UNDERSTANDING VOLUNTEER MOTIVATIONS TO PARTICIPATE IN CITIZEN SCIENCE PROJECTS: A DEEPER LOOK AT WATER QUALITY MONITORING

by

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ABSTRACT

Understanding Volunteer Motivations to Participate in Citizen Science Projects: A Deeper Look at Water Quality Monitoring

Bethany J. Alender

Volunteer water quality monitors represent the cross section between citizen science and environmental stewardship. They provide a vital resource to society and the environment by identifying sources of pollution and unhealthy water bodies, yet these volunteers have been understudied. Volunteer retention is one of the biggest challenges faced by citizen science, and understanding what motivates participation will enable project managers to improve recruitment and retention.

This study surveyed 271 volunteers from eight water quality monitoring organizations in five U.S. states. Survey questions were designed to identify both intrinsic and extrinsic motivators as well as variations by age, gender, and length of involvement with the organization. Motivations that allow volunteers to express their values (particularly those related to altruism) were the most important (e.g. to help the environment or the community). Other highly important motivators helped individuals escape negativity (to get outside or connect with nature) or contributed to understanding (to contribute to scientific knowledge, to learn about water quality, and to learn new skills or knowledge). Social learning was also an important motivator (to learn from others and to share knowledge with others). The least important motivator was career advancement. There was no difference in the importance of motivations based on gender. However, younger volunteers have different motivations and preferences than older volunteers.

Preferences about training, weather, responsibility, group size, and type of recognition were revealed. Respondents indicated a strong desire for results to be shared with them and even more importance was placed on identifying and addressing environmental problems with the use of their data. Volunteers value the communication of tangible results more than recognition or reward.

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Chapter 1: Introduction

1.1 Purpose

Citizen science projects involve the general public in scientific research and have the capacity to collect and analyze more data than scientists alone. This enables community groups and government agencies to monitor and respond to environmental issues more efficiently (Conrad & Hilchey, 2011). Because citizen science depends on volunteers, project managers need to have a thorough understanding of volunteers, but most organizations lack the resources to conduct internal research.

The purpose of my thesis research is to gain an understanding of volunteer motivations to participate in citizen science projects – specifically those that focus on environmental stewardship. To complete this research, I have reviewed the published literature and surveyed volunteers from organizations that monitor water quality because this activity reflects a unique characteristic of volunteers who want to contribute both to environmental protection and the scientific process. This study provides insight into strength of motivations and how motivations vary by demographics. Project coordinators can use this information to reduce costs associated with volunteer recruitment and retention.

I will begin this chapter by introducing the reader to citizen science and its significance. This is followed by a discussion of the importance of understanding volunteers and an introduction to volunteer water quality monitoring. Finally, I give an overview of the contributions of this study and the contents of this thesis.

1.2 What is Citizen Science?

"Citizen science" is a term that refers to public involvement in scientific research and inquiry (Dickinson & Bonney, 2012; "SciStarter," n.d.; Theobald et al., 2015). A "citizen scientist" is any member of the public who voluntarily contributes to research, typically by collecting or analyzing data (Dickinson & Bonney, 2012; Raddick et al., 2010; "SciStarter," n.d.). Anyone can be a citizen scientist, trained or untrained, and projects may contribute to any field of research including, but not limited to: ecology, environment, pollution, health, medicine, psychology, statistics, computer science, and astronomy (Dickinson & Bonney, 2012; Rotman et al., 2014; "SciStarter," n.d.; Theobald et al., 2015).

The longest running example of a citizen science project is the National Audubon Society's Annual Christmas Bird Count ("About the Christmas Bird Count," n.d.). Celebrating its 115th anniversary in 2014, the Bird Count began as an alternative to the traditional "Side Hunt," a hunting competition that led to concern for observed declines in bird populations. For the Christmas Bird Count, volunteers sign up to join a group of counters during December; they identify birds in a specified location and submit their data online. The data show changes in bird populations over both time and space, which can indicate environmental changes and inform management decisions about habitat ("About the Christmas Bird Count," n.d.).

There are hundreds of citizen science projects around the world and their topics vary tremendously ("SciStarter," n.d.). Another example of citizen science is a fish survey conducted by the Reef Environmental Education Foundation (REEF). Volunteers receive training and record fish species while they enjoy snorkeling or scuba diving

("REEF," n.d.). Countless organizations support volunteer water quality monitoring efforts, which vary from chemical tests to macroinvertebrate surveys of water bodies from estuaries to groundwater (US EPA, n.d.). Other projects monitor light pollution ("Dark Sky Meter," n.d.) or seasonal changes in plants and animals ("Project BudBurst," n.d., "USA National Phenology Network," n.d.).

Because citizen science projects vary widely across disciplines and activities, it is helpful to narrow the scope of this study to offer a deeper understanding of a subset of the population. My own interest in environmental stewardship and outdoor activity has led me to focus on projects that promote those interests rather than citizen science projects that are completely online or that fall in different disciplines. Therefore, this thesis will be limited to projects that pertain to water quality monitoring, but the results will be useful to any organization with a focus on environmental stewardship and data collection.

