypothesized model with the association values. Organizational capacity ($\beta = 0.297$; $P < 0.01$) and transformational leadership ($\beta = 0.37$; $P < 0.001$) were found to be positively associated with social capital. Social capital was found to be positively associated with volunteer engagement ($\beta = 0.653$; $P < 0.01$). Linear regression revealed a statistically significant correlation between organizational capacity and transformational leadership ($\beta = 0.609$; $P < 0.001$).

Figure 3-3: A path model with path coefficients and significance values.



3.4 Discussion

We have found a relationship between organizational capacity, transformational leadership and social capital, and a relationship between social capital and volunteer engagement. Organizational capacity and transformational leadership were positively correlated with each other. We found no significant association directly between organizational capacity, transformational leadership and volunteer engagement.

Hypothesis 3 (H3): Social capital is positively associated with volunteer engagement.

Hypothesis 6 (H6): Organizational capacity and transformational leadership are positively associated with social capital, which positively affects volunteer engagement.

Our model supported Hypotheses 3 and 6– social capital was shown to have a positive relationship with volunteer engagement and to be affected by organizational capacity and transformational leadership. It is noteworthy that social capital appears to have a direct effect on volunteer engagement, but organizational capacity and transformational leadership have indirect effects. The direct association of social capital with volunteer engagement is consistent with other studies: a survey of members of conservation groups in New Zealand found that members of conservation groups reported higher levels of social capital than non-members (Gerolemou et al. 2022). Social capital developed from co-working relationships has been found to affect volunteer satisfaction (Zappa & Zavarrone 2010). The indirect relationship between organizational capacity, transformational leadership and volunteer engagement suggests that informal, social interactions combined with leadership and organizational factors may lead to increased engagement.

This study confirms the applicability of the model developed by Igalla et al (2020) to volunteer engagement. Their original research connected social capital, transformational leadership and organizational capacity to the performance of community-based initiatives (Igalla et al. 2019). Further research has found that government support is also connected to the performance of these initiatives

(Edelenbos et al. 2020). Our research examined volunteer engagement in place of performance in their model and found statistically significant positive relationships, which suggests that this one aspect may also be conditioned by the same factors that affect performance.

Environmental organizations have a specific need for engaged volunteers: the goal of these programs is often more than just accomplishing tasks, it is to increase pro-environmental behaviours and connectedness with nature (Molsher & Townsend 2016). It is important that volunteers are not just committed and productive, but deeply engaged in the work. While the relationship between social capital and volunteer engagement is clear, what is less clear is the directionality of that relationship. Social capital is a significant and important area of research in environmental volunteering. A viable future direction of inquiry may be to determine whether engaged volunteers develop more social capital, or whether volunteers with higher social capital tend to become more engaged.

Our results did not find a significant direct association between transformational leadership and volunteer engagement (H1) but did find a direct association between transformational leadership and social capital (H2). There were similar results for organizational capacity (H4 was not supported; H5 was supported). This result is similar to Mayr (2017), who found that the effect of transformational leadership on the engagement of volunteer firefighters was mediated by group identification and perceived social impact – two factors related to social capital. Our results suggest that the social impacts of transformational leadership affect volunteer engagement, rather than the leadership style directly. The implication is that volunteer restoration activities with a weak social dynamic (e.g. species monitoring in isolation) may be perceived as less engaging despite having transformational leadership. This finding is particularly relevant given the context of the Covid-19 pandemic and ongoing cultural shifts away from communal in-person efforts.

Organizational capacity was found to be significantly associated with social capital but not directly with volunteer engagement. The questions that formed this latent variable focused on the volunteers' perception of having the tools and knowledge to perform the task assigned to them. Given that

tools and knowledge may be provided by their fellow volunteers, it is plausible that organizational capacity was perceived as another dimension of social capital. Research into empirical measures of organizational capacity (e.g. budget, number of paid staff, infrastructure) have been shown to significantly affect volunteer recruitment (Swierzy et al. 2018). An examination of the relationship between number of volunteers and the budgets, staff size and other organizational factors of conservation groups would be a productive area of research.

3.4.1 Further research opportunities

The survey for this study used a Likert scale to measure volunteers' perception of four factors: transformational leadership, organizational capacity, social capital and volunteer engagement. The Likert scale is a subjective measure and measured the perception of volunteers at a given point in time. There may be objective measures for some concepts (e.g. budget as representative of organizational capacity) that could be explored in future studies. For example, researchers used the budget of sports clubs combined with surveys on engagement to assess the role organizational capacity plays (Swierzy et al. 2018). However, in that case (and many others) Likert scale data were still used to measure subjective concepts like volunteer engagement. Future research could implement objective measures of the latent variables (e.g. budget could be used to measure organizational capacity) and volunteer engagement could be compared across different measures. Researchers could also investigate methods (such as incentives for survey completion) to reach volunteers who are minimally engaged, as those volunteers are less likely to commit time to doing a survey.

3.5 Conclusion

This study adapts a framework on community-based initiatives to attempt to explain project organization in ecological restoration volunteer initiatives. Project organization has been identified as an important factor in volunteer commitment (Asah et al. 2014; Ding & Schuett 2020; Ryan et al. 2001). Our results show relationships between three elements of community-based initiatives (transformational

leadership, organizational capacity and social capital) and volunteer engagement. The nature of the relationships suggests that social capital is a crucial component of volunteer engagement, as it mediates the effect of transformational leadership and organizational capacity in our model.

Chapter 4 What makes a convivial community tool? Investigating grassroots ecological restoration

4.1 Introduction

Ecological restoration has the potential to address global biodiversity collapse and create nature-based solutions to climate change, offering communities tangible actions to take in the face of global degradation (Murphy 2018). Much research has been conducted into the professional practices of ecological restoration – principles and standards are debated; practitioners have been surveyed; researchers regularly probe the knowledge-practice divide (Nelson et al. 2017; Dickens & Suding 2013; Clewell & Aronson 2013). While a great deal of ecological restoration is undertaken by communities, neighbourhood groups and private citizens (Watkins et al. 2015; Cruz et al. 2014; Haigh 2016), there is little understanding of how non-professionals engage in ecological restoration. Research that focuses on community members tends to examine volunteers who are part of larger initiatives orchestrated by professional organizations (Asah et al. 2014; Ding & Schuett 2020). There is a need to understand the practice of ecological restoration by non-professionals in order to expand ecological restoration and meet the ambitious promise of the UN Decade on Ecosystem Restoration, which aims to create a cultural shift to support the restoration of ecosystems (United Nations 2019).

The idea of "convivial community tools" has been used to describe efforts that make tools, knowledges and practices open and accessible as a counterweight to professionalization and the restriction of access through capitalism (Bradley 2018; Kozubaev & DiSalvo 2020; Illich 1973). For instance, bike kitchens are communal bicycle repair workshops that allow anyone to access bicycle repair tools and knowledge (Bradley 2018). If native plant gardening is considered the tool, can it be made into a "convivial community tool" and what would be required to do so? While there are practical examples of community tools and principles on designing technology with that framework, there is a gap in operationalizing the concept in community-based work like native plant gardening (Mancini & Mancini 2015; Vetter 2018; Voinea 2018). Illich provided the philosophical underpinnings of the idea rather than a

prescriptive guide on how to create such a tool (Illich 1973). Before it is possible to develop a blueprint, it is important to examine the phenomenon as it occurs naturally. Conviviality is not only a quality of the tool itself, but also something that must be practiced by spaces or organizations that govern access (Mehra & Rioux 2016). This paper investigates the practices that a grassroots association uses to support ecological restoration as a convivial community tool.

We conducted a qualitative case study of the Ottawa Wildflower Seed Library (OWSL) to understand if (and how) a grassroots ecological restoration organization empowers people to engage in the practice, and specifically if (and how) that organization operates as a convivial community tool. Typical urban properties are degraded – there is little native biodiversity, poor linkages between patches of quality habitat and a lack of habitat features on the landscape (Hobbs 2016). Small garden habitats can support a significant population and provide habitat (Soanes et al. 2019). Conventional gardening practices usually involve planting with non-native species and prioritizing turfgrass. Individual property owners make planting decisions that cumulatively degrade ecosystems further, creating a "tyranny of small decisions" (Thompson 2004). Shifting people towards pro-environmental behaviours like native plant gardening requires more than motivation – barriers to the desired behaviour must be lowered or eliminated (McKenzie-Mohr & Schultz 2014). Barriers to the practice of native plant gardening include availability of native plants, specialized knowledge and community support (Beckwith et al. 2022). This study investigated how a community organization helps people overcome those barriers and expands the potential of ecological restoration as a community practice.

4.2 Methods

The Ottawa Wildflower Seed Library is a community project started by Mélanie Ouellette in 2020. It was selected for this research because it combines restoration with a library, which has been called a prototypical community tool (Mehra & Rioux 2016). As a nascent organization, it most resembles a grassroots association because it consists of entirely unpaid volunteers (Smith 2000).

Participants in the seed library communicate with each other through a private Facebook group, where they regularly exchange knowledge and coordinate events.

We examined the practices of the seed library using data collected through one-on-one semi-structured interviews with participants who contributed to the work of the seed library (Appendix G). Two rounds of interviews were conducted to capture a broad range of the seed library's practices, including plant swaps that happen in the spring and seed giveaways that happen in the fall. Interview subjects were recruited through the Ottawa Wildflower Seed Library Facebook group using several postings at different times. Posts were made with the permission of the group administrator on weekday mornings, afternoons and weekend days for maximum visibility. Participants were eligible for an interview if they had any involvement with the seed library, including relatively minor participation such as engaging in the Facebook group or more extensive participation like hosting seed giveaways. Oral consent was recorded for each participant (Appendix E). A modified consent script was used for Mélanie Ouellette, who indicated her consent for being named in this research (Appendix F). Participants were asked to email the lead author, and interviews were scheduled to take place using Zoom. This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB 44185). Mélanie Ouellette agreed to be named in this study.

The interview schedule was developed through a review of the literature on convivial community tools (Vetter 2018; Voinea 2018; Illich 1973). Interview questions were piloted with three subjects who have hands-on experience running grassroots associations and familiarity with the idea of a convivial community tool. The interview schedule contained a series of 17 questions (Appendix G) that were asked about each of the tasks the subject participated in. This approach allowed for a thorough exploration of the dynamics of each practice the seed library requires in order to function. This research takes place at the mesoscale, focusing on aspects of how a grassroot associations is organized, with results that may be transferrable to other associations (Smith et al. 2016). This scale is in between the individual scale (e.g. a study of leadership) and the macro scale (e.g. a study of many organizations).

The resulting interviews were transcribed by TA, using Zoom's automated transcription feature and manually verifying each transcript with the recording. The transcripts were coded using Atlas.ti 9. Initial codes were a combination of *in vivo* codes and created codes (Saldaña 2013). The initial coding phase was followed by axial coding, where the initial codes were grouped together to identify common themes present in the data.

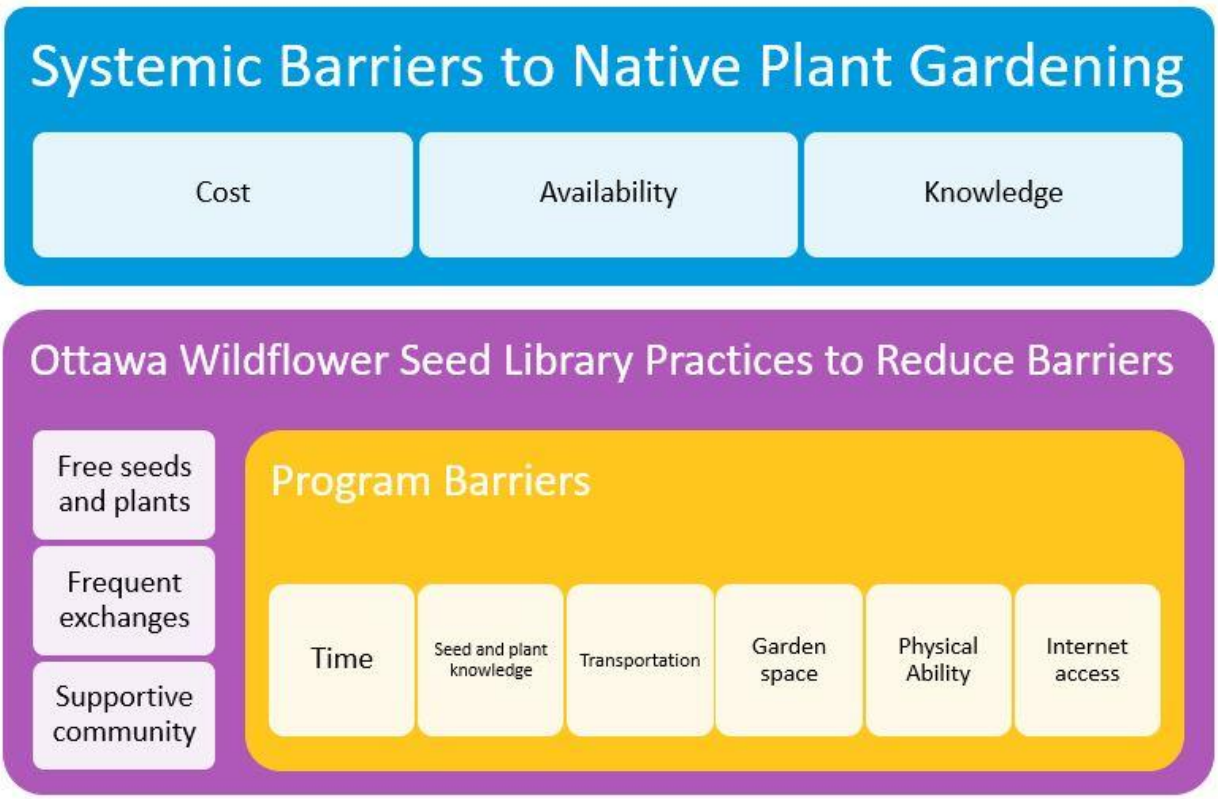
Member-checking is a process of bringing ideas back to participants, allowing them to verify the interpretation and add details where merited (Charmaz 2006). A synopsis of the findings of this research was shared with all interview participants in 2023 (Appendix H), to bolster the reliability of this study by verifying findings with participants who contributed to them (Birt et al. 2016). No participants offered additional information or corrections as a result of this process.

The first round of interviews was conducted in May 2022 and included 18 participants. The second round of interviews was conducted in November 2022, and included 10 total interviews — 6 new participants as well as 4 returning participants (Participants 1, 5, 13 and Mélanie Ouellette). There were a total of 24 unique participants in these interviews, which lasted between 20 minutes and 2 hours. The age of participants ranged from 22 years old to 64 years old, with an average age of 50.4 years old. Many participants were first-time native plant gardeners who became involved with the seed library when they adopted the practice. The initial coding process yielded 988 codes, which were then grouped into 43 code groups through axial coding.

4.3 Results

All participants were asked about the accessibility and barriers of the activities of the seed library, as well as barriers to native plant gardening that the seed library helped them overcome. Two categories of barriers emerged from the data: external systemic barriers to native plant gardening, and internal program barriers.

Figure 4-1: Nested diagram showing the systemic barriers identified by participants in the Ottawa Wildflower Seed Library.



The diagram shows barriers that prevented participants from gardening with native plants, and the seed library sought to help people overcome these barriers. The measures used by the seed library were providing free seeds and plants (overcoming the cost barrier), frequent seed and plant exchanges (overcoming the availability barrier) and a supportive community (overcoming the knowledge barrier). The nested diagram shows additional barriers that exist because of the seed library's programming. Such barriers are addressed through program design choices and community support, but nonetheless exist.

Systemic barriers identified by participants included the cost of native plants, the availability of those species of plants and knowledge about how to grow and care for them.

Table 4-1: Systemic barriers to native plant gardening

Barrier	Attempts to overcome	Example quote
Availability of native plants	• Seed pickups at multiple locations. • Year-round plant exchange facilitated through shared document. • Wide variety of species sought, donated and shared.	"I feel like they're doing a really wonderful service in in Ottawa, because before them, we all knew that accessing native plants was quite difficult and if you're relying on going to a Loblaws Superstore, you're not gonna find what you're looking for. We need to have a service like this where there's the due diligence, there's the knowledge of how to do it ethically, and how to do it locally and small batch, so that it's sustainable." *– Participant 3*
Cost of native plants	• Seeds given away for free. • Growing materials (e.g. pots, screens, soil) donated and shared. • Plant swaps facilitated.	"You get stuff for free and it seems like such a generous thing, because normally, you have to pay for seeds, and it's quite difficult to get native plant varieties. I've went on many fruitless trips to garden centers and stuff, looking for specifically native seeds, and here they are all available to us, and very conveniently too, at different locations across the city in the fall." *– Participant 7*
Native plant knowledge	• Resources posted on Facebook and website.	"I had so many aha moments, and I'm still on my learning curve, but man have I ever learned a lot in the last less than a year and I just want to share that because this is important, and it's easy, it's super easy."