1.3 Citizen Science: The Term

Citizen science refers to projects that engage the public in scientific research (Dickinson & Bonney, 2012). The field of projects belonging to citizen science has taken many names, such as volunteer biological monitoring, community science, community-based monitoring, and participatory monitoring (Shirk et al., 2012). Shirk et al. proposed a new umbrella term in 2012 for all fields that involve the public in the scientific process: public participation in scientific research (PPSR). PPSR can be applied to projects in health, astronomy, ecology, the environment, or any other field. Although PPSR is an all-encompassing and self-explanatory term, many authors have more readily adopted use of the term "citizen science." For example, the Ecological Society of America recently

published a series of articles specifically dedicated to citizen science in the journal *Frontiers in Ecology and the Environment*. Additionally, a new professional society, called the Citizen Science Association (CSA), has emerged in the past year; CSA will be hosting a conference entirely dedicated to citizen science and will publish a journal in 2015 ("Citizen Science Association," n.d.). In this thesis I will use the term "citizen science" because it is simple, does not require an acronym, and is gaining acceptance in the scientific community.

1.4 Why Citizen Science?

Citizen science is growing in number of projects and participants (Conrad & Hilchey, 2011; Dickinson & Bonney, 2012; "SciStarter," n.d.; Theobald et al., 2015). Technology and the Internet have allowed for more efficient data collection and more immediate engagement for participants (Raddick et al., 2010; Rotman et al., 2014); the multifaceted and interconnected benefits of citizen science provide services to both ecosystems and people (Dickinson & Bonney, 2012). Citizen science projects generally have several overlapping goals that yield benefits in three major categories: outcomes for scientific research such as data collection, outcomes for participants including education and new skills, and outcomes for social-ecological systems like conservation, stewardship, and policy (Dickinson & Bonney, 2012; Shirk et al., 2012). In this section I describe some of the benefits and limitations that accompany citizen science projects.

Benefits

Social and ecological benefits derived from citizen science projects include: enhanced relationships between citizens and management agencies, better wildlife habitat, improved ability to address environmental problems, and increased citizen engagement in policy (Shirk et al., 2012). Ecosystem research efforts often lack resources for thorough and on-going monitoring, yet government agencies require monitoring to make management decisions (Conrad & Hilchey, 2011). Citizen science provides a cost-effective alternative to employee monitoring (Conrad & Hilchey, 2011; Nov, Arazy, & Anderson, 2014). Additionally, when the public collaborates with researchers, community groups are enabled to "monitor, track, and respond" to environmental issues (Conrad & Hilchey, 2011, p. 274; Nov et al., 2014).

For example, Santa Barbara ChannelKeeper is a non-profit organization that conducts monthly water quality monitoring with volunteers in a program called Stream Team ("Stream Team," n.d.). Stream Team promotes stewardship by engaging community members in an accessible outdoor activity and educates the community about local water issues. Local government agencies use Stream Team data to evaluate stream health and address pollution problems. Stream Team data has led to the cleanup of sixteen impaired streams between Santa Barbara and Ventura, California ("Stream Team," n.d.). Without the effort of volunteers, the state agencies responsible for enforcing water quality regulations may not have been able to effectively monitor and address these problems.

Limitations

Because funding and resources are limited, citizen science projects make trade-offs between their goals of research, education, and stewardship (Dickinson & Bonney, 2012), which may reduce the project's ability to tackle complex issues (Shirk et al., 2012). The main challenges for citizen science projects include collection of rigorous data and program organization (Conrad & Hilchey, 2011).

The scientific and government communities struggle to trust citizen science data for several reasons: data may be subjected to fragmentation, inaccuracy, lack of objectivity, poor experimental design, and inadequate sample size (Conrad & Hilchey, 2011). Some scientists and government agencies also do not have confidence in the level of training volunteers receive. On the other hand, some researchers have found that data collected by volunteers can be comparable to data collected by trained professionals when a little effort is applied to validation and calibration (Conrad & Hilchey, 2011).

At the organizational level, the main challenges to citizen science projects include funding and volunteer recruitment (Conrad & Hilchey, 2011). These two issues may be reinforcing since funding is needed to recruit volunteers and volunteer participation is often needed to attract funding (Dickinson & Bonney, 2012). Thus understanding volunteer motivations to participate is a critical element of producing a successful citizen science project.

1.5 Understanding Volunteers

Volunteers are the backbone of citizen science projects. If project managers want to generate the best outcomes possible, they need to understand what drives volunteers.

Further, understanding volunteers helps managers tailor their projects and recruitment strategies, reducing time and money spent on the wrong techniques.

Volunteer project outcomes are influenced by both quantity and quality of participation (Shirk et al., 2012). *Quantity* of participation reflects the number of participants and how much time they spend participating. *Quality* of participation reflects "the extent to which a project's goals and activities align with, respond to, and are relevant to the needs and interests of public participants" (Shirk et al., 2012, p.4). If the *quality* of participation is carefully cultivated, then increased *quantity* of participation can lead to enhanced outcomes. Thus taking volunteer motivations into account can increase both the quantity and quality of participation and improve the ability of the project to meet its goals (Shirk et al., 2012).

While citizen science projects offer a cost-effective way to collect more data than scientists could accomplish on their own, it is important to point out that volunteers are *not* free labor: "Financial and human resources are required to recruit, train, supervise, and retain volunteers and to recognize their accomplishments" (Jacobson, Carlton, & Monroe, 2012, p.53). Understanding volunteer motivations will help project managers reduce recruitment and retention costs and maximize the benefits derived from volunteerism (Jacobson et al., 2012; Raddick et al., 2010; Shirk et al., 2012).

1.6 Volunteer Water Quality Monitoring

Not all citizen science projects are environmental and not all environmental projects involve citizen science. However, water quality monitoring projects represent the intersection because they have stewardship goals and they collect data to meet those

goals (**Figure 1**). For this reason, it is useful to understand both types of volunteers and analyze the overlap.

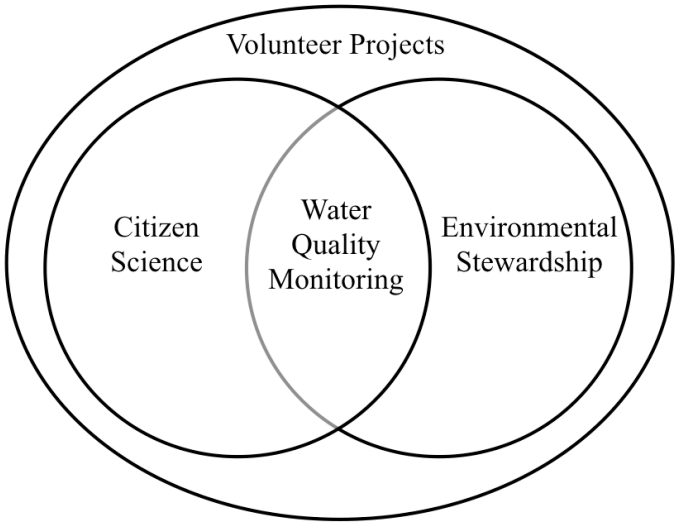

Figure 1. Venn diagram showing the relationships of volunteer projects. Water quality monitoring projects lie at the intersection of citizen science and environmental stewardship.

Water quality monitoring is an established volunteer activity in the United States. Approximately 1,800 volunteer groups are represented in the National Volunteer Water Monitoring Program Directory as of 2013 ("Volunteer Water Monitoring and Master Naturalist Programs in the US," 2013). An estimated 8,500 volunteers across the U.S. monitor all types of water bodies including rivers, streams, lakes, ponds, wells, wetlands and estuaries (Overdevest, Orr, & Stepenuck, 2004). Currently, twenty-six states sponsor volunteer monitoring programs and efforts are being made to enhance nationwide support for these programs (Overdevest et al., 2004).

The Environmental Protection Agency is pushing state agencies to increase the number of water bodies assessed in their reports to Congress, yet these agencies are

typically understaffed (Addy, Green, Herron, & Stepenuck, 2010). Thus, volunteer water quality monitoring programs provide a great service to society while also engaging the public in watershed protection and enhancement (Addy et al., 2010).

Due to personal connections to water bodies – such as being a recreational user, being a property owner, or valuing a cultural aspect of the water – volunteers are passionate about water bodies (Addy et al., 2010). This passion translates into a dedication to protect water resources. Through training and monitoring activities, volunteers can learn about water quality issues, how their actions affect the water, and what can be done to protect water bodies and human health. Volunteers often share what they have learned with others and become involved in management decisions (Addy et al., 2010), effectively meeting all three goals of citizen science: education, research, and stewardship.

1.7 Contributions of this Study

Peer-reviewed literature on citizen science projects is "both limited and dispersed across fields;" existing empirical evidence is insufficient to guide project managers toward successful project design (Nov et al., 2014; Shirk et al., 2012, p.2). Volunteer motivations have been studied in many fields, but few studies have been published on motivations that pertain specifically to participants in citizen science projects (Nov et al., 2014; Raddick et al., 2010). If project managers have a good understanding of what motivates participation, they can reduce recruitment and retention costs and maximize the benefits derived from volunteers (Jacobson et al., 2012; Raddick et al., 2010; Shirk et al., 2012). This study illuminates motivations specific to citizen science volunteers and

explores how these motivations vary by demographics so that managers can prioritize their resources.

1.8 Overview

In Chapter 1, I have given the reader a brief introduction to citizen science, benefits and limitations of citizen science, water quality monitoring, and why understanding volunteer motivations is important. In Chapter 2, I review the peer-reviewed literature to understand volunteers in citizen science and environmental stewardship programs. This review will serve to support the methods I have chosen for my research, which are described in Chapter 3. Chapter 4 will reveal the results of the study along with analysis and discussion. A summary of the study and my conclusions are presented in the final Chapter 5.

Chapter 2. Literature Review

2.1 Introduction

Citizen science projects have the ability to tackle complex environmental issues by educating the public, providing data to researchers, and informing management agencies. The momentum building behind these projects can be attributed to an increased awareness and concern about human impacts on ecosystems (Conrad & Hilchey, 2011). Because citizen science projects inherently depend on volunteers, understanding their motivations is critical to developing a successful program (Jacobson et al., 2012). In this section I review the published literature on volunteer motivations. Although the literature specific to citizen science is limited (Nov et al., 2014; Rotman et al., 2014), particularly to ecology-driven citizen science, volunteerism cuts across disciplines. Thus, many articles reviewed pertain to environmental volunteerism in general.