	• Knowledgeable volunteers at seed pick-up events. • Collaboration and knowledge-sharing encouraged.	*– Participant 11*

Program barriers refer to barriers that exist within the programs and activities of the seed library. Participants identified six main barriers that are present to varying degrees in seed library activities: time, seed and plant knowledge, transportation, garden space, physical ability and internet access. Each of the three systemic barriers was addressed by the strategy of the seed library as described by participants who engaged in the organization's practices.

Table 4-2: Internal program barriers.

Barrier	Description	Attempt to overcome	Example quote
Time	Participants expressed that they needed to have free time to be able to participate in seed library events and activities.	Tasks are split into smaller chunks to make them less time-consuming and provide multiple ways for people to engage with the work.	"I didn't feel like I had the time or the means. They were all doing such beautiful little seed packets, so I just chose to do an easier, really time commitment, was purchasing stamps." – *Participant 3*
Seed and plant knowledge	Participants often expressed feeling uncertain about seed sowing or plant identification and said that knowledge could be a barrier to participation.	Information is provided through the Facebook group. Volunteers are present at events provide guidance. Mélanie dedicates one-on-one time to help people get started.	"I'm a bit nervous. I'm not that great of a gardener. Any time they've talked about stratification or all that like it all seems so complicated to me like having to like freeze things or make sure they get really cold, I kind of panic, but i'm hoping that maybe next year, […] my kids will be a bit older, I'll be able to maybe spend a bit more time learning about the process. I don't want to kill all these seeds that somebody else

			might be able to make live. If I end up doing it, I want to do it right." – *Participant 24*
Transportation	Getting to seed pickups and plant events can be a barrier for some participants.	Seed pick-ups are planned throughout the city, in locations accessible by transit. Mélanie offers to mail seeds to those who cannot attend.	"Again, the biggest [barrier] would have been transportation. So the events were held, I think there were five events that were held, and they were all in different parts of the city, so that the idea was, try and make it as accessible as possible to people that they could even just walk up to these things. But in order to participate in them you had to drive to get there." – *Participant 11*
Garden space	In order to grow the plants, participants need access to some sort of outdoor space.	Connecting participants with one another to garden in shared spaces. Providing plants and resources for container gardening.	"You need to have, probably, you need to have your own garden, which means you need to have access to land. Or I suppose it's possible that you could definitely go into wild spaces, parks. But I believe it's, it's difficult to access a lot of different species. You know, you'd be limited to the kinds of species you could donate if you were only going to collect from wild areas." – *Participant 2*
Physical ability	Some tasks, such as handling small seeds, may	Task splitting has been used to make some tasks more	"Some of the seeds being so small it's kind of, you need some dexterity to be able to grab the seeds and put them in

	contain barriers for people with disabilities.	accessible (e.g. people who do not have the dexterity to sort seeds may be able to fold seed envelopes).	the put them in the envelopes. But again, most seeds are big enough that it's not an issue." – *Participant 11*
Internet access	The seed library primarily operates through Facebook and its website, which may be a barrier for people who lack technology skills or internet access.	In-person presence at big events and festivals. Plans to do further outreach.	"The fact that it's mostly Internet-based I guess might not be completely accessible to everyone, both from a like a computer or technical skills component." – *Participant 16*

The seed library employs two distinct pathways towards helping people overcome barriers: top-down program design and emergent practices (i.e. spontaneous initiative-taking by participants to improve the work of the seed library). Mélanie, as the leader and manager of the project, endeavours to keep activities accessible. For instance, Mélanie intentionally selects pick-up locations in parts of Ottawa accessible by transit and holds at least five seed pick-up events in order to ensure people can access the locations. Additionally, she mails seeds to those who may have difficulty coming to in-person events. The top-down program design of seed giveaways, plant exchanges and maintaining the Facebook community helped participants overcome systemic barriers of cost, availability and knowledge while creating an environment where emergent practices, such as offering rides, could develop.

4.3.1 Cost as a systemic barrier

Seed giveaways were one of the core practices that all participants took part in. The practice of a seed giveaway consisted of several steps: harvesting seed for donation, cleaning seed, packaging seed, coordinating pick-up events. Mélanie led the coordination of pick-up events, with the support of

participants in the seed library. The other three practices – harvesting seed, cleaning seed and packaging seed – were primarily done by participants, with Mélanie's support. The seed library holds seed giveaway events in the fall, so that participants can winter sow the seeds and provide the necessary conditions for stratification and germination. The seed library also operates a plant exchange year-round coordinated through the Facebook group and hosts large in-person plant exchange events in the spring.

4.3.2 Availability as a systemic barrier

The seed library hosts both in-person plant exchanges and Mélanie also maintains a spreadsheet where participants can sign up to share plants on an ad-hoc basis as a means of providing plants for people who do not yet feel comfortable growing them from seed. Some interview participants expressed feelings of intimidation about growing plants from seed. Plant exchanges and seed giveaways both address the systemic barrier of availability by making multiple native plant species accessible for people.

Availability was identified not only as a barrier to getting started, but also to advancing one's own native plant gardening efforts: "I was looking for shade plants in particular and it's very hard to find native plants in Ottawa. There's really no nurseries in town that specialize in native plants. Much, much harder here to actually pick up the plants." (*Participant 9*). Participants credited the seed library with helping them overcome initial hesitation, and also being able to provide a variety of desirable plants.

4.3.3 Knowledge as a systemic barrier

The systemic barrier of knowledge was addressed through the use of the Facebook group, where participants expressed both asking and answering questions. Participants said they could rely on the Facebook group for niche knowledge that may not be easily accessible through internet searches. Mélanie said she made a regular practice of sharing native plant resources several times per day in the group, including webinars, scientific papers and articles.

Most participants in the seed library said it was their first time gardening with native plants and that their connection with the seed library facilitated their adoption of the practice. While many reported

feeling intimidated at the beginning, they said the practice of native plant gardening was easy once they acquired the requisite knowledge: “I had so many aha moments, and I'm still on my learning curve, but man have I ever learned a lot in the last less than a year and I just want to share that because this is important, and it's easy, it's super easy.” (Participant 11). Participants characterized the Facebook group as both a source of knowledge and an opportunity to share things they have learned in an effort to advance the work of the seed library and spread the practice of native plant gardening.

Participants relied on information provided by Mélanie through the seed library Facebook page to select plants, manage their yards and perform essential tasks like seed collection and cleaning. Knowledge transfer happened in three ways: peer-to-peer, top-down through Mélanie’s posts, and seeking external research. External research and resources were very important to the generation of knowledge – Mélanie told interviewers she posted only scientific sources and quoted rather than paraphrased. Her stated intention was to direct people to these resources. Peer-to-peer knowledge transfer was common, with volunteers answering questions for others at seed pickup events, event organizers providing technical information, and participants answering questions on Facebook.

4.3.4 Community-led system change

Mélanie said the seed library’s strategy was to share native wildflower seeds and also to advocate for large-scale system change, such as reforming bylaws and encouraging native plant gardening in public areas. In this way, they are both temporarily bridging barriers for participants and dismantling those barriers within the broader culture. Several participants highlighted yard bylaws, which specify a maximum height that limits the native plants that can be planted, as a barrier to greater participation. Mélanie described a desired vision for the future that would constitute a restorative culture: “…people come to each others’ houses, talk about their gardens and then we build people that feel like they’ve met like-minded people and are hopeful for the future, and then that native gardens become the standard, and lawns become obsolete because we’re so used to seeing those gardens in the city.” (Mélanie Ouellette,

interview 2). In order to achieve this vision, Mélanie and other participants planned and executed several in-person events, including an event to clean and pack seeds and plant exchanges.

Many participants described the work of the seed library as shared by all rather than the work of Mélanie alone. While participants described themselves as involved to varying degrees, participants did not see a hierarchy among volunteers in the seed library, though all recognized Mélanie as the leader. All work – from folding seed envelopes to hosting seed pickups – was recognized, primarily by Mélanie through a post in the Facebook group. Mélanie described how she would split tasks into smaller pieces to make them more accessible for more people. For instance, a given packet of seed could have been folded by one volunteer, packed by another volunteer (with seed donated by a third volunteer) and given away by another, allowing four people to be involved in the process. Many participants reported a strong desire to "give back" to the work of the seed library after receiving free seeds or plants.

4.4 Discussion

This study focused on the operation of the Ottawa Wildflower Seed Library as a convivial community tool. We conducted a qualitative case study of the seed library to understand if (and how) a grassroots ecological restoration organization empowers people to engage in the practice, and specifically if (and how) that organization operates as a convivial community tool. We found that the seed library is a grassroots ecological restoration association that empowers people to engage in restoration by lowering the barriers to participation, and that these barriers are lowered both through top-down program design, horizontal support between participants and emergent practices (i.e. conviviality), which makes it a convivial community tool.

4.4.1 Facilitating engagement by overcoming external systemic barriers

Participants credited their native plant journeys to the existence of the seed library. Many participants began native plant gardening because of the seed library, specifically they said the seed library helped them overcome the barriers of availability, cost and knowledge (Table 4-1). Prior research

into volunteer activity in ecological restoration has focused on motivation to participate (Asah et al. 2014; Ryan et al. 2001; Measham & Barnett 2008), however motivation is a necessary but not sufficient condition for pro-environmental behaviour change (Kollmuss & Agyeman 2002). Community-based social marketing (CBSM) is a behaviour change approach that postulates lowering barriers is the key to enabling pro-environmental behaviour (McKenzie-Mohr & Schultz 2014). The seed library operates by lowering systemic barriers to native plant gardening for people who are motivated to take on the practice.

Participants identified knowledge barriers around the collection and treatment of native plant seeds. Most plants native to Ontario need to experience cold-stratification prior to germination – a step that was intimidating to some participants. One participant reported trying to grow native plants prior to their involvement with the seed library, without following the proper stratification protocol, and becoming discouraged. This suggests that the seed library provides support that enables people to garden with native plants when they would have otherwise been unable to. This can be characterized as the seed library's impact, which refers to "changes that a [grassroots association] brings about, whether internally or externally." (Smith, 2000: p. 195). Smith (2000) differentiates the study of impact from "effectiveness," which he defines as how a grassroots association accomplishes its impact. The seed library achieves its impact by addressing the barriers of availability, cost and knowledge using both top-down program delivery and emergent practices.

The top-down programs delivered by the seed library (e.g. seed exchange, plant exchange) were credited by participants as being their main entry point to native plant gardening. Emergent practices – initiatives planned and executed by participants other than Mélanie – were discussed by many participants. The term "emergent practices" is often used at the macro scale in the volunteering literature to refer to spontaneous post-disaster aid, such as community search and rescue groups (Twigg & Mosel 2017). At the organizational (i.e. meso) scale, this term refers to individual participants performing actions that further the goal of the seed library, independent of instruction from the founder. For instance, several participants organized an event to rescue native plants from a planned development site. One

participant created a bin for people to drop off donated supplies. Another participant regularly picked up and dropped off materials in an area of Ottawa she frequented. Participants frequently turned to the seed library community with questions, seeking collaboration or making offers of assistance. This kind of emergence was enabled by Mélanie in her administration of the Facebook page, providing a safe space for community members to interact: “On the Facebook group, I'm pretty tight about it. It's so I have certain rules like everybody being positive and we don’t accept invasive species […] And I've set the tone that I always share evidence-based information with quotation marks, and references, and I find people are pretty good at doing that…” (*Mélanie Ouellette, interview 1*). While Mélanie characterized her leadership style as that of a “benevolent dictator,” no participant complained of heavy-handedness or micro-management in her leadership of the seed library. Many participants remarked on how receptive Mélanie was to their ideas and initiatives, something which contributes to the conviviality of the organization. Participation in the seed library was task-oriented, done by a small group, featured a high degree of communication – three aspects of informal structures highlighted by Freeman (1972) as conducive to effective collaboration.

4.4.2 Operating as a convivial community tool

The central role of emergent practices in the seed library, and the overall strategy of overcoming barriers, are core organizational practices that support making ecological restoration a convivial community tool. Much like a communal bike repair workshop enhances the conviviality of an already-convivial tool, so too does the seed library take something already theoretically accessible to everyone and make it practically accessible (Bradley 2018). Illich posited that some tools (e.g. bicycles) are inherently convivial – that the tool itself can be easily used, repaired and maintained. In the case of the seed library, seeds are collaboratively collected and distributed, knowledge is shared by participants and organizers alike, and volunteers seek to enhance their own gardens and those of others using the tool of native wildflower seeds. Seeds do require specialized knowledge (i.e. stratification) to grow, however the practice of collecting and germinating native wildflower seed is inherently accessible as it does not

require special tools or licenses. People who have their own garden can freely collect and distribute seed from that garden. This suggests that native wildflower seed has inherent conviviality (Illich 1973), and lends itself well to the open approach of a convivial community tool.

Whether the practice of ecological restoration should have a rigid definition, with standards and practices, or is open to interpretation has long been debated (Light & Higgs 1996; Nelson et al. 2017; Murphy 2018). The idea of conviviality has been applied to technology and five key elements have been identified as important to the development of convivial technologies: relatedness (e.g. connection to ecological processes), accessibility, adaptability (e.g. is there a monopoly over usage?), bio-interaction (e.g. level of environmental harm), and appropriateness (Vetter 2018). Accessibility and adaptability are particularly relevant to the discussion of restoration's convivial potential. The seed library demonstrates how restoration can be made accessible (e.g. through the provision of free seeds and plants) and adaptable (e.g. Mélanie expressed willingness to share the seed library model). One key division in restoration has been between whether it is a packageable, reproducible means to an end, or a focal practice where there is value in both the process and the product (Higgs 2003). Participants in the seed library frequently talked about the value of their volunteering in terms beyond adding plants to their gardens. They viewed the project as more than just a source of free seeds – for many, it was a supportive community:

> "It's education it's community. It's knowing that there are other people out there who are like-minded, because yes, you walk into a plant nursery, and you can't find anything. My Facebook feed is filled with all of this, so I feel very supported, and I'm like there's a lot of us out there. But then I go out to a store and just like, there's nothing there! Okay, I'll go back to my underground group, my grassroots underground group." – *Participant 23*

Several participants in addition to Participant 23 remarked on the importance of social support to their native plant gardening practice. In contrast, research into formal non-profit volunteering has highlighted a gap, and potential conflict, between practitioners and lay-people (Weng 2015). One advantage of a grassroots association like the seed library is that this dynamic is minimized.

4.4.3 Towards convivial restoration

The findings of this case study point towards a novel conceptualization of ecological restoration as a convivial practice – "convivial restoration." Convivial restoration prioritizes the accessibility of the practice. Leading literature for ecological restoration conceptualizes the accessibility of the practice as "engagement" in restoration projects (Suding et al. 2015; Gann et al. 2019). Engagement tends to be interpreted and studied as citizen engagement, often using Arnstein's ladder of citizen engagement, which outlines a spectrum of engagement from superficial consultation to citizen control (Arnstein 1969; Reed et al. 2018). Research into engagement in restoration uses the language of stakeholders, and models the public as involved to varying degrees but rarely owning the project (Baker 2017). Convivial restoration exists at the top rung of Arnstein's ladder, as Illich's original conception of convivial tools outlined a need for people to be able to make the tool their own (Illich 1973).

Prioritizing accessibility presents a challenge for conventional restoration: What if enhancing accessibility compromises other principles of restoration like effectiveness, efficiency or sustainability? For example, several participants in the seed library discussed the need to maintain the image of a conventional garden by incorporating some native plants rather than exclusively native plants. Such a garden would not qualify as restoration under the International Standards for the Practice of Ecological Restoration (Gann et al. 2019), yet the flexible approach is more accessible, which may result in greater uptake. Convivial restoration aligns with critics of Gann et al. (2019) who have argued for a principle-based definition of restoration that is more flexible (Higgs, Harris, Murphy, Bowers, Hobbs, Jenkins, Kidwell, Nik Lopoukhine, et al. 2018). A convivial approach to restoration would not be completely

flexible so as to render it meaningless. Further research is needed to develop principles that maintain restoration and allow for the flexibility required to make it a convivial community tool.

4.4.4 Future research directions

This case study provides preliminary insights into two key elements of a convivial community tool: programs that lower the barriers for participants to access the tool, and emergent practices that do the same. This research presents a snapshot of the seed library at the early stage in its lifecycle. It would be beneficial to study convivial community tools that have been around for a longer period of time. This may reveal whether they were able to shift the norm, and what impact that had on the tool itself. Many of the participants in this study spoke about their own gardens, but some were active on community pollinator gardens as well. Such garden initiatives should be further studied as meeting places for a restorative culture. Large-scale research into volunteers taking initiative within organizations could provide fruitful insights into how widespread emergent practices are and what can be done to encourage them.

This case study did not assess the quality of the restoration work being done by the seed library (e.g. the number of plants planted). A productive area of inquiry would be whether and to what extent convivial restoration is effective as compared to large-scale, organization-led restoration. Research comparing volunteer-managed areas with those managed by city staff in Chicago found biodiversity was similar in volunteer-managed areas, suggesting volunteer restoration efforts have a high degree of effectiveness (Heneghan et al. 2020). Such a study could employ a quantitative assessment of the ecological outcomes of citizen action in comparison with the outcomes of organization-led projects.