First I present the predominant framework for assessing volunteer motivations for any type of volunteer (Section 2.2). Then I review articles that pertain to volunteers involved in environmental stewardship projects (Section 2.3). These projects do not necessarily ask volunteers to be involved with the scientific process but they ask volunteers to participate in environmental protection or enhancement projects, such as invasive weed control, pollution cleanup, and habitat protection. Next I review studies that pertain specifically to citizen science projects (Section 2.4). These are related to water quality monitoring because they ask volunteers to collect or analyze data. Last, I review motivations specific to water quality monitors (Section 2.5) and conclude this chapter with a summary (Section 2.6).

2.2 Framework for Assessing Volunteer Motivations

In the 1990s, much of the literature on people who voluntarily make sacrifices for others focused on situations where there is an unexpected need for help. Referred to as "spontaneous helping," the helper makes a brief singular action to assist someone in immediate need (Clary et al., 1998, p. 1516). Yet at this time, not many studies had evaluated the psychology of *volunteerism*, which is a very different form of helping. Those who volunteer typically engage in "planned helping" by actively seeking out opportunities to help (Clary et al., 1998, p. 1517). Volunteers may deliberate for quite some time about where, when, and how much they will volunteer; and they often make a commitment to help on many occasions over a long period of time.

In a seminal article on volunteer motivations, Clary et al. (1998) explored reasons for people to volunteer and why they continue volunteering. Hypothesizing that volunteerism serves psychological functions, Clary et al. developed the Volunteer Functions Inventory (VFI) as an instrument to evaluate these functions. A core property of functionalism – the underlying theory of the VFI – is that people can serve distinct psychological functions by performing the same actions (Clary et al., 1998). Six motivational functions were identified:

1) *Values.* Volunteering allows individuals to express their values, particularly those related to altruism and concern for others.
2) *Understanding.* Volunteering offers the opportunity to learn, have new experiences, and "exercise knowledge, skills, and abilities that might otherwise go unpracticed" (p. 1518).

3) *Social.* Volunteering has a social element that allows individuals to develop relationships or to "engage in an activity viewed favorably" by people of personal importance (p. 1518).
4) *Career.* Volunteers may be able to prepare for a new career by developing skills or networking.
5) *Ego Protective.* Volunteering may allow individuals to protect their ego by escaping negative feelings and reducing guilt associated with the feeling of being more fortunate than others.
6) *Ego Enhancement.* In contrast to the protective function, volunteering also serves an enhancing function for the ego related to personal growth and self-esteem.

In the study by Clary et al., volunteers reported satisfaction and intent to continue volunteering when they received benefits relevant to their primary motivations. Clary et al. (1998) found that motivations must match the opportunities provided by the volunteer activities:

> "It follows from the functional account of volunteerism that people can be recruited into volunteer work by appealing to their own psychological functions, that they will come to be satisfied volunteers to the extent that they engage in volunteer work that serves their own psychological functions, and that they will plan to continue to serve as volunteers to the extent that their psychological functions are being served by their service" (p. 1518).

Many researchers have since used the VFI to assess volunteer motivations in an array of fields (Bruyere & Rappe, 2007), and the VFI has been adapted and referenced in many studies on environmental volunteers as illustrated by the studies in the next section.

One of the limitations to the VFI is that many motivations expressed by volunteers may fall into more than one of the six functions identified. Therefore, categorizing motivations uniformly is difficult and researchers have not adopted a standard categorization methodology. Comparing results and findings across studies is consequently impaired to some degree. For future research, I would urge researchers to establish a standard framework that could be adapted for unique situations. Because of its reputation, the Volunteer Functions Inventory would be a great starting point and researchers should attempt to place motivations in one of the six categories.

2.3 Motivations to Participate in Environmental Stewardship Projects

The first study to evaluate the motivations of people who volunteer for environmental organizations was conducted in 1998, the same year as the Clary et al. publication on VFI, so it does not incorporate the functional motivations (King & Lynch, 1998). In this study the researchers surveyed 86 volunteers from the Ohio Chapter of The Nature Conservancy. They sorted volunteer motivations into three categories based on previous literature:

1) *Altruistic*. People motivated by altruism aim to help others.
2) *Social*. People with social motives seek out engagement with others.
3) *Egoistic.* People with egoistic motives aim to increase their own knowledge, skills, or self-esteem. (King & Lynch, 1998)

If these three motivations were categorized into the VFI functions, altruistic motivations could fit into the values function; social motivations correlate with the social function;

and egoistic motivations could be divided into protective, enhancement, and understanding functions.

The survey included a series of four statements in each of the three categories above. Respondents could select all that apply from the 12 options, and they were asked if their motives were fulfilled. Respondents were also asked to select one motivation that most strongly aligned with their initial reason to participate and if their motivations had changed over time.

For the first question (in which respondents could choose all motivators that applied to them) almost all of the respondents (82 of 86) selected an altruistic motivation – "to do something for nature" – as one motivation (**Table 1**). The next most frequent choice (40 of 86) was also altruistic – "to allow the organization to provide more goods/services for less money" (King & Lynch, 1998, p. 8). Other frequent choices (34-36 of 86) were an altruistic motivation ("to help create a better society"), a social motivation ("to stay active")[1], and an egoistic motivation ("to learn new skills") (p.8). This study shows that the most popular reason to volunteer for the Nature Conservancy is altruistic – "to do something for nature" – and two more altruistic motivations also floated to the top in frequency (King & Lynch, 1998).

[1] Many categories of motivators established by the authors of the articles reviewed here are overlapping and sometimes the fits are arguable. For example, I question the categorization of "to stay active" as a social motivation because it is not exclusively a social activity. At its root "staying active" seems like a personal gain that would help one

Reason	Motive	Number of respondents out of 86 who marked this response.*
To do something for nature	Altruistic	82
To allow the organization to provide more goods/services for less money	Altruistic	40
To learn new skills	Egoistic	36
To stay active	Social	35
To help create a better society	Altruistic	34
Makes me feel better about myself	Egoistic	32
To develop social contacts	Social	30
To feel useful	Egoistic	30
To make friends	Social	26
To explore career options	Egoistic	22
To change social injustices	Altruistic	12
Because of the prestige of the organization	Egoistic	9

*Each reason (motive) could have a possible value of 86 because respondents were permitted to mark multiple reasons for volunteering.

Table 1. Motivations to volunteer for The Nature Conservancy (choose all that apply). Motivations are in order of most frequently selected to least frequently selected (King & Lynch, 1998).

In the second question (when asked to select the single motivation that most strongly aligned with the individual's reason to participate) the most popular choice (62.7%) was the same as when the respondents could choose all that apply – "to do something for nature" (**Table 2**). The second most frequent choice (10.2%), "to explore career options," was one of the least frequent choices in the previous question when respondents could choose all that apply (King & Lynch, 1998). The results from this question may be subjected to response bias because only 31% of respondents answered it; additionally, the gap between the first (62.7%) and secondary (10.2%) choices shows that the secondary motivators are relatively weak.

Reason	Motive	Number of respondents who marked this response*	Percentage
To do something for nature	Altruistic	37	62.7
To explore career options	Egoistic	6	10.2
To help create a better society	Altruistic	5	8.5
To allow the organization to provide more goods/services for less money	Altruistic	4	6.8
To feel useful	Egoistic	3	5.1
Makes me feel better about myself	Egoistic	2	3.3
To make friends	Social	1	1.7
To learn new skills	Egoistic	1	1.7
Total		59	100

*Respondents were permitted to identify only one reason (motive) in this question.

Table 2. Motivations to volunteer for The Nature Conservancy (choose only one option). Motivations are in order of most frequently selected to least frequently selected (King & Lynch, 1998).

A few more important results came out of this study. Most of the respondents were male, middle-aged, and very well-educated; however no attempt was made by the authors to see if motivations vary by gender, age, or other demographics (King & Lynch, 1998). Nearly all respondents chose more than one option when they could choose all that apply, showing that volunteers usually participate for multiple reasons, although most identified with altruistic motivations more frequently. Finally, when asked if their motivations had changed over time (the average service time was 3.5 years), just under 20% of respondents said yes, and 95% reported that their motivations were fulfilled (King & Lynch, 1998). This suggests that the activities offered by The Nature Conservancy are well matched to volunteers' motivations and the activities have some flexibility to adapt to changing motivations over time.

A study published three years later, found important differences between initial motivators and motivators that correlate with long-term commitment, showing that motivations to participate *do* change over time (Ryan, Kaplan, & Grese, 2001). The

authors found from previous literature that altruism (e.g. helping the environment) was an important motivation for initializing participation, but self-interest motivations (e.g. developing relationships) were important for continued participation. Ryan et al. (2001) specifically surveyed long-term volunteers – defined as volunteers who had spent at least one year with one organization. The researchers surveyed 148 volunteers from three stewardship organizations in Michigan, one of which was a watershed council with water quality monitoring activities.

First, the researchers assessed volunteer commitment scores by combining the responses of those who volunteer on a regular and basis and those who consider volunteering a high priority. Volunteers with strong commitment scores correlated with high frequency of participation, but length of involvement with the organization did not correlate with either commitment or frequency. This suggests that a key to volunteer retention is frequent opportunities to participate (Ryan et al., 2001). It can be inferred that participation frequency may tie in with social motivators: the more often volunteers participate, the more likely they are to develop relationships which reinforce the motivation to participate. Later in the study, social motivators are revealed to be a predictor of commitment, reinforcing this inference.

Ryan et al. (2001) found that age, distance to volunteering site, time, and specific activity were not correlated to a volunteer's commitment, duration, or frequency of volunteering. I would argue, based on discussions with volunteers and volunteer managers, that these are important to initial volunteers. An individual is likely to make a decision to *begin* volunteering for an organization based on these factors. However, since the volunteers in this study have been volunteering for at least one year, they have

already gone through a decision-making process based on these factors and their continued service is more dependent on other elements. Volunteer recruiters could benefit from a survey that asks how far or how much time individuals would be willing to travel to volunteer sites. This would enable the recruiters to target people that live within a specific radius of their project sites. Ryan et al. found that more than half of volunteers lived within five miles of their project site (2001).