4.5 Conclusion

The Ottawa Wildflower Seed Library addresses three major systemic barriers to native plant gardening: cost, availability and knowledge. The seed library emphasizes accessibility by ensuring that it puts up minimal barriers when creating and executing programs. Ivan Illich did not provide a blueprint for

a convivial community tool in *Tools for Conviviality*, but the case of the seed library shows that operationalizing the idea of a convivial community tool involves addressing barriers people face to accessing that tool.

As restoration ecology develops as a scientific field, and ecological restoration grows as a profession, it is vital that community-led restoration also grow its reach and efficacy. This research serves as a foundation on which to further develop an understanding of community-led efforts to enhance ecosystem integrity. While top-down, non-profit led volunteering can provide valuable experiences, grassroots associations like the Ottawa Wildflower Seed Library can both bridge and dismantle barriers, pushing for systems change.

Chapter 5 Conclusion

This chapter synthesizes the significant and original contributions to knowledge made by this dissertation. I begin by reviewing the purpose and objectives of this dissertation as well as the key findings for the three research chapters (Chapters 2, 3, 4).

5.1 Purpose and objectives

The goal of this thesis was to gain a better understanding of community engagement in ecological restoration. This research used three methods to achieve this goal: a systematic map of the literature, a survey and a qualitative case study. These methods were employed to answer the following research questions:

1) What are the motivations for volunteers to participate in ecological restoration and how are they interconnected? What are the barriers that prevent volunteers from participating in ecological restoration? What are the demographics of volunteer populations studied in the literature?

2) What is the relationship between the three factors of community-based initiative performance – social capital, transformational leadership and organizational capacity – and volunteer engagement?

3) How does a grassroots ecological restoration organization empower people to engage in the practice of ecological restoration, and specifically how does that organization operates as a convivial community tool?

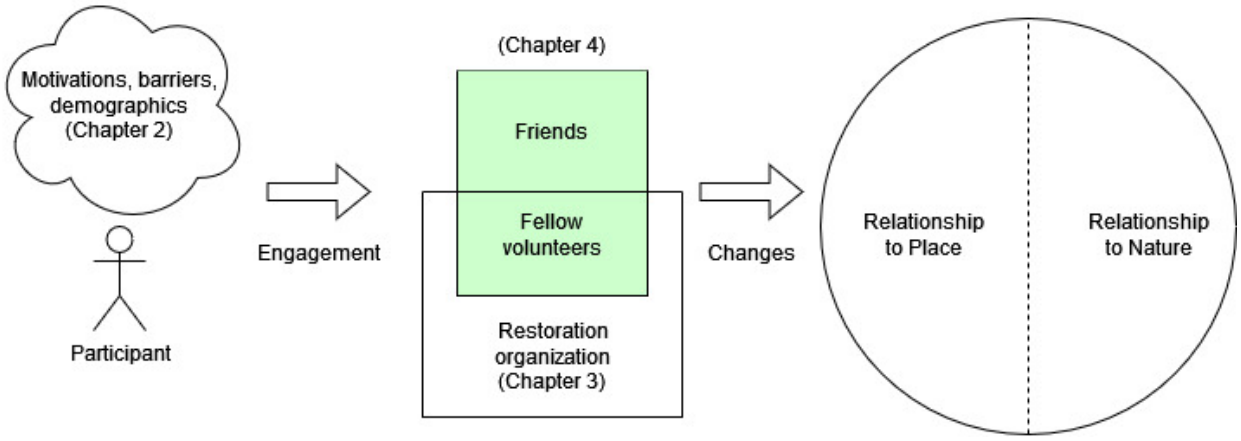
This chapter presents a summary of the major findings of each paper and identifies the major contributions of the research. The chapter also outlines contributions to the theory and practice of ecological restoration.

5.2 Major findings

This thesis includes three research data chapters (Chapters 2, 3 and 4). Chapter 2 reported the results of a systematic map of the published literature on volunteer motivation to participate in ecological restoration initiatives. The study revealed five volunteer motivations that appear most frequently in the literature: having a positive environmental impact, acquiring and sharing knowledge, care for the environment, social interactions and community and health and well-being. Chapter 3 reported the results of a survey of volunteers to understand the relationship between social capital, transformational leadership and organizational capacity, and volunteer engagement. The results of a path analysis of survey data revealed that social capital plays a mediating role between organizational capacity, transformational leadership and volunteer engagement. Finally, Chapter 4 reported the results of a qualitative case study that investigated the Ottawa Wildflower Seed Library and practices that make it a convivial community tool. It revealed that overcoming barriers people face to native plant gardening was one of the main strategies of the seed library. Taken together, all three papers provide insights that further the study of volunteer engagement in ecological restoration and will aid practitioners in designing and executing volunteer programs by understanding motivations, prioritizing social capital and focusing on barriers to participation.

5.2.1 Relationship as a central concept in ecological restoration

Figure 5-1: Layers of relationships condition connection to place and nature



The above diagram shows how participant engagement changes the relationship between a participant and a particular place, and through that their relationship with nature. This diagram synthesizes the contributions of Chapters 2, 3 and 4 into a cohesive concept of the role of relationships in restoration outcome. The role of motivations, barriers and demographic factors in participation is explored in Chapter 2. The role of the restoration organization, and the importance of social capital, is detailed in Chapter 3. The impact of participants' relationship with their friends and fellow volunteers, who may be the same, on their participation in restoration are explored in Chapter 4. Taken together, this thesis highlights the importance of interpersonal and organizational relationships in the establishment of a restorative culture through individual participation.

Relationships emerged as a core theme across all three empirical chapters (Chapters 2, 3, 4) in this dissertation. Chapter 2 revealed a typology of motivations that includes extrinsic and intrinsic motivations – the satisfaction of each requiring some action on behalf of project coordinators or other volunteers. Some motivational categories are closely tied with relationships: social interactions and community, health and wellbeing, future generations and project organization (Subheading 2.3.1). Further research into project organization revealed the connection between volunteer engagement and social capital, which is one way of measuring the quality of connections between people within an organization (Gerolemou et al. 2022). Finally Chapter 4 demonstrated the mechanisms by which relationships can

advance restoration, namely through helping participants overcome the barriers to engaging in the practice through lateral assistance. Taken together, all three chapters make the case for a vision of restoration science that includes consideration and study of relationships between people and nature, and relationships within and among groups of people, as illustrated by Figure 5-1.

Restoration social science is an emerging field of study that focuses on the social dynamics of ecological restoration typically as those dynamics relate to projects. Research tends to focus on governance, consultation and implications of projects themselves (Biedenweg & Gross-Camp 2018; Baker 2017; Mansourian 2017). For instance, Biedenweg et al. (2021) conducted research in Puget Sound for several years that documented the impact of extensive stakeholder involvement on ecological restoration projects in the region. This thesis contributes an understanding of the social dynamics of restoration practice broadly construed. Much of the guidance and research on restoration practice is targeted towards professionals (i.e. those who make their income from working in restoration) and relegates volunteers to a population to be engaged. This thesis highlights the importance of relationships among the non-professional practitioners of ecological restoration. Namely, relationships play a role in motivating people to participate in restoration, in maintaining engagement in restoration organizations, and in helping people overcome barriers to participation.

5.2.2 Conviviality in restoration ecology

The notion of convivial restoration was introduced in Subheading 4.4.3. Here I use the word "convivial" in the same sense as Illich – meaning, to live together. Relationships are at the heart of convivial restoration, supported by the research conducted for this dissertation. This thesis does not propose to add another term to the crowded field of restoration synonyms (e.g. rewilding, rehabilitation, reclamation), but rather to characterize the implementation of restoration as convivial. Such an approach to restoration prioritizes engagement above other principles of restoration, but also situates the practice in a different social dynamic. Illich originally proposed the convivial society as a counterweight to industrial society. Philosophers have carried forward this thinking and suggest convivialism as an antidote to, and

successor for, neoliberalism (International Convivialist 2020). The ambition of the UN Decade on Ecosystem Restoration is to shift to a "culture of restoration" – the type of large-scale shift that requires a social-ecological approach (United Nations 2019; Fischer et al. 2020). A convivial approach to ecological restoration could form an important part of this cultural shift by engaging more people in restoration and allowing people to adapt the practice to their own life and context.

Convivial restoration fits most cleanly with a principles-based approach to the practice of restoration. Approaches based on principles are flexible and responsive to shifting contexts (Higgs, Harris, Murphy, Bowers, Hobbs, Jenkins, Kidwell, Nik Lopoukhine, et al. 2018). In this way, the notion of convivial restoration fits neatly with four principles proposed by Suding et al. (2015) as a replacement for engagement. Convivial restoration still strives to be effective, efficient and sustainable, but prioritizes accessibility above those three principles. This brings the notion into conflict with the *International Principles and Standards for the Practice of Ecological Restoration* (Gann et al. 2019). Specifically, Gann et al. (2019) outlines a restorative continuum of practices that delineates anything other than partially or fully recovering native ecosystems as something other than restoration (e.g. rehabilitation, remediation or reduced impacts). The rigid boundaries suggested by the document would frustrate efforts for people to make the practice their own. Under the framework presented by Gann et al. (2019), many participants in the seed library would not be conducting restoration, but merely reducing their impact.

It may be argued that restoration practiced by non-professionals could be considered something different. For example, if a doctor gives someone CPR, it may be considered practicing medicine. If a civilian were to do so, it would be called first aid. This thesis highlights the power of social relationships to engage people in restoration, and that finding suggests that sowing the seeds of division by gatekeeping what qualifies as restoration could compromise social relationships. Already strain exists between professionals and volunteers in restoration projects, as scientific guidance at times leads to conflict (Weng 2015). There is a divide between science and practice which may be further exacerbated by subdividing

the practitioner community into those who practice restoration and those who practice something else entirely (Dickens & Suding 2013).

5.3 Academic contributions to theory and implications for practice

Each paper makes distinct contributions to both theory and practice. Restoration ecology is the science of restoration – a rapidly evolving field with its own theoretical frameworks and literature. It is closely tied to ecological restoration – the practice of restoring degraded ecosystems, though there has historically been a divide between theory and practice (Higgs 2005). In this section I present contributions from my research that advance both the theory and practice of ecological restoration.

5.3.1 Chapter 2 — Contributions

5.3.1.1 Towards a comprehensive theory of volunteer motivation in restoration

Volunteer motivation is a frequent subject of study in restoration ecology, primarily with the goal of increasing the number of volunteers engaged in projects (Miles et al. 1998; Ryan et al. 2001). The research has uncovered a diverse range of motivations using a variety of conceptual frameworks. Mixed-methods research has found that non-environment related motivations, including the desire for positive emotions and social interactions, are significant drivers of participation in ecological restoration (Asah et al. 2014). In one case study researchers found that volunteers were motivated by both pleasure- and obligation-related emotions, meaning they enjoyed the work and also felt compelled to do it because of the degree of ecosystem degradation (DiEnno & Thompson 2013). The study also highlighted that people are eager to participate in activities that have direct impacts on the environment and view ecological restoration as one of those activities. Increasingly costly and ambitious restoration projects can benefit from the use of volunteers to defray labour costs, which can be the most significant component of restoration project budgets (Asah et al. 2014; Li & Gornish 2020). While there has been a breadth of study on motivation, it has not been drawn together into a unified theoretical framework.

The typology that resulted from the systematic map (Chapter 2) is a step towards such a framework. Typologies are an important step in the research process and become an analytical tool to refine concepts (Collier et al. 2012). This typology also responds to calls from the volunteering literature for theoretical explorations of specific volunteer domains (e.g. environmental volunteering) to enable evidence-based volunteer management (Einolf 2018).

5.3.1.2 Implications for practice

Within the practice of ecological restoration, volunteers are often looked to for labour to implement restoration. Volunteer contributions to ecological restoration projects include labour for interventions (e.g. planting, invasive species removal), monitoring (e.g. citizen science), and stewardship (Keenleyside et al, 2012). Contributions to restoration can embody different levels of involvement from executing actions recommended by practitioners to co-designing ecological restoration projects (Weng, 2015; Reed et al, 2018). Stakeholder engagement is distinct from volunteering in that it considers the inclusion of organizations and people in high-level decision-making processes specifically (Reed et al, 2018). The extent and nature of the contributions that volunteers make will depend on their level of motivation.

The typology developed in Chapter 2 can guide practitioners in the development and execution of volunteer engagement programs by informing which motivations they speak to in briefings and activity design. Packard (2017) offered the practical advice of selecting volunteer facilitators who are doing the restoration work, and provided guidance on motivating by "hope, vision and ongoing success…" (Packard 2017, pg. 423) I suggest that volunteer facilitators familiarize themselves with the typology of motivational categories developed in Chapter 2 and use those categories to structure coaching sessions, plan activities and speak with volunteers. For instance, a volunteer facilitator may plan a tour day to show volunteers the results of a restoration project they (or other volunteers) worked on previously, which would speak to the extrinsic environmental motivation held by some to see the impact of their work.

5.3.2 Chapter 3 — Contributions

5.3.2.1 Social capital and its connection to volunteer engagement

Project organization has received some attention in the literature on motivation to volunteer in restoration, but has not been meaningfully explored until now (Ryan et al. 2001; Ding & Schuett 2020; He et al. 2019). Chapter 2 revealed project organization as an outlier among other motivations in that it does not fit neatly within a typology derived from an extensive literature review. In addition to its importance in volunteer engagement, project organization has been described as important to restoration outcomes through the lens of organizational capacity (Galatowitsch 2023). However, that depiction and the resulting framework do not directly examine the role of volunteers in restoration projects. Volunteers are significant participants in restoration and their inclusion can greatly influence project outcomes (Baker 2017). Chapter 3 adapts and validates a framework on community-based initiatives to examine organizational factors and their connection with volunteer engagement (Igalla et al. 2019). The result suggests that social capital is tightly connected to volunteer engagement, and other organizational elements influence volunteer engagement through their effect on social capital.

The literature on social capital has been applied to a broad range of fields. Its application in restoration ecology suggests that participation in restoration projects can increase the social capital of volunteers (Gerolemou et al. 2022). Social engagement in restoration increases trust, which can have beneficial effects on restoration outcomes (Covelli Metcalf et al. 2017). The framework adapted in Chapter 3 suggests that organizational capacity and transformational leadership may increase social capital, highlighting an important mechanism by which to increase volunteer engagement. Importantly, the survey does not assess the directionality of relationships, which forms an important future direction for work in this area.

5.3.2.2 Implications for practice

The important role of social capital highlighted by Chapter 3 suggests that practitioners may benefit by implementing practices that are designed to build connections between people and with the broader community. Volunteer management practices like providing food for volunteers may build social capital, which in turn could increase volunteer engagement and the effectiveness of the practice. Practitioners could benefit from enacting enablers of positive social capital, fostering high-quality connections among volunteers and embracing reciprocity (Baker & Dutton 2017). Focusing on the impact that volunteers have and empowering leaders who emerge from the participants can help build the core team (Packard 2017).

The results presented in Chapter 3 make clear the importance of questions about volunteer management that may not seem directly connected to project success. For instance, the question of whether providing snacks increases the likelihood of volunteers returning (Sutherland et al. 2022) may seem trite, but given the outsized importance of social capital, snacks may be a linchpin in a volunteer engagement strategy. The results from Chapter 3 suggest that practitioners ought to consider activities productive if they have a chance of building social capital, whether there are shovels in the ground.

5.3.3 Chapter 4 — Contributions

5.3.3.1 Convivial society from the grassroots

Chapter 4 contributes insights to operationalizing what has been a largely theoretical concept until now: convivial community tools. While there has been some examination of convivial community tools, and documentation of the practice, there is little academic understanding of what makes such an organization work (Bradley 2018; Mancini & Mancini 2015; Illich 1973). Chapter 4 finds that helping people overcome barriers to the use of a tool (e.g. native wildflower seeds) is a core function of a convivial community tool. In particular, Chapter 4 finds that it is not only top-down program design that helps people overcome barriers, but emergent practices of cooperation between volunteers.

Convivialism is emerging as a political philosophy and alternative to neoliberalism that prioritizes interdependence and cooperation over individual achievement (International Convivialist 2020). The political philosophy is closely tied with the degrowth movement, which seeks to halt and reverse the rampant growth driving ecological degradation (Vetter 2018). Convivial practices, of which community tools are one, form part of the praxis of convivialism (Joaquim Elói Cirne de Toledo Júnior & Adloff 2018). Since the early days of restoration ecology, there has been a conflict between whether the science is a tightly-defined set of ideas and practices, or an open democratic practice that can be defined and employed by individuals according to their needs (Light & Higgs 1996). A related divide between rigid technocratic practice and flexible, focal employment of restoration has also been active in the conceptual literature (Higgs 2003; Higgs, Harris, Murphy, Bowers, Hobbs, Jenkins, Kidwell, Nikita Lopoukhine, et al. 2018). Convivial restoration, as characterized by Chapter 4, is an approach to the science and practice that prioritizes openness and access by lowering barriers to participation. It is the enactment of Light & Higgs (1996) contention that restoration remain open and flexible. It is, I argue, an example of both a focal and convivial practice.