Ryan et al. (2001) identified seven motivational themes using a five-point rating scale (**Table 3**). The highest rated motivation was "feeling of doing something useful," which is related to the second highest rated motivation – "helping the environment" – but might be broader and less tangible. "Feeling of doing something useful" would best fit in the ego enhancement function of the VFI, while "helping the environment" would be considered a value function because it is related to altruism. Third highest rated was "learning," which would fit in the understanding function of the VFI, but its score is not significantly different from "helping the environment." "Project organization" and "social" followed without significant difference between each other. "Reflection" was rated lower than "social" but showed no significant difference. The lowest rated item was "making decisions about projects." This was surprising because it is contrary to literature that suggests volunteers (any type of volunteer) can be retained by offering them leadership positions (Knoke, 1981; Ryan et al., 2001).

	Cronbach α	Mean	Standard deviation
Helping the environment	0.79	4.09[a]	1.02
Seeing improvements to the environment			
Helping to restore natural areas			
Learning	0.77	3.98[a]	0.89
Nature observation			
Learning about specific plants/animals			
Learning new things			
Project organization	0.75	3.26[b]	0.92
Projects are well organized			
Feeling needed			
Knowing what is expected of me			
Working with a good leader			
Social	0.79	3.14[b,c]	0.95
Seeing familiar faces			
Meeting new people			
Having fun			
Reflection	0.80	3.05[c]	0.80
Having a chance to reflect			
Opportunities to work at my own pace			
Doing something physical			
Feeling peace of mind			
Individual items			
Feeling of doing something useful		4.39	
Making decisions about projects		2.10[b,c]	

Note: Same superscripts are not significantly different at $p < 0.05$.

Table 3. Motivations for continued participation in three stewardship projects. Motivations are in order of highest to lowest mean score (except for the "Individual items" category). Responses were weighted on a five-point scale (Ryan et al., 2001).

Ryan et al. (2001) also wanted to see if any of these motivators were predictors of long-term commitment. They used multiple regression analysis and found that "project organization" and "social" were positive predictors for commitment. Disorganized projects can dampen an individual's willingness to participate. Project managers could enhance the volunteer's experience by asking volunteers with expertise to help newer

volunteers which would serve the VFI social and enhancement functions by recognizing the individual's value to the group (Ryan et al., 2001).

In 2007, Bruyere and Rappe surveyed 401 volunteers from six environmental stewardship organizations located near Colorado State University. The survey asked respondents to rate the importance of motivations on a seven-point scale from "strongly unimportant" to "strongly important" (Bruyere & Rappe, 2007, p. 508). Motivation categories were based on the Volunteer Functions Inventory (Clary et al., 1998) plus three additional categories – "help the environment," "project organization," and "user" (a "user" is a person who uses or enjoys a particular area, e.g. for hiking or fishing). Again, "help the environment" could fit under the value function of the VFI, but the other two are more difficult to categorize.

Bruyere and Rappe (2007) also found that "help the environment" was the highest rated motivation to participate (mean = 6.11 out of 7) and the lowest rated motivation was "career" (**Table 4**). Only 20% of respondents were current students while 40% were 50 years of age or older (thus more likely to be settled in career); these factors may explain why "career" was rated lowest. The authors mention a possible relationship between students and the "career" motivator, but they do not quantitatively assess the relationship. The remaining five categories – "user," "learning," "social," "project organization," and "values and esteem" – were rated almost equally to each other (mean scores were between 4.59 and 4.96) (Bruyere & Rappe, 2007). These results are very similar to those found by King and Lynch (1998) and Ryan et al. (2001). No demographic patterns were explored in this study.

	Loading[2]	Cronbach's Alpha	Mean[3]
Help the Environment		*0.92*	*6.11*
Concern for the environment	0.87		
Protecting natural areas from disappearing	0.83		
Do something for a cause that is important to me	0.73		
See improvements to the environment	0.80		
Ensure future of natural areas for my enjoyment	0.69		
Help restore natural areas	0.71		
Help preserve natural areas for future generations	0.80		
Career		*0.92*	*2.82*
Get a foot in the door at a place where I would like to work	0.90		
Make contacts that might help career	0.90		
Explore possible career options	0.89		
Experience will look good on resume	0.87		
Help me succeed in chosen profession	0.92		
User		*0.76*	*4.96*
Allow me to work on an area where I visit	0.70		
Enrich my future recreation experiences	0.80		
Enhance the activities I enjoy doing	0.70		
Learning		*0.81*	*4.91*
Learn about specific animals	0.75		
Learn about specific plants	0.73		
Learn about environment	0.62		
Observe Nature	0.55		
Social		*0.71*	*4.88*
Meet new people	0.67		
Work with friends	0.36[4]		
See familiar faces	0.23[4]		
Have fun	0.72		
Project organization		*0.76*	*4.59*
Work with a good leader	0.72		
Know what is expected of me	0.69		
Be part of a well organized project	0.53		
Values and esteem		*0.68*	*4.96*
Feel better about myself	0.50		
To express my values through my work	0.58		
Feel needed	0.60		
To live closely to my values	0.55		

Notes: [1]Retained factors had an eigenvalue >1.025.
[2]Items with a loading below 0.40 were deleted.
[3]Rated on a scale of strongly unimportant (1) to strongly important (7).
[4]Although loading is <0.40, item was retained for strong theoretical fit.

Table 4. Motivations to participate in six stewardship projects. Means are highlighted for clarity. The first two categories have the highest and lowest means. The other five categories have means very close to each other. Responses were weighted from 1 for "strongly unimportant" to 7 "strongly important" (Bruyere & Rappe, 2007).

This study also asked a few open-ended questions and identified an additional motivation that occurred in 18% of the responses: "to get outside" (Bruyere & Rappe, 2007). This motivator is not clearly expressed by the respondents; "to get outside" could serve a variety of psychological functions depending on the individual. For example, getting outside may act as a form of respite from daily life (Bruyere & Rappe, 2007) and thus serves an ego protective function allowing individuals to escape negativity, as described by the VFI. Getting outside could also relate to a desire to maintain physical well-being. This motivation may imply that volunteers will be less likely to attend outdoor events when the weather is unfavorable (Bruyere & Rappe, 2007).

This study supports the claim made by King and Lynch (1998) that volunteers have multiple reasons for participation. Volunteers not only want to help the environment, but they also want to feel like they are part of something with purpose that allows them to express themselves. Additionally, project organization is equally important as the psychological motivations. Volunteers do not want to give their time when they feel it is being wasted.

Asah and Blahna (2012) found that the study by Ryan et al. (2001) was the only study to assess whether motivations are predictors of long-term participation and conducted another study to address the same topic. They developed a survey that asked 242 volunteers in urban conservation to rate motivations on a five-point scale from "very unimportant" to "very important." Asah and Blahna (2012) found six motivational categories that are similar to previous studies (in order of highest to lowest mean): "environment," "community," "social interactions," "ego defense and enhancement," "escape and exercise," and "career and learning," (**Table 5**). These motivations are very

similar to the VFI and could be easily compared with other studies except in cases where motivations are lumped together. For example, "career and learning" should not be combined, because they serve very different functions and project coordinators will need to know which of the two is more motivating.

Dimensions of motivations and constitutive items	Mean	Standard deviation	Cronbach α
Environment	4.25	0.61	0.89
To help protect the environment			
To contribute to environmental sustainability			
To help restore some aspect of the environment			
To give back to the environment			
To enhance parks and recreational areas			
To feel connected to my surrounding landscape			
Career and learning	3.10	0.80	0.72
To get my foot in the door for jobs			
To learn job skills			
To learn about the volunteering organization concerned			
To learn more about the type of work being done			
Community	3.96	0.58	0.66
To show my community that I care			
To feel connected with my community			
To show that I can make a difference			
To give something back to my community			
Escape and exercise	3.17	0.84	0.67
To get out of the house			
To get away from the busy demands of everyday life			
To get exercise			
Social interactions	3.70	0.61	0.63
To be with like-minded people			
To be with friends			
To enjoy the experience			
To see people and talk with them about volunteering and other things			
Ego defense and enhancement	3.32	0.81	(0.36)
To feel less guilty about the problems we cause to the environment			
To show that I can make a difference			

Table 5. Motivations to participate in urban conservation. The first two categories have the highest and lowest means. The other four categories have means very close to each other. Responses were weighted from 1 for "very unimportant" to 5 "very important" (Asah & Blahna, 2012).

During a preliminary interview process, Asah and Blahna (2012) found that volunteers noted a distinct difference in their reasons for volunteering in general compared to their reasons for volunteering for their favorite stewardship organization, which was largely motivated by social reasons. The researchers looked at how different motivators influenced volunteer intensity between volunteering in general and volunteering for a favorite organization. They found that "helping the environment" was only a marginally significant predictor of participation. "Ego defense and enhancement" was a significant predictor of participation frequency for general volunteering, whereas "social interactions" turned out to be the most significant predictor for participating with a favorite organization. In other words, the more people want to make a positive change in the environment and feel less guilty about anthropogenic harm to the environment, the more often they will volunteer *in general*; and the more people want to develop relationships and interact with like-minded others, the more they will volunteer *with their favorite organization* (Asah & Blahna, 2012).

Another study published in 2012 surveyed volunteers at the Florida Fish and Wildlife Conservation Commission (FWC). FWC volunteers participate in environmental stewardship through a variety of activities including: exotic plant removal, infrastructure construction, outreach and education programs, animal population monitoring, and habitat restoration (Jacobson et al., 2012). The researchers administered a web survey to all volunteers with a valid email address. Being entered in a raffle to win a wildlife magazine subscription incentivized volunteers, and staff members encouraged

volunteers to participate in the survey[2]. The researchers recognize the responses were biased against people who do not use email or who do not have access to a computer. To check for non-response bias, the researchers compared the first 10% of responders (the most eager) with the last 10% of responders (the least eager) and found no significant difference (Jacobson et al., 2012).