5.3.3.2 Implications for practice

This paper amplifies the implication from Chapter 3 and suggests a mechanism by which social capital can directly influence volunteer engagement. Chapter 4 found that volunteers were helping one another overcome barriers. For example, several volunteers offered transportation to individuals who could not get to events on their own. The environment for this kind of lateral assistance was created by Mélanie Ouellette through the choice of a Facebook group as the main platform and by facilitating connections among volunteers.

Chapter 4 suggests that practitioners would benefit from creating opportunities for ongoing community-building that extend beyond specific events to accomplish project tasks. For instance, practitioners may consider a group, or email list, to facilitate connections between volunteers after they

leave events. Such connections may lead to greater participation as volunteers help one another stay involved, as demonstrated in Chapter 4.

5.4 Future research directions and research limitations

This thesis establishes the groundwork for a convivial approach to ecological restoration by investigating the motivations of volunteers, important factors of project organization and necessary strategies to enable the practice. While the empirical chapters have identified important characteristics of convivial restoration, they did not investigate how to affect those characteristics. For instance, it is not clear which practices would serve the motivations identified by the typology in Chapter 2. While Chapter 3 highlights the importance of social capital for project organization, further research is needed to understand how social capital can be enhanced. Chapter 4 identifies the mechanism by which convivial organizations can engage more people in restoration (i.e. through overcoming barriers to participation), but further research is needed to assess the effectiveness of such an approach to restoration. This section outlines the limitations and opportunities for future research of the empirical chapters of this thesis and the thesis as a whole.

Chapter 2 employed a systematic map methodology which drew on several major databases, but did not include grey literature, which can contain a significant amount of knowledge in the restoration field (Alamenciak et al. 2023). I screened the literature alone, as expected for a dissertation . Guidance for systematic reviews and maps suggests multiple authors conduct screening and a comparison of their inclusion and rejection of manuscripts is conducted to ensure accurate application of criteria (James et al. 2016). The typology of motivation did not make claims as to the relative significance of each motivational category because the methodology did not allow for it. The typology could be verified and further developed by a wide-scale survey of volunteers assessing motivations based on the categories suggested. Another possible research direction would be to conduct a meta-analysis of studies that use the Volunteer Functions Inventory to assess volunteer motivation, as a sufficient number for such statistical analysis was documented in the map. Furthermore, the typology could be deepened by conducting

interviews with volunteers to determine how exactly their volunteering experience connected with their motivation. The summary of demographics presented in Chapter 2 suggests that a study of under-represented populations who volunteer, or research to determine why such populations are under-studied, would be beneficial.

Chapter 3 focused on volunteers' perceptions of three criteria of community-based initiatives and how those perceptions affected self-reported engagement. An online survey was used to assess the volunteers' perceptions of these criteria. Online surveys can exclude individuals with limited access to technology (Rea & Parker 2014). Conversely, individuals who are more engaged would be more likely to fill out a survey than those who are poorly engaged, which may have affected outcomes. Social capital is a rich field of study in the social sciences, and this paper indicates that it plays a strong role in conditioning volunteer engagement. Further studies could examine social capital in-depth and establish the directionality of the relationship (e.g. does volunteering increase social capital or does social capital increase volunteering?). The three types of social capital – bonding, bridging and linking – could be disaggregated and studied individually to determine which plays the strongest role in conditioning volunteer engagement. This research highlighted the importance of social capital but did not explore ways in which social capital is increased or decreased. Further research, possibly employing action research methodologies, could explore ways in which restoration organizations can improve the social capital of volunteers.

Chapter 4 provides the groundwork for operationalizing a convivial community tool. A single organization was studied, which resulted in findings that may be transferrable but not generalizable. This qualitative case study could be expanded by conducting a large scale, quantitative analysis of volunteers for grassroots restoration organizations. This analysis could focus on barriers to participation and how volunteers help one another overcome such barriers, since the case study suggests this is a core feature of convivial community tools. Chapter 4 can also inform deeper theoretical work bridging the burgeoning political philosophy of convivialism, degrowth and ecological restoration. There exists a trend towards

growth within restoration out of necessity, and how that growth will happen without causing further damage remains an open question.

Convivial restoration prioritizes engagement, though it is important that restoration also be effective, efficient and sustainable. This thesis proposed a hierarchy of these principles, with a convivial approach placing engagement at the top, but there remains much work to be done on how to maintain the effectiveness of restoration practice under that framework. Restoration must be more than a simulacrum of ecosystems but must also be more than a token gesture towards native ecosystems among otherwise introduced flora and fauna. Conversely, it is unclear whether and to what degree comprises on effectiveness, efficiency and sustainability are required in order to make restoration more accessible. For instance, food forests (which may include non-native food plants) have been evaluated as a potential tool for ecological restoration (Park et al. 2018). It is not clear whether that approach is more or less effective, efficient and sustainable than one that uses exclusively native plants. Further research should also be conducted on various forms of engagement in restoration (e.g. using plant materials, tending to plants, nature appreciation), and how convivial restoration can maximize engagement.

5.5 Conclusion

Convivial restoration has the potential to reconceptualize restoration as a public practice involving deep, honest engagement with ecosystems and intervention towards positive futures. This thesis investigated three aspects of convivial restoration: motivation, project organization and addressing barriers through program design and interpersonal relationships. This research has established the importance of relationships to engagement in restoration and lays out a future research agenda that may dramatically expand the reach of restoration and potentially realize the ambitious goal of creating a culture of restoration.

References

Alamenciak T, Pomezanski D, Shackelford N, Murphy SD, Cooke SJ, Rochefort L, Voicescu S, Higgs E (2023) Ecological restoration research in Canada: who, what, where, when, why, and how? Pelletier, F, editor. FACETS 8:1–11

Alavi M, Visentin DC, Thapa DK, Hunt GE, Watson R, Cleary M (2020) Exploratory factor analysis and principal component analysis in clinical studies: Which one should you use? Journal of Advanced Nursing 76:1886–1889

Arnstein SR (1969) A Ladder Of Citizen Participation. Journal of the American Planning Association 35:216–224

Asah ST, Blahna DJ (2013) Practical implications of understanding the influence of motivations on commitment to voluntary urban conservation stewardship. Conservation Biology 27:866–875

Asah ST, Lenentine MM, Blahna DJ (2014) Benefits of urban landscape eco-volunteerism: Mixed methods segmentation analysis and implications for volunteer retention. Landscape and Urban Planning 123:108–113

Athihirunwong N, Janekarnkij P, Sanglestsawai S (2018) Understanding youth motivation for water onion (Crinum thaianum J. Schulze) conservation in Thailand. Kasetsart Journal of Social Sciences 39:42–50

Baker S (2017) Social Engagement in Ecological Restoration. In: Routledge Handbook of Ecological and Environmental Restoration. Allison, SK & Murphy, SD, editors.

Baker W, Dutton JE (2017) Enabling Positive Social Capital in Organizations. In: Exploring Positive Relationships at Work. Dutton, JE & Ragins, BR, editors. Psychology Press pp. 325–346.

Barendse MT, Oort FJ, Timmerman ME (2015) Using Exploratory Factor Analysis to Determine the Dimensionality of Discrete Responses. Structural Equation Modeling: A Multidisciplinary Journal 22:87–101

Bartlett JE, Kotrlik JW, Higgins CC (2001) Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning and Performance Journal 19

Beaujean AA (2013) Factor Analysis using R. sment, Research, and Evaluation Practical Assessment, Research, and Evaluation 18

Beaujean AA (2014) Latent Variable Modeling Using R. 0 ed. Routledge

Beckwith BR, Johansson EM, Huff VJ (2022) Connecting people, plants and place: A native plant society's journey towards a community of practice. People and Nature 4:1414–1425

Bénabou R, Tirole J (2003) Intrinsic and Extrinsic Motivation. The Review of Economic Studies 70:489–520

Biedenweg K, Gross-Camp ND (2018) A brave new world: Integrating well-being and conservation. Ecology and Society 23:1–4

Bin Saeed B, Afsar B, Shahjeha A, Imad Shah S (2019) Does transformational leadership foster innovative work behavior? The roles of psychological empowerment, intrinsic motivation, and creative process engagement. Economic research-Ekonomska istraživanja 32:254–281

Birt L, Scott S, Cavers D, Campbell C, Walter F (2016) Member Checking: A Tool to Enhance Trustworthiness or Merely a Nod to Validation? Qualitative Health Research 26:1802–1811

Boone HN, Boone DA (2012) Analyzing Likert Data. Journal of Extension 50:5

Borkhataria RR, Wetzel PR, Henriquez H, Davis III SE (2017) The Synthesis of Everglades Restoration and Ecosystem Services (SERES): a case study for interactive knowledge exchange to guide Everglades restoration. Restoration Ecology 25:S18–S26

Bradley K (2018) Bike Kitchens – Spaces for convivial tools. Journal of Cleaner Production 197:1676–1683

Bruyere B, Rappe S (2007) Identifying the motivations of environmental volunteers. Journal of Environmental Planning and Management 50:503–516

Cabin RJ (2007) Science-Driven Restoration: A Square Grid on a Round Earth? Restoration Ecology 15:1–7

Carballo-Cárdenas EC, Tobi H (2016) Citizen science regarding invasive lionfish in Dutch Caribbean MPAs: Drivers and barriers to participation. Ocean and Coastal Management 133:114–127

Charmaz K (2006) Constructing grounded theory. Sage Publications, London ; Thousand Oaks, Calif

Chaskin RJ (2001) Building community capacity: A definitional framework and case studies from a comprehensive community initiative. Urban Affairs Review 36:291–323

Clary EG, Snyder M (1999) The Motivations to Volunteer: Theoretical and Practical Considerations. Current Directions in Psychological Science 8:156–159

Clewell AF, Aronson J (2007) Ecological Restoration: Principles, Values, and Structure of an Emerging Profession. Island Press, Washington DC

Clewell AF, Aronson J (2013) Ecological restoration: Principles, values, and structure of an emerging profession: Second edition.

Collier D, LaPorte J, Seawright J (2012) Putting Typologies to Work: Concept Formation, Measurement, and Analytic Rigor. Political Research Quarterly 65:217–232

Covelli Metcalf E, Metcalf AL, Mohr JJ (2017) Building Social Capacity for Restoration Success. In: Routledge Handbook of Ecological and Environmental Restoration. Allison, SK & Murphy, SD, editors.

Cruz DW, Villanueva RD, Baria MVB (2014) Community-based, low-tech method of restoring a lost thicket of Acropora corals. ICES Journal of Marine Science 71:1866–1875

Cutillo L (2019) Parametric and multivariate methods. In: Encyclopedia of bioinformatics and computational biology. Ranganathan, S, Gribskov, M, Nakai, K, & Schönbach, C, editors. Elsevier, Amsterdam Boston Heidelberg London New York Oxford Paris San Diego San Francisco Singapore Sydney Tokyo.

Daniels JM, Robbins AST, Brinkley WR, Wolf KL, Chase JM (2014) Toward estimating the value of stewardship volunteers: A cost-based valuation approach in King County, Washington, USA. Urban Forestry and Urban Greening 13:285–289

De Winter JCF, Dodou D, Wieringa PA (2009) Exploratory Factor Analysis With Small Sample Sizes. Multivariate Behavioral Research 44:147–181

Dickens SJM, Suding KN (2013) Spanning the Science-Practice Divide: Why Restoration Scientists Need to be More Involved with Practice. Ecological Restoration 31:134–140

DiEnno CM, Thompson JL (2013) For the love of the land: How emotions motivate volunteerism in ecological restoration. Emotion, Space and Society 6:63–72

Ding C, Schuett MA (2020) Predicting the Commitment of Volunteers' Environmental Stewardship: Does Generativity Play a Role? Sustainability 12:6802

Domroese MC, Johnson EA (2016) Why watch bees? Motivations of citizen science volunteers in the Great Pollinator Project. Biological Conservation 208:40–47

Downey RG, King CV (1998) Missing Data in Likert Ratings: A Comparison of Replacement Methods. The Journal of General Psychology 125:175–191

Edelenbos J, van Meerkerk I, Schenk T (2018) The Evolution of Community Self-Organization in Interaction With Government Institutions: Cross-Case Insights From Three Countries. The American Review of Public Administration 48:52–66

Edelenbos J, Molenveld A, Mojanchevska K, Ensenado E, Ballinas MB-P, Esteban A, Ruijsink S, Igalla M, Tsatsou A (2020) Community-based initiatives in the urban realm what conditions their performance? Journal of Environmental Planning and Management 1–24

Einolf C (2018) Evidence-based volunteer management: A review of the literature. Voluntary Sector Review 9:153–176

Fabrigar LR, Wegener DT, MacCallum RC, Strahan EJ (1999) Evaluating the Use of Exploratory Factor Analysis in Psychological Research. Psychological Methods 4:272–299

Field B, Booth A, Ilott I, Gerrish K (2014) Using the Knowledge to Action Framework in practice: a citation analysis and systematic review. Implementation Science 9:172

Fischer J, Riechers M, Loos J, Martin-Lopez B, Temperton VM (2020) Making the UN Decade on Ecosystem Restoration a Social-Ecological Endeavour. Trends in Ecology and Evolution xx:1–9

Fleeger WE, Becker ML (2008) Creating and sustaining community capacity for ecosystem-based management: Is local government the key? Journal of Environmental Management 88:1396–1405

Follstad Shah JJ, Dahm CN, Gloss SP, Bernhardt ES (2007) River and Riparian Restoration in the Southwest: Results of the National River Restoration Science Synthesis Project. Restoration Ecology 15:550–562

Fowler FJ (2014) Survey research methods. Fifth edition. SAGE, Los Angeles

Fox H, Cundill G (2018) Towards Increased Community-Engaged Ecological Restoration : A Review of Current Practice and Future Directions. 208–218

Freeman J (1972) The Tyranny of Structurelessness. Berkeley Journal of Sociology 17:151–165

Fruchterman TMJ, Reingold EM (1991) Graph drawing by force-directed placement. Software: Practice and Experience 21:1129–1164

Galatowitsch S (2023) Organizational capacity and ecological restoration. Restoration Ecology 31

Gann GD, McDonald T, Aronson J, Dixon KW, Walder B, Hallett JG, Decleer K, Falk DA, Gonzales EK, Murcia C, Nelson CR, Unwin AJ (2018) The SER Standards: a globally relevant and inclusive tool for improving restoration practice—a reply to Higgs et al. Restoration Ecology 26:426–430

Gann GD, McDonald T, Walder B, Aronson J, Nelson CR, Jonson J, Hallett JG, Eisenberg C, Guariguata MR, Liu J, Hua F, Echeverria C, Gonzales E, Shaw N, Decleer K, Dixon KW (2019) International Principles and Standards for the Practice of Ecological Restoration.

Ganzevoort W, van den Born RJG (2020) Understanding citizens' action for nature: The profile, motivations and experiences of Dutch nature volunteers. Journal for Nature Conservation 55

Gargoum SA, El-Basyouny K (2016) Exploring the association between speed and safety: A path analysis approach. Accident Analysis & Prevention 93:32–40

Gerolemou RV, Russell JC, Stanley MC (2022) Social capital in the context of volunteer conservation initiatives. Conservation Science and Practice 4

Graham ID, Logan J, Harrison MB, Straus SE, Tetroe J, Caswell W, Robinson N (2006) Lost in knowledge translation: Time for a map? Journal of Continuing Education in the Health Professions 26:13–24

Groves RM, ed. (2004) Survey methodology. J. Wiley, Hoboken, NJ

Guiney MS (2009) Caring for Nature: Motivations for and Outcomes of Conservation Volunteer Work. Doctor of Philosophy, University of Minnesota

Gurevitch J, Koricheva J, Nakagawa S, Stewart G (2018) Meta-analysis and the science of research synthesis. Nature 555:175–182

Haddaway NR, Macura B, Whaley P, Pullin AS (2018) ROSES RepOrting standards for Systematic Evidence Syntheses: pro forma, flow-diagram and descriptive summary of the plan and conduct of environmental systematic reviews and systematic maps. Environmental Evidence 7:7

Haigh M (2016) Fostering Global Citizenship – tree planting as a connective practice. Journal of Geography in Higher Education 40:509–530

He Y, Parrish JK, Rowe S, Jones T (2019) Evolving interest and sense of self in an environmental citizen science program. Ecology and Society 24

Heneghan L, Westphal LM, Ross KA, Watkins C, Gobster PH, Iannone BV, Tudor M, Vining J, Wali A, Zellner M, Wise DH (2020) Institutional Diversity in the Planning Process Yields Similar Outcomes for Vegetation in Ecological Restoration. Society and Natural Resources 33:949–967

Higgs E (2003) Nature by design: people, natural process, and ecological restoration. MIT Press

Higgs E (2005) The two-culture problem: Ecological restoration and the integration of knowledge. Restoration Ecology 13:159–164

Higgs E, Harris J, Murphy S, Bowers K, Hobbs R, Jenkins W, Kidwell J, Lopoukhine Nikita, Sollereder B, Suding K (2018) On principles and standards in ecological restoration. Restoration Ecology 26:399–403

Higgs E, Harris J, Murphy S, Bowers K, Hobbs R, Jenkins W, Kidwell J, Lopoukhine Nik, Sollereder B, Suding K, Thompson A, Whisenant S (2018) The evolution of Society for Ecological Restoration's principles and standards—counter-response to Gann et al. Restoration Ecology 26:431–433

Hill R (1998) What sample size is 'enough' in internet survey research? Interpersonal Computing and Technology: An Electronic Journal for the 21st Century 6

Hobbs RJ (2016) Degraded or just different? Perceptions and value judgements in restoration decisions. Restoration Ecology 24:153–158

Hoon C (2013) Meta-Synthesis of Qualitative Case Studies: An Approach to Theory Building. Organizational Research Methods 16:522–556

Hooper D, Couglan J, Mullen MR (2008) Structural equation modelling: guidelines for determining model fit. Electronic Journal of Business Research Methods 6

Horton Smith D (2016) A Survey of Voluntaristics: Research on the Growth of the Global, Interdisciplinary, Socio-behavioral Science Field and Emergent Inter-discipline. Voluntaristics Review 1:1–81

Hustinx L, Cnaan RA, Handy F (2010) Navigating Theories of Volunteering: A Hybrid Map for a Complex Phenomenon. Journal for the Theory of Social Behaviour 40:410–434

Igalla M, Edelenbos J, van Meerkerk I (2019) Citizens in Action, What Do They Accomplish? A Systematic Literature Review of Citizen Initiatives, Their Main Characteristics, Outcomes, and Factors. VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations 30:1176–1194

Igalla M, Edelenbos J, van Meerkerk I (2020) What explains the performance of community-based initiatives? Testing the impact of leadership, social capital, organizational capacity, and government support. Public Management Review 22:602–632

Illich I (1973) Tools for conviviality. Calder and Boyars, London

International Convivialist (2020) THE SECOND CONVIVIALIST MANIFESTO: Towards a Post-Neoliberal World. Civic Sociology 1:12721

James KL, Randall NP, Haddaway NR (2016) A methodology for systematic mapping in environmental sciences. Environmental Evidence 5:1–13

Jarzabkowski P, Paul Spee A (2009) Strategy-as-practice: A review and future directions for the field. International Journal of Management Reviews 11:69–95

Joaquim Elói Cirne de Toledo Júnior, Adloff F (2018) Practices of Conviviality and the Social and Political Theory of Convivialism. Maria Sibylla Merian International Centre for Advanced Studies in the Humanities and Social Sciences Conviviality-Inequality in Latin America

Jones HP, Jones PC, Barbier EB, Blackburn RC, Rey Benayas JM, Holl KD, McCrackin M, Meli P, Montoya D, Mateos DM (2018) Restoration and repair of Earth's damaged ecosystems. Proceedings of the Royal Society B: Biological Sciences 285

Jones MS, Teel TL, Solomon J, Weiss J (2021) Evolving systems of pro-environmental behavior among wildscape gardeners. Landscape and Urban Planning 207:104018

Keenleyside K, Dudley N, Cairns S, Hall C, Stolton S (2012) Ecological Restoration for Protected Areas.

Kittinger JN, Bambico TM, Minton D, Miller A, Mejia M, Kalei N, Wong B, Glazier EW (2016) Restoring ecosystems, restoring community: socioeconomic and cultural dimensions of a community-based coral reef restoration project. Regional Environmental Change 16:301–313

Kline RB (2023) Principles and practice of structural equation modeling. Fifth edition. The Guilford Press, New York

Kollmuss A, Agyeman J (2002) Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? Environmental Education Research 8:239–260

Kozubaev S, DiSalvo C (2020) The Future of Public Libraries as Convivial Spaces: A Design Fiction. In: Companion of the 2020 ACM International Conference on Supporting Group Work. ACM, Sanibel Island Florida USA pp. 83–90.

Kyriazos TA (2018) Applied Psychometrics: Sample Size and Sample Power Considerations in Factor Analysis (EFA, CFA) and SEM in General. Psychology 09:2207–2230

Larson LR, Cooper CB, Futch S, Singh D, Shipley NJ, Dale K, LeBaron GS, Takekawa JY (2020) The diverse motivations of citizen scientists: Does conservation emphasis grow as volunteer participation progresses? Biological Conservation 242

Lempa M, Goodman RM, Rice J, Becker AB (2008) Development of Scales Measuring the Capacity of Community-Based Initiatives. Health Education & Behavior 35:298–315

Levac D, Colquhoun H, O'Brien KK (2010) Scoping studies: advancing the methodology. Implementation Science 5:69

Li YM, Gornish ES (2020) General attributes and practice of ecological restoration in Arizona and California, USA revealed by restoration stakeholder surveys. Restoration Ecology 28

Light A, Higgs ES (1996) The politics of ecological restoration. Environmental Ethics 18:227–246

Linley GD, Paton DC, Weston MA (2017) A citizen-trapper effort to control Common Myna: Trap success, specificity and preferred bait type. Ecological Management and Restoration 18:249–252

Løkke A-K, Sørensen PD (2014) Theory Testing Using Case Studies. 12:9

Lucrezi S, Milanese M, Palma M, Cerrano C (2018) Stirring the strategic direction of scuba diving marine Citizen Science: A survey of active and potential participants Bianchi, CN, editor. PLOS ONE 13:e0202484

Macura B, Suškevičs M, Garside R, Hannes K, Rees R, Rodela R (2019) Systematic reviews of qualitative evidence for environmental policy and management: An overview of different methodological options. Environmental Evidence 8:1–11

Mancini J, Mancini S (2015) Transition to Common Work: building community at the Working Centre.

Mansourian S (2017) Governance and Restoration. In: Routledge Handbook of Ecological and Environmental Restoration. Allison, SK & Murphy, SD, editors.

Markus N, Blackshaw JK (1998) Motivations and Characteristics of Volunteer Flying-Fox Rehabilitators in Australia. Anthrozoös 11:203–209

Martin VY, Greig EI (2019) Young adults' motivations to feed wild birds and influences on their potential participation in citizen science: An exploratory study. Biological Conservation 235:295–307

Maund PR, Irvine KN, Lawson B, Steadman J, Risely K, Cunningham AA, Davies ZG (2020) What motivates the masses: Understanding why people contribute to conservation citizen science projects. Biological Conservation 246

Mayr ML (2017) Transformational Leadership and Volunteer Firefighter Engagement: The Mediating Role of Group Identification and Perceived Social Impact. Nonprofit Management and Leadership 28:259–270

McKenzie-Mohr D, Schultz PW (2014) Choosing Effective Behavior Change Tools. Social Marketing Quarterly 20:35–46

McSkimming MJ, Berg BL (2008) Motivations for Citizen Involvement in a Community Crime Prevention Initiative: Pennsylvania's TIP (Turn in a Poacher) Program. Human Dimensions of Wildlife 13:234–242

Measham TG, Barnett GB (2008) Environmental Volunteering: Motivations, modes and outcomes. Australian Geographer 39:537–552

Mehra B, Rioux K, eds. (2016) Progressive community action: critical theory and social justice in library and information science. Library Juice Press, Sacramento, CA

Méndez-López ME, García-Frapolli E, Ruiz-Mallén I, Porter-Bolland L, Reyes-Garcia V (2015) From Paper to Forest: Local Motives for Participation in Different Conservation Initiatives. Case Studies in Southeastern Mexico. Environmental Management 56:695–708

Merenlender AM, Crall AW, Drill S, Prysby M, Ballard H (2016) Evaluating environmental education, citizen science, and stewardship through naturalist programs. CONSERVATION BIOLOGY 30:1255–1265

Miles I, Sullivan WC, Kuo FE (1998) Ecological restoration volunteers: The benefits of participation. Urban Ecosystems 2:27–41

Millette V, Gagné M (2008) Designing volunteers' tasks to maximize motivation, satisfaction and performance: The impact of job characteristics on volunteer engagement. Motivation and Emotion 32:11–22

Moher D, Liberati A, Tetzlaff J, Altman DG, Altman D, Antes G, Atkins D, Barbour V, Barrowman N, Berlin JA, Clark J, Clarke M, Cook D, D'Amico R, Deeks JJ, Devereaux PJ, Dickersin K, Egger M, Ernst E, Gøtzsche PC, Grimshaw J, Guyatt G, Higgins J, Ioannidis JPA, Kleijnen J, Lang T, Magrini N, McNamee D, Moja L, Mulrow C, Napoli M, Oxman A, Pham B, Rennie D, Sampson M, Schulz KF, Shekelle PG, Tovey D, Tugwell P (2009) Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Medicine 6

Molsher R, Townsend M (2016) Improving wellbeing and environmental stewardship through volunteering in nature. EcoHealth 13:151–155

Murphy SD (2018) Restoration Ecology's Silver Jubilee: meeting the challenges and forging opportunities. Restoration Ecology 26:3–4

Nelson CR, Bowers K, Lyndall JL, Munro J, Stanley JT (2017) Professional certification in ecological restoration: improving the practice and the profession. Restoration Ecology 25:4–7

Niemiec RM, Ardoin NM, Brewer FK, Kung S, Lopez K (2018) Increased Neighbor Interaction and Fear of Social Sanctions: Associations with Resident Action to Control the Invasive Little Fire Ant. Society & Natural Resources 31:1149–1168

Osborne JW (2015) What is Rotating in Exploratory Factor Analysis? Practical Assessment, Research, and Evaluation 20

Packard S (2017) Restoration, volunteers and the human community. In: Routledge Handbook of Ecological and Environmental Restoration. Allison, SK & Murphy, SD, editors. pp. 414–425.

Pages M, Fischer A, van der Wal R, Pagès M, Fischer A, van der Wal R (2018) The dynamics of volunteer motivations for engaging in the management of invasive plants: insights from a mixed-methods study on Scottish seabird islands. JOURNAL OF ENVIRONMENTAL PLANNING AND MANAGEMENT 61:904–923

Park H, Turner N, Higgs E (2018) Exploring the potential of food forestry to assist in ecological restoration in North America and beyond. Restoration Ecology 26:284–293

Parks Canada, ed. (2008) Principles and guidelines for ecological restoration in Canada's protected natural areas. Parks Canada [u.a.], Gatineau, Quebec

Pastoriza D, Ariño MA (2013) Does the Ethical Leadership of Supervisors Generate Internal Social Capital? Journal of Business Ethics 118:1–12

Perring MP, Erickson TE, Brancalion PHS (2018) Rocketing restoration: enabling the upscaling of ecological restoration in the Anthropocene. Restoration Ecology 26:1017–1023

Pullin A, Frampton G, Jongman R, Kohl C, Livoreil B, Lux A, Pataki G, Petrokofsky G, Podhora A, Saarikoski H, Santamaria L, Schindler S, Sousa-Pinto I, Vandewalle M, Wittmer H (2016) Selecting appropriate methods of knowledge synthesis to inform biodiversity policy. Biodiversity and Conservation 25:1285–1300

Putnam RD (2001) Bowling alone: the collapse and revival of American community. 1. touchstone ed. Simon & Schuster, New York, NY

Rea LM, Parker RA (2014) Designing and conducting survey research: a comprehensive guide. Fourth edition. Jossey-Bass, San Francisco, CA

Reed MS, Vella S, Challies E, de Vente J, Frewer L, Hohenwallner-Ries D, Huber T, Neumann RK, Oughton EA, Sidoli del Ceno J, van Delden H (2018) A theory of participation: what makes stakeholder and public engagement in environmental management work? Restoration Ecology 26:S7–S17

Reid KA, Williams KJH, Paine MS (2011) Hybrid knowledge: Place, practice, and knowing in a volunteer ecological restoration project. Ecology and Society 16:11

Reiss S (2012) Intrinsic and Extrinsic Motivation. Teaching of Psychology 39:152–156

Rinkus MA, da Cal Seixas SR, Dobson T (2017) "Ninguém Me Chama" - "Nobody Asked Me": Gendered Patterns of Participation in sea Turtle Conservation in Northeast Brazil. Human Ecology 45:487–498

Robitzsch A (2020) Why Ordinal Variables Can (Almost) Always Be Treated as Continuous Variables: Clarifying Assumptions of Robust Continuous and Ordinal Factor Analysis Estimation Methods. Frontiers in Education 5:589965

Rosseel Y (2012) **lavaan** : An *R* Package for Structural Equation Modeling. Journal of Statistical Software 48

Ryan RL, Kaplan R, Grese RE (2001) Predicting volunteer commitment in environmental stewardship programmes. Journal of Environmental Planning and Management 44:629–648

Sakurai R, Kobori H, Nakamura M, Kikuchi T (2015) Factors influencing public participation in conservation activities in urban areas: A case study in Yokohama, Japan. Biological Conservation 184:424–430

Saldaña J (2013) The coding manual for qualitative researchers. 2nd ed. SAGE, Los Angeles

Schaufeli WB, Bakker AB, Salanova M (2006) The measurement of work engagement with a short questionnaire: A cross-national study. Educational and Psychological Measurement 66:701–716

Shackelford N, Miller BP, Erickson TE (2018) Restoration of Open-Cut Mining in Semi-Arid Systems: A Synthesis of Long-Term Monitoring Data and Implications for Management. Land Degradation and Development 29:994–1004

Sharma N, Greaves S, Siddharthan A, Anderson H, Robinson A, Colucci-Gray L, Wibowo AT, Bostock H, Salisbury A, Roberts S, Slawson D, van der Wal R (2019) From citizen science to citizen action: analysing the potential for a digital platform to cultivate attachments to nature. Journal of Science Communication 18:A07

Shrestha N (2021) Factor Analysis as a Tool for Survey Analysis. American Journal of Applied Mathematics and Statistics 9:4–11

Smith DH (2000) Grassroots associations. Sage Publications, Thousand Oaks, Calif

Smith DH (2018) The Global Historical and Contemporary Impacts of Voluntary Membership Associations on Human Societies. Voluntaristics Review 2:1–125

Smith DH, Smith DH, Smith DH, Smith DH, Smith DH, Stebbins RA, Grotz J, Grotz J (2016) The Palgrave Handbook of Volunteering, Civic Participation, and Nonprofit Associations. Palgrave Macmillan UK, London

Soanes K, Sievers M, Chee YE, Williams NSG, Bhardwaj M, Marshall AJ, Parris KM (2019) Correcting common misconceptions to inspire conservation action in urban environments. Conservation Biology 33:300–306

Stage FK, Carter HC, Nora A (2004) Path Analysis: An Introduction and Analysis of a Decade of Research. The Journal of Educational Research 98:5–13

Steele LS, Tinmouth JM, Lu A (2006) Regular health care use by lesbians: a path analysis of predictive factors. Family Practice 23:631–636

Streiner DL (2005) Finding Our Way: An Introduction to Path Analysis. Can J Psychiatry 50

Suding K, Higgs E, Palmer M, Callicott JB, Anderson CB, Gutrich JJ, Hondula KL, Lafevor MC, Larson BMH, Randall A (2015) Committing to ecological restoration. Science 348:638–641

Sundeen RA, Raskoff SA, Garcia MC (2007) Differences in perceived barriers to volunteering to formal organizations: Lack of time versus lack of interest. Nonprofit Management and Leadership 17:279–300

Sutherland WJ, Robinson JM, Aldridge DC, Alamenciak T, Armes M, Baranduin N, Bladon AJ, Breed MF, Dyas N, Elphick CS, Griffiths RA, Hughes J, Middleton B, Littlewood NA, Mitchell R, Morgan WH, Mosley R, Petrovan SO, Prendergast K, Ritchie EG, Raven H, Smith RK, Watts SH, Thornton A (2022) EDITORIAL: Creating testable questions in practical conservation: a process and 100 questions. Conservation Evidence Journal 19

Swierzy P, Wicker P, Breuer C (2018) The impact of organizational capacity on voluntary engagement in sports clubs: A multi-level analysis. Sport Management Review 21:307–320

Thompson RH (2004) Overcoming Barriers to Ecologically Sensitive Land Management: Conservation Subdivisions, Green Developments, and the Development of a Land Ethic. Journal of Planning Education and Research 24:141–153

Tidball KG, Metcalf S, Bain M, Elmqvist T (2018) Community-led reforestation: cultivating the potential of virtuous cycles to confer resilience in disaster disrupted social–ecological systems. Sustainability Science 13:797–813

Tucker BA, Russell RF (2004) The Influence of the Transformational Leader. Journal of Leadership & Organizational Studies 10:103–111

Twigg J, Mosel I (2017) Emergent groups and spontaneous volunteers in urban disaster response. Environment and Urbanization 29:443–458

United Nations (2019) Executive Summary: The UN Decade on Ecosystem Restoration.

Van Den Berg HA, Dann SL, Dirkx JM (2009) Motivations of Adults for Non-Formal Conservation Education and Volunteerism: Implications for Programming. Applied Environmental Education & Communication 8:6–17

Vecina ML, Chacón F, Sueiro M, Barrón A (2012) Volunteer Engagement: Does Engagement Predict the Degree of Satisfaction among New Volunteers and the Commitment of Those who have been Active Longer? Applied Psychology 61:130–148

Vetter A (2018) The Matrix of Convivial Technology – Assessing technologies for degrowth. Journal of Cleaner Production 197:1778–1786

Voinea C (2018) Designing for conviviality. Technology in Society 52:70–78

Watkins C, Westphal LM, Gobster PH, Vining J, Wali A, Tudor M (2015) Shared Principles of Restoration Practice in the Chicago Wilderness Region. Human Ecology Review 21:155-177,192-194

Weng YC (2015) Contrasting visions of science in ecological restoration: Expert-lay dynamics between professional practitioners and volunteers. Geoforum 65:134–145

Wolf KL, Blahna DJ, Brinkley W, Romolini M (2013) Environmental stewardship footprint research: Linking human agency and ecosystem health in the Puget Sound region. Urban Ecosystems 16:13–32

Wortley L, Hero JM, Howes M (2013) Evaluating ecological restoration success: A review of the literature. Restoration Ecology 21:537–543

Wright BE, Moynihan DP, Pandey SK (2012) Pulling the Levers: Transformational Leadership, Public Service Motivation, and Mission Valence. Public Administration Review 72:206–215

Wright DR, Underhill LG, Keene M, Knight AT (2015) Understanding the Motivations and Satisfactions of Volunteers to Improve the Effectiveness of Citizen Science Programs. Society and Natural Resources 28:1013–1029

Wyborn C, Jellinek S, Cooke B (2012) Negotiating multiple motivations in the science and practice of ecological restoration. Ecological Management and Restoration 13:249–253

Yeung AB (2004) The Octagon Model of Volunteer Motivation: Results of a Phenomenological Analysis. VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations 15:21–46

Yin RK (2018) Case study research and applications: design and methods. Sixth edition. SAGE, Los Angeles

Zappa P, Zavarrone E (2010) Social interaction and volunteer satisfaction: an exploratory study in primary healthcare. International Review of Economics 57:215–231

Appendix A List of 84 papers included in systematic map

1. Akin, H., Shaw, B., Stepenuck, K. F., & Goers, E. (2013). Factors Associated with Ongoing Commitment to a Volunteer Stream-Monitoring Program. Journal of Extension, 51(3), 13.

2. Asah, S. T., & Blahna, D. J. (2013). Practical Implications of Understanding the Influence of Motivations on Commitment to Voluntary Urban Conservation Stewardship: Commitment to Conservation Stewardship. Conservation Biology, 27(4), 866–875. https://doi.org/10.1111/cobi.12058

3. Asah, S. T., Lenentine, M. M., & Blahna, D. J. (2014). Benefits of urban landscape eco-volunteerism: Mixed methods segmentation analysis and implications for volunteer retention. Landscape and Urban Planning, 123, 108–113. https://doi.org/10.1016/j.landurbplan.2013.12.011

4. Atchison, J., Gibbs, L., & Taylor, E. (2017). Killing Carp (*Cyprinus carpio*) as a Volunteer Practice: Implications for community involvement in invasive species management and policy. Australian Geographer, 48(3), 333–348. https://doi.org/10.1080/00049182.2016.1265229

5. Athihirunwong, N., Janekarnkij, P., & Sanglestsawai, S. (2018). Understanding youth motivation for water onion (*Crinum thaianum* J. Schulze) conservation in Thailand. Kasetsart Journal of Social Sciences, 39(1), 42–50. https://doi.org/10.1016/j.kjss.2017.09.006

6. Broun, C. N. (2007). An evaluation of Missouri Master Naturalist Program: Changes in volunteer knowledge and the relationship between motivations and changes in volunteer knowledge [M.S., University of Missouri--Columbia]. https://doi.org/10.32469/10355/5065

7. Broun, C. N., Nilon, C. H., & Pierce II, R. A. (2009). An Evaluation of the Missouri Master Naturalist Program and Implications for Program Expansion. Journal of Extension, 47(3), 15.

8. Bruyere, B., & Rappe, S. (2007). Identifying the motivations of environmental volunteers. Journal of Environmental Planning and Management, 50(4), 503–516. https://doi.org/10.1080/09640560701402034

9. Caissie, L. T., & Halpenny, E. A. (2003). Volunteering for nature: Motivations for participating in a biodiversity conservation volunteer program. World Leisure Journal, 45(2), 38–50. https://doi.org/10.1080/04419057.2003.9674315

10. Carballo-Cárdenas, E. C., & Tobi, H. (2016). Citizen science regarding invasive lionfish in Dutch Caribbean MPAs: Drivers and barriers to participation. Ocean & Coastal Management, 133, 114–127. https://doi.org/10.1016/j.ocecoaman.2016.09.014

11. Currie, M. J. B., Lackova, P., & Dinnie, E. (2016). Greenspace matters: Exploring links between greenspace, gender and well-being with conservation volunteers. Landscape Research, 41(6), 641–651. https://doi.org/10.1080/01426397.2016.1208813

12. Davis, A., Taylor, C. E., & Martin, J. M. (2019). Are pro-ecological values enough? Determining the drivers and extent of participation in citizen science programs. Human Dimensions of Wildlife, 24(6), 501–514. https://doi.org/10.1080/10871209.2019.1641857

13. DiEnno, C. M. (2009). A case study of social capital and collaboration as a communication process in an urban community-based ecological restoration project [Doctor of Philosophy]. Colorado State University.

14. DiEnno, C. M., & Thompson, J. L. (2013). For the love of the land: How emotions motivate volunteerism in ecological restoration. Emotion, Space and Society, 6, 63–72. https://doi.org/10.1016/j.emospa.2012.02.002

15. Ding, C., & Schuett, M. A. (2020). Predicting the Commitment of Volunteers' Environmental Stewardship: Does Generativity Play a Role? Sustainability, 12(17), 6802. https://doi.org/10.3390/su12176802

16. Domroese, M. C., & Johnson, E. A. (2016). Why watch bees? Motivations of citizen science volunteers in the Great Pollinator Project. Biological Conservation, 208, 40–47. https://doi.org/10.1016/j.biocon.2016.08.020

17. Douglas, C., & Rollins, R. (2007). Motivations, Training and Supervision of Volunteers in Conservation. Environments Journal, 35(1), 11.

18. Dunkley, R. A. (2019). Monitoring ecological change in UK woodlands and rivers: An exploration of the relational geographies of citizen science. Transactions of the Institute of British Geographers, 44(1), 16–31. https://doi.org/10.1111/tran.12258

19. Gagliardi, C., Pillemer, K., Gambella, E., Piccinini, F., & Fabbietti, P. (2020). Benefits for Older People Engaged in Environmental Volunteering and Socializing Activities in City Parks: Preliminary Results of a Program in Italy. International Journal of Environmental Research and Public Health, 17(11), 3772. https://doi.org/10.3390/ijerph17113772

20. Ganzevoort, W., & van den Born, R. J. G. (2020). Understanding citizens' action for nature: The profile, motivations and experiences of Dutch nature volunteers. Journal for Nature Conservation, 55. https://doi.org/10.1016/j.jnc.2020.125824

21. Ganzevoort, W., van den Born, R. J. G., Halffman, W., & Turnhout, S. (2017). Sharing biodiversity data: Citizen scientists' concerns and motivations. Biodiversity and Conservation, 26(12), 2821–2837. https://doi.org/10.1007/s10531-017-1391-z

22. García, M. B., Silva, J. L., Tejero, P., Pardo, I., & Gómez, D. (2019). Tracking the long-term dynamics of plant diversity in Northeast Spain with a network of volunteers and rangers. Regional Environmental Change, 19(2), 391–401. https://doi.org/10.1007/s10113-018-1350-6

23. García-Llorente, M., Castro, A. J., Quintas-Soriano, C., López, I., Castro, H., Montes, C., & Martín-López, B. (2016). The value of time in biological conservation and supplied ecosystem services: A willingness to give up time exercise. Journal of Arid Environments, 124, 13–21. https://doi.org/10.1016/j.jaridenv.2015.07.004

24. Guiney, M. S. (2009). Caring for Nature: Motivations for and Outcomes of Conservation Volunteer Work [Doctor of Philosophy]. University of Minnesota.

25. Guiney, M. S., & Oberhauser, K. S. (2009). Conservation Volunteers' Connection to Nature. Ecopsychology, 1(4), 187–197. https://doi.org/10.1089/eco.2009.0030

26. He, Y., Parrish, J. K., Rowe, S., & Jones, T. (2019). Evolving interest and sense of self in an environmental citizen science program. Ecology and Society, 24(2), 33. https://doi.org/10.5751/ES-10956-240233

27. Hennessey, R., & Beazley, K. (2014). Leveraging Community Capacity for Nature Conservation in a Rural Island Context: Experiences from Brier Island, Canada. Landscape Research, 39(3), 237–254. https://doi.org/10.1080/01426397.2012.731498

28. Hermoso, M. I., Martin, V. Y., Stotz, W., Gelcich, S., & Thiel, M. (2019). How Does the Diversity of Divers Affect the Design of Citizen Science Projects? Frontiers in Marine Science, 6, 239. https://doi.org/10.3389/fmars.2019.00239

29. Higgins, O., & Shackleton, C. M. (2015). The benefits from and barriers to participation in civic environmental organisations in South Africa. Biodiversity and Conservation, 24(8), 2031–2046. https://doi.org/10.1007/s10531-015-0924-6

30. Hobbs, S. J. (2012). Community participation in biodiversity monitoring [Doctor of Philosophy]. University of York.

31. Hobbs, S. J., & White, P. C. L. (2012). Motivations and barriers in relation to community participation in biodiversity recording. Journal for Nature Conservation, 20(6), 364–373. https://doi.org/10.1016/j.jnc.2012.08.002

32. Hobbs, S. J., & White, P. C. L. (2015). Achieving positive social outcomes through participatory urban wildlife conservation projects. Wildlife Research, 42(7), 607. https://doi.org/10.1071/WR14184

33. Hunter, A. (2010). Why volunteer for the environment? An exploration of environmental volunteer motivation, satisfaction and retention [Master of Arts]. University of Victoria.

34. Hvenegaard, G. T., & Perkins, R. (2019). Motivations, commitment, and turnover of bluebird trail managers. Human Dimensions of Wildlife, 24(3), 250–266. https://doi.org/10.1080/10871209.2019.1598521

35. James, N. L. (2020). Identity and participation in citizen science [Doctor of Philosophy]. University of South Australia.

36. Johnson, M. F., Hannah, C., Acton, L., Popovici, R., Karanth, K. K., & Weinthal, E. (2014). Network environmentalism: Citizen scientists as agents for environmental advocacy. Global Environmental Change, 29, 235–245. https://doi.org/10.1016/j.gloenvcha.2014.10.006

37. Jones, M. S., Teel, T. L., Solomon, J., & Weiss, J. (2021). Evolving systems of pro-environmental behavior among wildscape gardeners. Landscape and Urban Planning, 207, 104018. https://doi.org/10.1016/j.landurbplan.2020.104018

38. Kaeser, A. S., Willcox, A. S., & Panti, N. C. (2018). Attitudes and perceived barriers to women participating in a proposed community-based conservation programme in Belize. Oryx, 52(1), 89–97. https://doi.org/10.1017/S0030605316000715

39. Khatimah, F. H., Fauzi, D., Chandra, A., & Wicaksono, S. A. (2019). Benefits over Threats: Understanding Community's Motivation to Participate in Restoration Initiatives in Gunung Leuser National Park, Sumatra. IOP Conference Series: Earth and Environmental Science, 298(1), 012027. https://doi.org/10.1088/1755-1315/298/1/012027

40. Kidd, A. H., & Kidd, R. M. (1997). Characteristics and Motives of Adolescent Volunteers in Wildlife Education. Psychological Reports, 80(3), 747–753. https://doi.org/10.2466/pr0.1997.80.3.747

41. Kieninger, P. R., Penker, M., & Yamaji, E. (2012). Esthetic and spiritual values motivating collective action for the conservation of cultural landscape—A case study of rice terraces in Japan. Renewable Agriculture and Food Systems, 28(4), 364–379. https://doi.org/10.1017/S1742170512000269

42. Kragh, G. (2017). A holistic approach to environmental volunteering: Connections between motivation, well-being and conservation achievement [Doctor of Philosophy]. Bournemouth University.

43. Krasny, M. E., Crestol, S. R., Tidball, K. G., & Stedman, R. C. (2014). New York City's oyster gardeners: Memories and meanings as motivations for volunteer environmental stewardship. Landscape and Urban Planning, 132, 16–25. https://doi.org/10.1016/j.landurbplan.2014.08.003

44. Larson, L. R., Cooper, C. B., Futch, S., Singh, D., Shipley, N. J., Dale, K., LeBaron, G. S., & Takekawa, J. Y. (2020). The diverse motivations of citizen scientists: Does conservation emphasis grow as volunteer participation progresses? Biological Conservation, 242, 108428. https://doi.org/10.1016/j.biocon.2020.108428

45. Lin, E. L. A., Juan, W. L., Bidin, S., & Mariapan, M. (2020). Nature conservation volunteerism among school students. The Malaysian Forester, 83(1), 48–63.

46. Lucrezi, S., Milanese, M., Palma, M., & Cerrano, C. (2018). Stirring the strategic direction of scuba diving marine Citizen Science: A survey of active and potential participants. PLOS ONE, 13(8), e0202484. https://doi.org/10.1371/journal.pone.0202484

47. MacPhail, V. J., Gibson, S. D., & Colla, S. R. (2020). Community science participants gain environmental awareness and contribute high quality data but improvements are needed: Insights from Bumble Bee Watch. PeerJ, 8, e9141. https://doi.org/10.7717/peerj.9141

48. Markus, N., & Blackshaw, J. K. (1998). Motivations and Characteristics of Volunteer Flying-Fox Rehabilitators in Australia. Anthrozoös, 11(4), 203–209. https://doi.org/10.2752/089279398787000562

49. Martin, V., Smith, L., Bowling, A., Christidis, L., Lloyd, D., & Pecl, G. (2016). Citizens as Scientists: What Influences Public Contributions to Marine Research? Science Communication, 38(4), 495–522. https://doi.org/10.1177/1075547016656191

50. Martin, V. Y., & Greig, E. I. (2019). Young adults' motivations to feed wild birds and influences on their potential participation in citizen science: An exploratory study. Biological Conservation, 235, 295–307. https://doi.org/10.1016/j.biocon.2019.05.009

51. Maund, P. R., Irvine, K. N., Lawson, B., Steadman, J., Risely, K., Cunningham, A. A., & Davies, Z. G. (2020). What motivates the masses: Understanding why people contribute to conservation citizen science projects. Biological Conservation, 246, 108587. https://doi.org/10.1016/j.biocon.2020.108587

52. McAteer, B., Flannery, W., & Murtagh, B. (2021). Linking the motivations and outcomes of volunteers to understand participation in marine community science. Marine Policy, 124, 104375. https://doi.org/10.1016/j.marpol.2020.104375

53. McSkimming, M. J., & Berg, B. L. (2008). Motivations for Citizen Involvement in a Community Crime Prevention Initiative: Pennsylvania's TIP (Turn in a Poacher) Program. Human Dimensions of Wildlife, 13(4), 234–242. https://doi.org/10.1080/10871200802023219

54. Measham, T. G., & Barnett, G. B. (2008). Environmental Volunteering: Motivations, modes and outcomes. Australian Geographer, 39(4), 537–552. https://doi.org/10.1080/00049180802419237

55. Méndez-López, M. E., García-Frapolli, E., Ruiz-Mallén, I., Porter-Bolland, L., & Reyes-Garcia, V. (2015). From Paper to Forest: Local Motives for Participation in Different Conservation Initiatives. Case Studies in Southeastern Mexico. Environmental Management, 56(3), 695–708. https://doi.org/10.1007/s00267-015-0522-0

56. Merenlender, A. M., Crall, A. W., Drill, S., Prysby, M., & Ballard, H. (2016). Evaluating environmental education, citizen science, and stewardship through naturalist programs. Conservation Biology, 30(6), 1255–1265. https://doi.org/10.1111/cobi.12737

57. Miller, S. (2020). Greenspace volunteering post-disaster: Exploration of themes in motivation, barriers, and benefits from post-hurricane park and garden volunteers. Journal of Environmental Planning and Management, 63(11), 2004–2021. https://doi.org/10.1080/09640568.2019.1700942

58. Mumaw, L. (2017). Transforming urban gardeners into land stewards. Journal of Environmental Psychology, 52, 92–103. https://doi.org/10.1016/j.jenvp.2017.05.003

59. Newberry, M. (2015). The Florida Master Naturalist Program: The motivations, psychological benefits and climate change perceptions of program participants [Doctor of Philosophy]. University of Florida.

60. Ng, C. S., Duncan, J. R., & Koper, N. (2018). Who's "hooting"? Motivations and scientific attitudes of Manitoban citizen science owl surveyors. Avian Conservation and Ecology, 13(2), art9. https://doi.org/10.5751/ACE-01265-130209

61. Niemiec, R. M., Ardoin, N. M., Brewer, F. K., Kung, S., & Lopez, K. (2018). Increased Neighbor Interaction and Fear of Social Sanctions: Associations with Resident Action to Control the Invasive Little Fire Ant. Society & Natural Resources, 31(10), 1149–1168. https://doi.org/10.1080/08941920.2018.1456594

62. Nilsson, D., Gramotnev, G., Baxter, G., Butler, J. R. A., Wich, S. A., & McAlpine, C. A. (2016). Community motivations to engage in conservation behavior to conserve the Sumatran orangutan: Motivations of Conservation Behavior. Conservation Biology, 30(4), 816–826. https://doi.org/10.1111/cobi.12650

63. O'Brien, L., Townsend, M., & Ebden, M. (2010). 'Doing Something Positive': Volunteers' Experiences of the Well-Being Benefits Derived from Practical Conservation Activities in Nature. VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations, 21(4), 525–545. https://doi.org/10.1007/s11266-010-9149-1

64. Ohmer, M. L., Meadowcroft, P., Freed, K., & Lewis, E. (2009). Community Gardening and Community Development: Individual, Social and Community Benefits of a Community

Conservation Program. Journal of Community Practice, 17(4), 377–399. https://doi.org/10.1080/10705420903299961

65. Pagès, M., Fischer, A., & van der Wal, R. (2018). The dynamics of volunteer motivations for engaging in the management of invasive plants: Insights from a mixed-methods study on Scottish seabird islands. Journal of Environmental Planning and Management, 61(5–6), 904–923. https://doi.org/10.1080/09640568.2017.1329139

66. Pagès, M., Fischer, A., van der Wal, R., & Lambin, X. (2019). Empowered communities or "cheap labour"? Engaging volunteers in the rationalised management of invasive alien species in Great Britain. Journal of Environmental Management, 229, 102–111. https://doi.org/10.1016/j.jenvman.2018.06.053

67. Richter, A., Hauck, J., Feldmann, R., Kühn, E., Harpke, A., Hirneisen, N., Mahla, A., Settele, J., & Bonn, A. (2018). The social fabric of citizen science—Drivers for long-term engagement in the German butterfly monitoring scheme. Journal of Insect Conservation, 22(5–6), 731–743. https://doi.org/10.1007/s10841-018-0097-1

68. Rinkus, M. A., da Cal Seixas, S. R., & Dobson, T. (2017). "Ninguém Me Chama" - "Nobody Asked Me": Gendered Patterns of Participation in sea Turtle Conservation in Northeast Brazil. Human Ecology, 45(4), 487–498. https://doi.org/10.1007/s10745-017-9914-5

69. Sakurai, R., Kobori, H., Nakamura, M., & Kikuchi, T. (2015). Factors influencing public participation in conservation activities in urban areas: A case study in Yokohama, Japan. Biological Conservation, 184, 424–430. https://doi.org/10.1016/j.biocon.2015.02.012

70. Sarvilinna, A., Lehtoranta, V., & Hjerppe, T. (2018). Willingness to participate in the restoration of waters in an urban–rural setting: Local drivers and motivations behind environmental behavior. Environmental Science & Policy, 85, 11–18. https://doi.org/10.1016/j.envsci.2018.03.023

71. Schuett, M. A., Kyle, G. T., Leitz, J., Kurzawski, K., & Lee, K. (2014). Anglers' Motivations for Volunteering with Fishing or Conservation Organizations. Fisheries, 39(7), 305–311. https://doi.org/10.1080/03632415.2014.924407

72. Sharma, N., Greaves, S., Siddharthan, A., Anderson, H., Robinson, A., Colucci-Gray, L., Wibowo, A. T., Bostock, H., Salisbury, A., Roberts, S., Slawson, D., & van der Wal, R. (2019). From citizen science to citizen action: Analysing the potential for a digital platform to cultivate attachments to nature. Journal of Science Communication, 18(01), A07. https://doi.org/10.22323/2.18010207

73. Shinbrot, X. A. (2019). The nature of choice: Unraveling individual decision-making for climate-adaptation, science-participation and environmental stewardship in Mexico [Doctor of Philosophy]. Colorado State University.

74. Sloane, G. M.-T., & Pröbstl-Haider, U. (2019). Motivation for environmental volunteering—A comparison between Austria and Great Britain. Journal of Outdoor Recreation and Tourism, 25, 158–168. https://doi.org/10.1016/j.jort.2019.01.002

75. Sullivan, T. K., & Syvertsen, A. K. (2019). Conservation Leadership: A Developmental Model. Journal of Adolescent Research, 34(2), 140–166. https://doi.org/10.1177/0743558417752638

76. Takase, Y., Hadi, A. A., & Furuya, K. (2019). The Relationship Between Volunteer Motivations and Variation in Frequency of Participation in Conservation Activities. Environmental Management, 63(1), 32–45. https://doi.org/10.1007/s00267-018-1106-6

77. Thomas, J. L., Cullen, M., O'Leary, D., Wilson, C., & Fitzsimons, J. A. (2021). Characteristics and preferences of volunteers in a large national bird conservation program in Australia. Ecological Management & Restoration, 22(1), 100–105. https://doi.org/10.1111/emr.12442

78. Toomey, A. H., Strehlau-Howay, L., Manzolillo, B., & Thomas, C. (2020). The place-making potential of citizen science: Creating social-ecological connections in an urbanized world. Landscape and Urban Planning, 200, 103824. https://doi.org/10.1016/j.landurbplan.2020.103824

79. Turnbull, J. W., Johnston, E. L., Kajlich, L., & Clark, G. F. (2020). Quantifying local coastal stewardship reveals motivations, models and engagement strategies. Biological Conservation, 249, 108714. https://doi.org/10.1016/j.biocon.2020.108714

80. Van Den Berg, H. A., Dann, S. L., & Dirkx, J. M. (2009). Motivations of Adults for Non-Formal Conservation Education and Volunteerism: Implications for Programming. Applied Environmental Education & Communication, 8(1), 6–17. https://doi.org/10.1080/15330150902847328

81. Weston, M., Fendley, M., Jewell, R., Satchell, M., & Tzaros, C. (2003). Volunteers in bird conservation: Insights from the Australian Threatened Bird Network. Ecological Management and Restoration, 4(3), 205–211. https://doi.org/10.1046/j.1442-8903.2003.00169.x

82. Woosnam, K. M., Strzelecka, M., Nisbett, G. S., & Keith, S. J. (2019). Examining Millennials' Global Citizenship Attitudes and Behavioral Intentions to Engage in Environmental Volunteering. Sustainability, 11(8), 2324. https://doi.org/10.3390/su11082324

83. Wright, D. R., Underhill, L. G., Keene, M., & Knight, A. T. (2015). Understanding the Motivations and Satisfactions of Volunteers to Improve the Effectiveness of Citizen Science Programs. Society & Natural Resources, 28(9), 1013–1029. https://doi.org/10.1080/08941920.2015.1054976

84. Wyles, K. J., Pahl, S., Carroll, L., & Thompson, R. C. (2019). An evaluation of the Fishing For Litter (FFL) scheme in the UK in terms of attitudes, behavior, barriers and opportunities. Marine Pollution Bulletin, 144, 48–60. https://doi.org/10.1016/j.marpolbul.2019.04.035

Appendix B Full survey on community-based initiatives and volunteer engagement

Volunteers in community-led ecological restoration projects - Draft 2

Start of Block: Consent

Title of the study: Facilitators and barriers to community-led ecological restoration

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Student investigator: Tim Alamenciak, PhD candidate, School of Environment, Resources and Sustainability, University of Waterloo. Email: tim.a@uwaterloo.ca

To help you make an informed decision regarding your participation, this letter explains what the study is about, the possible risks and benefits, and your rights as a research participant. If you do not understand something in the letter, please ask one of the investigators prior to consenting to the study. Please print/save a copy of this letter for your records.

What is the study about?

You are invited to participate in a research study to help understand the roles that motivation, social capital and organizational capacity (e.g. funding, technical knowledge) play in volunteer engagement in community-led ecological restoration projects. This is important as it will help restoration practitioners support people in creating more community-led projects. This study is being undertaken as a part of my (Tim Alamenciak) PhD research. I plan to combine the results of this survey with a strategic literature

review and interviews with select volunteers.

I. Your responsibilities as a participant

What does participation involve?

Participation involves completing a survey, which will take approximately 10 minutes. This survey is designed for participants in community-led ecological restoration and conservation projects. You will be asked a series of questions about your perceptions of engagement, transformational leadership, social capital and organizational capacity. You will also be asked demographic information including your gender, age and ethnicity.

Who may participate in the study?

In order to participate in the study, you must be at least 18 years of age and volunteer with a community-based ecological restoration or conservation group.

II. Your rights as a participant

Is participation in the study voluntary?

Your participation in this study is voluntary. You may decline to answer any questions that you do not wish to answer and you can withdraw your participation at any time by not submitting your responses.

Will I receive anything for participating in the study?

There is no remuneration for participating.

What are the possible benefits of the study?

Participation in this study will not provide any personal benefit to you. I hope that the data from the surveys will further our understanding of community-based ecological restoration and conservation.

What are the risks associated with the study?

There are no known or anticipated risks from participating in this study. If a question makes you uncomfortable, you can choose not to answer. See above for more details on voluntary participation.

Privacy, data retention and storage

This survey is anonymous in that it will not ask for your name or other identifying information. You may choose to provide your e-mail address for a follow-up interview. That address will be collected with a separate form and not tied to your survey responses. You will be asked the name of the group that you volunteer for, which will be used for analysis and not reported in the results. Collected data will be securely stored on password protected computers for a minimum of 7 years. Given that the survey is

anonymous, it will not be possible to remove your data from the study after you submit your responses because the researchers will have no way of identifying which responses are yours.

You will be completing the study by an online survey operated by Qualtrics. Qualtrics has implemented technical, administrative, and physical safeguards to protect the information provided via the Services from loss, misuse, and unauthorized access, disclosure, alteration, or destruction. However, no Internet transmission is ever fully secure or error free. Please Note: We do not collect or use internet protocol (IP) addresses or other information which could link your participation to your computer or electronic device.

III. Questions, comments, or concerns

Who is sponsoring/funding this study?

This study is being conducted without external funding. The student investigator is funded by the School of Environment, Resources and Sustainability through work as a teaching assistant.

Has the study received ethics clearance?

This study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Board (REB #43278). If you have questions for the Board contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or reb@uwaterloo.ca.

Who should I contact if I have questions regarding my participation in this study?

If you have any questions regarding this study or would like additional information to assist you in reaching a decision about participation, please contact Tim Alamenciak or the Faculty Supervisor, Stephen Murphy, at the contact information listed below.

Tim Alamenciak, PhD candidate School of Environment, Resources and Sustainability, University of Waterloo Email: tim.a@uwaterloo.ca

Stephen D. Murphy, PhD School of Environment, Resources and Sustainability, University of Waterloo Phone: (519) 888-4567 ext. 45616. Email: Stephen.murphy@uwaterloo.ca

Consent section

By providing your consent, you are not waiving your legal rights or releasing the investigators or involved institution from their legal and professional responsibilities.

Q01 With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

- ○ I agree to participate. (1)
- ○ I do not wish to participate (please close your web browser now). (2)

Q02 I agree to the use of anonymous quotations in reports.

- ○ Yes (1)
- ○ No (2)

Q4 Which organization do you mainly volunteer for? (responses to this question will only be used for analysis; names will not be mentioned in study results)

_____

Q5 How frequently do you volunteer with that organization?

- ○ Daily (1)
- ○ 4-6 times a week (2)
- ○ 2-3 times a week (3)
- ○ Once a week (4)
- ○ 4-6 times a month (5)
- ○ 2-3 times a month (6)
- ○ Once a month (7)
- ○ A few times a year (8)

Q6 How many years have you been volunteering with that organization?

- ○ Less than 1 year (1)
- ○ 2 to 5 years (2)
- ○ 6 to 10 years (3)
- ○ 11 or more years (4)

Q7 How old are you?

- ○ 18 to 25 years old (1)
- ○ 26 to 35 years old (2)
- ○ 36 to 45 years old (3)
- ○ 46 to 55 years old (4)
- ○ 56 to 65 years old (5)
- ○ Above 65 years old (6)

Q8 What is your gender? (e.g. female, male, non-binary)

_____

Q9 Which of the following best describes your ethnic background? Please check all that apply.

- ☐ Indigenous (Inuit/First Nations/Métis) (1)
- ☐ White/European (4)
- ☐ Black/African/Caribbean (5)
- ☐ Southeast Asian (e.g., Chinese, Japanese, Korean, Vietnamese, Cambodian, Filipino) (6)
- ☐ Arab (e.g., Saudi Arabian, Palestinian, Iraqi) (7)
- ☐ South Asian (e.g., East Indian, Sri Lankan) (8)
- ☐ Latin American (e.g., Costa Rican, Guatemalan, Brazilian, Colombian) (9)
- ☐ West Asian (e.g., Iranian, Afghani) (10)
- ☐ Other (please specify) (11) _____

Q10 Which activities do you do while volunteering?

- [ ] Monitoring (e.g. bird counts, plant surveys, etc.) (1)
- [ ] Planting (seeds) (2)
- [ ] Planting (nursery stock) (3)
- [ ] Invasive species management (4)
- [ ] Trail maintenance (5)
- [ ] Outreach (6)
- [ ] Fundraising (7)
- [ ] Project planning (8)
- [ ] Project management (9)

Q11 Did you have environmental education prior to joining this project?

- ○ Yes, lots (1)
- ○ Yes, some (2)
- ○ None (3)

Q12 Do you have work experience in ecological restoration or conservation?

- ○ Yes, lots (1)
- ○ Yes, some (2)
- ○ None (3)

Q13 How often do you feel the following in relation to your volunteering:

	Never (1)	Almost never (2)	Rarely (3)	Sometimes (4)	Often (5)	Very Often (6)	Always (7)
During my volunteer work, I feel bursting with energy. (1)	○	○	○	○	○	○	○
During my volunteer work, I feel strong and vigorous. (2)	○	○	○	○	○	○	○
I am enthusiastic about my volunteer work. (3)	○	○	○	○	○	○	○
My volunteer work inspires me. (4)	○	○	○	○	○	○	○
When I get up in the morning, I feel like going to my volunteer work. (5)	○	○	○	○	○	○	○

I feel happy when I am volunteering intensely. (6)	○	○	○	○	○	○	○
I am proud of the volunteer work that I do. (7)	○	○	○	○	○	○	○
I am immersed in my volunteer work. (8)	○	○	○	○	○	○	○
I get carried away when I am volunteering. (9)	○	○	○	○	○	○	○

End of Block: Volunteer engagement

Start of Block: Community capacity - transformational leadership

Q14 Rate your level of agreement with the following statements.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
The project leadership is motivated by helping others. (1)	○	○	○	○	○	○	○
Volunteers involved with the project trust the leadership. (2)	○	○	○	○	○	○	○
The leadership shows compassion for people. (3)	○	○	○	○	○	○	○
The volunteers involved with the project support the principles or values of the leadership. (4)	○	○	○	○	○	○	○

Volunteers involved with the project agree with the leadership's vision. (5)	○	○	○	○	○	○	○
The leadership tries to develop agreement in group decision-making. (6)	○	○	○	○	○	○	○
The leadership's vision is clear to people involved with the project. (7)	○	○	○	○	○	○	○
The leadership spells out its principles or values clearly. (8)	○	○	○	○	○	○	○

The leadership follows through on their commitments. (9)	○	○	○	○	○	○	○

Q15 Rate your agreement with the following statements:

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
In our group, volunteers engage in open and honest communication with one another. (1)	○	○	○	○	○	○	○
In our group, volunteers share and accept constructive criticism without making it personal. (2)	○	○	○	○	○	○	○
In our organization, volunteers keep each other informed at all times. (3)	○	○	○	○	○	○	○
I can rely on the volunteers I work with. (4)	○	○	○	○	○	○	○

Volunteers in our group show a great deal of integrity. (5)	○	○	○	○	○	○	○
Volunteers have confidence in one another in this group. (6)	○	○	○	○	○	○	○
Volunteers share the same ambitions and vision for this group. (7)	○	○	○	○	○	○	○
There is a commonality of purpose among volunteers in this group. (8)	○	○	○	○	○	○	○
Volunteers view themselves as partners in charting this group's direction. (9)	○	○	○	○	○	○	○

Q16 Rate your agreement with the following statements:

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
I have the technical knowledge needed to complete my volunteer tasks. (1)	○	○	○	○	○	○	○
There is someone I can ask for help if there is something I do not know how to do. (2)	○	○	○	○	○	○	○
I feel confident in my ability to complete volunteer tasks. (3)	○	○	○	○	○	○	○

I always have the tools needed to do my volunteer tasks. (4)	○	○	○	○	○	○	○
There are enough supplies for all the volunteers to complete their tasks. (5)	○	○	○	○	○	○	○
We have an adequate number of tools for the projects we take on. (6)	○	○	○	○	○	○	○
The group knows where it can go for funding. (7)	○	○	○	○	○	○	○

I feel confident that our group will continue to receive funding. (8)	○	○	○	○	○	○	○
Before the pandemic, I had many chances to work with government officials on projects. (9)	○	○	○	○	○	○	○

End of Block: Community capacity - organizational capacity

Start of Block: Other information

Q17 Do you supervise or manage other volunteers during events?

- ○ Yes, often (1)
- ○ Yes, sometimes (2)
- ○ No (3)

Q18 Why do you choose to volunteer with this organization?

_____

_____

_____

_____

_____

Q19 Is there anything else you wish to tell us about volunteering in ecological restoration?

_____

_____

_____

_____

_____

Q20 We will be contacting some people for follow-up interviews. May we contact you?

- Yes (1)
- No (2)

Display This Question:

If We will be contacting some people for follow-up interviews. May we contact you? = Yes

Q21 Your email address will not be associated with this survey response. Please use the following form to submit your email address (link opens in a new window):

https://uwaterloo.ca1.qualtrics.com/jfe/form/SV_3julQHP3lrCvT1A

Appendix C Results of multiple linear regression

```
lm(formula = compEngage ~ compOrgCap + compSocialCap + compTransfLdr,
    data = likert_comps)

Residuals:
     Min       1Q   Median       3Q      Max
-27.7770  -3.6581   0.5526   5.4158  18.9691

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)   14.59424    6.82943   2.137 0.034352 *
compOrgCap     0.13262    0.16844   0.787 0.432422
compSocialCap  0.53815    0.15435   3.486 0.000655 ***
compTransfLdr  0.07607    0.10645   0.715 0.476039
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 7.423 on 139 degrees of freedom
Multiple R-squared:  0.1734,  Adjusted R-squared:  0.1555
F-statistic: 9.716 on 3 and 139 DF,  p-value: 7.296e-06
```

Appendix D Results of path analysis model

```
lavaan 0.6-8 ended normally after 36 iterations

  Estimator                                         WLS
  Optimization method                           NLMINB
  Number of model parameters                         8

  Number of observations                           143

Model Test User Model:

  Test statistic                                 1.398
  Degrees of freedom                                 2
  P-value (Chi-square)                           0.497

Model Test Baseline Model:

  Test statistic                                38.417
  Degrees of freedom                                 6
  P-value                                        0.000

User Model versus Baseline Model:

  Comparative Fit Index (CFI)                    1.000
  Tucker-Lewis Index (TLI)                       1.056

Root Mean Square Error of Approximation:

  RMSEA                                          0.000
  90 Percent confidence interval - lower         0.000
  90 Percent confidence interval - upper         0.150
  P-value RMSEA <= 0.05                          0.607
```

Standardized Root Mean Square Residual:

SRMR	0.030

Parameter Estimates:

Standard errors	Standard
Information	Expected
Information saturated (h1) model	Unstructured

Regressions:

	Estimate	Std.Err	z-value	P(>|z|)
compSocialCap ~				
compOrgCap	0.297	0.106	2.795	0.005
compTransfLdr	0.370	0.101	3.680	0.000
compEngage ~				
compSocialCap	0.653	0.111	5.890	0.000

Covariances:

	Estimate	Std.Err	z-value	P(>|z|)
compOrgCap ~~				
compTransfLdr	10.357	3.317	3.123	0.002

Variances:

	Estimate	Std.Err	z-value	P(>|z|)
.compSocialCap	16.000	2.327	6.875	0.000
.compEngage	54.195	7.861	6.894	0.000
compOrgCap	16.538	2.567	6.443	0.000
compTransfLdr	48.815	9.152	5.334	0.000

R-Square:

	Estimate

```
compSocialCap     0.395

compEngage        0.172
```

Appendix E Consent Script

Introduction:

Thank you for meeting with me today. As a reminder, this study is about activities undertaken by participants in the Ottawa Wildflower Seed Library. I'm conducting this as part of my research for my PhD studies at the School of Environment, Resources and Sustainability at the University of Waterloo in Waterloo, Ontario, Canada. I'm working under the direction of Dr. Stephen Murphy the School of Environment, Resources and Sustainability at the University of Waterloo.

Have you had a chance to read the information and consent letter that was sent prior to this interview? Do you have any questions about the letter?

I will give you a brief summary of the key points of this letter. Your participation in this interview is voluntary and you can skip any questions you do not wish to answer.

I will ask you questions about activities that you took part in with the Ottawa Wildflower Seed Library, how accessible those activities were, and how your participation in those activities affected your level of skill and knowledge about ecological restoration.

I will take handwritten notes as well as use an audio recorder to make sure I don't miss what you say.

Your participation will be considered confidential and identifying information will be removed from the data that is collected and stored separately. Your name will not appear in any paper or publication resulting from this study, however with your permission, anonymous quotations from your interview responses may be used. The Ottawa Wildflower Seed Library will be named.

Participating in this study will contribute to an understanding of community-led ecological restoration. It may reveal ways of structuring activities that lead to reaching more participants, participants taking greater ownership over their work and improving their social connections, otherwise known as conviviality. If you have any questions about this study or would like more information you can email Tim Alamenciak at tim.a@uwaterloo.ca. You may also contact my supervisor, Prof. Stephen Murphy at Stephen.murphy@uwaterloo.ca.

This study has been reviewed and cleared by the University of Waterloo Research Ethics Board (REB# 44185). If you have questions for the Board, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or reb@uwaterloo.ca.

I would be pleased to send you a short summary of the study results when I finish going over our results. Please let me know if you would like a summary and what would be the best way to get this to you.

Consent:

By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

Consent questions:

- Do you have any questions or would like any additional details? [Answer questions.]

- Are you aware that the interview will be audio-recorded to ensure accurate transcription and analysis?
- Do you agree to the use of anonymous quotations in any paper or publication resulting from this study?
- Do you agree to participate in this study knowing that you can withdraw at any point
- up until February 2023 with no consequences to you?

[If yes, begin the interview.]

[If no, thank the participant for his/her time.]

Appendix F Modified consent script (Mélanie Ouellette)

Introduction

Thank you for meeting with me today. As a reminder, this study is about activities undertaken by participants in the Ottawa Wildflower Seed Library. I'm conducting this as part of my research for my PhD studies at the School of Environment, Resources and Sustainability at the University of Waterloo in Waterloo, Ontario, Canada. I'm working under the direction of Dr. Stephen Murphy the School of Environment, Resources and Sustainability at the University of Waterloo.

Have you had a chance to read the information and consent letter that was sent prior to this interview? Do you have any questions about the letter?

I will give you a brief summary of the key points of this letter. Your participation in this interview is voluntary and you can skip any questions you do not wish to answer.

I will ask you questions about activities that you took part in with the Ottawa Wildflower Seed Library, how accessible those activities were, and how your participation in those activities affected your level of skill and knowledge about ecological restoration.

I will take handwritten notes as well as use an audio recorder to make sure I don't miss what you say.

Are you comfortable being identified by name in reports resulting from this study, or would you like your participation to be confidential?

I will allow you to verify any direct quotations that will be used, and you will be able to review any reports that use your name prior to publication.

The Ottawa Wildflower Seed Library will be named.

Participating in this study will contribute to an understanding of community-led ecological restoration. It may reveal ways of structuring activity that leads to participants taking greater ownership over their work, otherwise known as conviviality. If you have any questions about this study or would like more information you can email Tim Alamenciak at tim.a@uwaterloo.ca. You may also contact my supervisor, Prof. Stephen Murphy at Stephen.murphy@uwaterloo.ca.

This study has been reviewed and cleared by the University of Waterloo Research Ethics Board (REB# 44185). If you have questions for the Board, contact the Office of Research Ethics, at 1-519-888-4567 ext. 36005 or reb@uwaterloo.ca.

I would be pleased to send you a short summary of the study results when I finish going over our results. Please let me know if you would like a summary and what would be the best way to get this to you.

Consent:

By providing your consent, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

Consent questions:

- Do you have any questions or would like any additional details? [Answer questions.]
- Are you aware that the interview will be audio-recorded to ensure accurate transcription and analysis?
- Do you agree to the use of anonymous quotations in any paper or publication resulting from this study?
- Do you agree to participate in this study knowing that you can withdraw at any point
- up until February 2023 with no consequences to you?

[If yes, begin the interview.]

[If no, thank the participant for his/her time.]

Appendix G Interview guide

Construct	Question	Probes/Notes
General	What is your age and primary occupation?	
General	How long have you been volunteering with the Ottawa Wildflower Seed Library?	
General	What inspired you to start volunteering with the Ottawa Wildflower Seed Library?	
General	Can you tell me what kinds of tasks you do while volunteering with the Ottawa Wildflower Seed Library?	Activities identified here will be explored in-depth below.
General	What does ecological restoration mean to you?	Would you call the work you do with OWSL ecological restoration? Are you familiar with the Society for Ecological Restoration?

Now we are going to begin the main portion of the interview. You identified several tasks that you do while volunteering with the OWSL. I will go through several questions for each task you do. Please provide as much detail as possible when answering each question.		
General	Walk me through what [Identified task – e.g. Seed Collecting] involves.	Where did you go? Who organized it? Did you need to get any permission? Why were you collecting seed? Where did the seed go? How many times did you engage in seed collecting? How much was collected?
Adaptability	While doing this task, did you learn skills that you could or have used elsewhere?	Would you feel comfortable using those skills to help other projects? Would you feel comfortable teaching someone else?
Adaptability	Would you feel comfortable engaging in the task outside of an organized event?	Have you engaged in the activity outside of the organization?
Sociality	Were there opportunities to socialize while doing the task?	How were those opportunities structured?
Sociality	Did you meet new people or deepen connections with existing friends?	Was there adequate time for socializing? How much of the focus was on getting the work done versus spending time together?
Sharedness	How many other people participated in the activity?	
Sharedness	What kind of recognition was given for the activity?	Was that recognition given to all or to one or two people?
Accessibility	Were there any restrictions on participation?	What were those restrictions? Was there any training or measures that would allow people to participate?
Accessibility	Do you think there are barriers to participating in this activity?	What are those barriers? Is there any effort to help people overcome them?

Accessibility	Would you describe participation in the activity as equitable?	For example, who might be excluded from participation?
Transparency	When doing seed collecting, do you feel you understood why you were doing it and to what ends?	
Transparency	What kinds of questions did you have about the activity?	Were there any questions you did not have answered?

Appendix H Member checking email

Dear <Participant>,

Thank you again for participating in an interview for my doctoral dissertation. I have spent a lot of time with the transcripts and done a great deal of data analysis. I have drawn some conclusions from the interviews and would like to share those with you in this email. I invite you to reflect on the themes and results, and to provide any feedback or additional thoughts you may have. What I have included below is a summary of the data that will be the basis for one of my dissertation articles. I welcome your reply by September 1, 2023, if you have anything you wish to add or clarify.

I am so appreciative of everyone who took the time to share their experiences. It has been a pleasure to work on this research, and inspiring to talk to so many passionate people.

Sincerely,

Tim Alamenciak

Abstract

Community practice of ecological restoration through native plant gardening is emerging as a means of addressing degradation in urban landscapes. However, the practice of native plant gardening remains niche and in opposition to the dominant horticultural standard. While native seeds can easily be harvested and shared, the knowledge of how to do so is not commonplace. Grassroots associations are emerging to support people in growing native plants, but within restoration ecology, there remains little understanding of how non-professionals engage in the practice. We expand and adapt Ivan Illich's concept of a convivial community tool (i.e. a tool that is accessible to all) to ecological restoration through a case study of the Ottawa Wildflower Seed Library. Through semi-structured interviews, participants highlighted two main strategies of the seed library: overcoming barriers and emergent practices. The seed library helped people overcome the barriers of plant availability, cost and knowledge, while supporting spontaneous initiatives from volunteers to further the mission of the seed library. We argue that these two strategies operationalize the idea of a convivial community tool. Future research could look at a wider sample of grassroots associations to verify and expand upon these two strategies. This research contributes an understanding of one way that ecological restoration can broaden its appeal by empowering non-professionals to engage in restoration.

Key results

- One primary strategy of the Ottawa Wildflower Seed Library is to help people overcome the barriers they face to native plant gardening. Specifically, three main barriers are: the availability of native plants, the cost of native plants and knowledge about native plants.
- Those barriers are overcome in two ways: through programming from the seed library (for example: seed giveaway, plant swap, educational workshops) and through community support (for example: answering questions, providing guidance, meeting like-minded peers).
- There are many volunteers who take initiative to do things to help further the mission of the seed library. For instance, several talked about picking up and dropping off materials. This is called "emergent practices" – these are things that are not planned, but offered by people to support the mission.
- Emergent practices occur because the Facebook group is a safe space, everyone feels welcome and there is a positive tone to the discussions.
- Overcoming external barriers can result in the creation of internal program barriers, which are often addressed through emergent practices (e.g. participants providing rides for each other).

Tables

Table 1 – Systemic barriers to native plant gardening

Barrier	Attempts to overcome	Example quote
Availability of native plants	• Seed pickups at multiple locations. • Year-round plant exchange facilitated through shared document. • Wide variety of species sought, donated and shared.	"I feel like they're doing a really wonderful service in in Ottawa, because before them, we all knew that accessing native plants was quite difficult and if you're relying on going to a Loblaws Superstore, you're not gonna find what you're looking for. We need to have a service like this where there's the due diligence, there's the knowledge of how to do it ethically, and how to do it locally and small batch, so that it's sustainable." *– Participant 3*
Cost of native plants	• Seeds given away for free. • Growing materials (e.g. pots, screens, soil) donated and shared. • Plant swaps facilitated.	"You get stuff for free and it seems like such a generous thing, because normally, you have to pay for seeds, and it's quite difficult to get native plant varieties. I've went on many fruitless trips to garden centers and stuff, looking for specifically native seeds, and here they are all available to us, and very

		conveniently too, at different locations across the city in the fall." – *Participant 7*
Native plant knowledge	• Resources posted on Facebook and website. • Knowledgeable volunteers at seed pick-up events. • Collaboration and knowledge-sharing encouraged.	"I had so many aha moments, and I'm still on my learning curve, but man have I ever learned a lot in the last less than a year and I just want to share that because this is important, and it's easy, it's super easy." – *Participant 11*

Table 2 – Program barriers

Barrier	Description	Attempt to overcome	Example quote
Time	Participants expressed that they needed to have free time to be able to participate in OWSL events and activities.	Tasks are split into smaller chunks to make them less time-consuming and provide multiple ways for people to engage with the work.	"I didn't feel like I had the time or the means. They were all doing such beautiful little seed packets, so I just chose to do an easier, really time commitment, was purchasing stamps." *– Participant 3*
Seed and plant knowledge	Participants often expressed feeling uncertain about seed sowing or plant identification and said that knowledge could be a barrier to participation.	Information is provided through the Facebook group. Volunteers are present at events provide guidance. Melanie dedicates one-on-one time to help people get started.	"I'm a bit nervous. I'm not that great of a gardener. Any time they've talked about stratification or all that like it all seems so complicated to me like having to like freeze things or make sure they get really cold, I kind of panic, but i'm hoping that maybe next year, […] my kids will be a bit older, I'll be able to maybe spend a bit more time learning about the process. I don't want to kill all these seeds that somebody else might be able to make live. If I end up doing it, I want to do it right." *– Participant 24*
Transportation	Getting to seed pickups and plant events can be a barrier for some participants.	Seed pick-ups are planned throughout the city, in locations accessible by transit. Melanie offers to mail	"Again, the biggest [barrier] would have been transportation. So the events were held, I think there were five events that were held, and they were all in different parts of the city, so that the idea was, try and make it as accessible as possible to people that they could

		seeds to those who cannot attend.	even just walk up to these things. But in order to participate in them you had to drive to get there.” – *Participant 11*
Garden space	In order to grow the plants, participants need access to some sort of outdoor space.	Connecting participants with one another to garden in shared spaces. Providing plants and resources for container gardening.	“You need to have, probably, you need to have your own garden, which means you need to have access to land. Or I suppose it's possible that you could definitely go into wild spaces, parks. But I believe it's, it's difficult to access a lot of different species. You know, you'd be limited to the kinds of species you could donate if you were only going to collect from wild areas.” – *Participant 2*
Physical ability	Some tasks, such as handling small seeds, may contain barriers for people with disabilities.	Task splitting has been used to make some tasks more accessible (e.g. people who do not have the dexterity to sort seeds may be able to fold seed envelopes).	“Some of the seeds being so small it's kind of, you need some dexterity to be able to grab the seeds and put them in the put them in the envelopes. But again, most seeds are big enough that it's not an issue.” – *Participant 11*
Internet access	The OWSL primarily operates through Facebook and its website, which may be a barrier for people	In-person presence at big events and festivals. Plans to do further outreach.	“The fact that it's mostly Internet-based I guess might not be completely accessible to everyone, both from a like a computer or technical skills component.”

	who lack technology skills or internet access.		– *Participant 16*