Seven motivators were measured using a Likert scale of relevant importance: "helping the environment, enhancing personal use of the environment, furthering career goals, engaging in social interactions, having opportunities for learning, being involved in effective projects, and expressing values and esteem" (**Table 6**; Jacobson et al., 2012, p. 51). These factors were developed based on a combination of frameworks published in previous studies, including the VFI developed by Clary et al., a set of motivation categories developed by Schroeder, and a volunteer satisfaction scale developed by Stallings (Clary et al., 1998; Schroeder, 2000; Stallings, 1998). The means for each motivation category and show that the strongest motivator was a sense of helping the environment and the weakest motivator was gaining something to advance one's career.

[2] I mirrored this method for my survey.

Motivation Category/Item	Category/ Question Mean	(S.D.)	Category Chronbach's alpha
Help the environment	6.29	0.84	0.90
Concern for the environment	6.19	1.09	
Protecting natural areas from disappearing	6.41	0.88	
Do something for a cause that is important to me	6.34	0.94	
See improvements to the environment	6.17	1.14	
Ensure future of natural areas for my enjoyment	6.23	1.05	
Help preserve natural areas for future generations	6.42	0.85	
Learning	5.23	1.14	0.80
Learn about specific animals	5.04	1.40	
Learn about specific plants	4.85	1.36	
Learn about the environment	5.76	1.24	
User	5.03	1.12	0.56
Allow me to work at an area where I visit	4.13	1.74	
Enrich my future recreation experiences	5.23	1.55	
Enhance the activities I enjoy doing	5.70	1.13	
Values and esteem	5.02	1.07	0.70
Feel better about myself	4.74	1.48	
Express my values through work	5.78	1.28	
Feel needed	3.86	1.63	
Live closely to my values	5.67	1.28	
Project organization	4.80	1.13	0.66
Work with a good leader	4.86	1.41	
Know what is expected of me	4.29	1.62	
Be part of a well organized project	5.24	1.34	
Social	4.79	1.09	0.72
Meet new people	4.85	1.37	
Work with friends	5.15	1.51	
See familiar faces	4.25	1.43	
Have fun	5.71	1.14	
Career	3.36	1.71	0.94
Get a foot in door where I would like work	3.26	1.83	
Make contacts that might help my career	3.44	1.93	
Explore possible career options	3.29	1.93	
The experience will look good on my resume	3.14	1.84	
Help me succeed in my chosen profession	3.61	1.97	

Table 6. Motivations to participate in a Florida stewardship project. Responses were weighted from 1 for "strongly unimportant" to 7 "strongly important" (Jacobson et al., 2012).

Jacobson et al. (2012) gathered information about demographics (gender, age, ethnicity, employment, education), time contribution (number of hours per year and years), training, and acknowledgement. This is the first study, chronologically, that I found to explore relationships between motivations and demographics. The researchers did not collect income data, which may be a factor that could enable or prevent volunteering. The authors found that females rated the following motivators significantly higher than males: helping the environment, career, learning, and values and esteem. Volunteers over 40 years of age rated the following motivators significantly lower than younger volunteers: user, project organization, and career.

Jacobson et al. (2012) found that the number of years of volunteer service was positively correlated with helping the environment and negatively correlated with advancing one's career. The number of hours volunteered per year was significantly correlated with social motivations. This is aligned with the findings by Ryan et al. (2001) showing that social motivations were more important to volunteers who participated frequently.

Tangible results of restoration work are also an important motivator for land stewardship volunteers (Jacobson et al., 2012); this could translate to citizen science volunteers who monitor ecosystems. However, it is important to note that the results must be communicated to the volunteers in some form because the results for a monitor are not immediately visible as they are for a land steward who may be pulling weeds or planting trees (Roggenbuck, Haas, Hall, & Hull, 2001).

Many guidelines for volunteer management emphasize rewarding volunteers to enhance participation (Jacobson et al., 2012). Rewards may come in many forms: verbal

appreciation, clothing, appreciation events, or recognition in a publication. Individuals who are "users" of natural areas (e.g. hikers, fishermen, boaters, etc.) are motivated to enhance, protect, or somehow be involved with an area they enjoy; managers could reward these individuals with special access to restricted or difficult to reach areas. For example, Reef Environmental Education Foundation rewards volunteers who have completed a certain number of fish surveys and a certain level of training by inviting them to accompany biologists on research boats (Nichols, 2014).

Although rewards are considered necessary for volunteer retention, Jacobson et al. found that 12% of their survey respondents preferred no recognition (2012). Perhaps these individuals are truly altruistic, or they may have other reasons, unstated, for wanting no recognition. Roggenbuck et al. (discussed later in Section 2.5) also found that a majority of volunteers did not want recognition (2001). This could be due to societal perceptions of volunteering as altruistic, and thus the individual feels they should not desire reward (Roggenbuck et al., 2001).

In summary, while "helping the environment" might be the most important reason for a person to decide to start volunteering, this motivator is not necessarily what drives volunteers to participate often or over time. This may be because "helping the environment" is readily satisfied: the results of one's actions are tangible in a short amount of time (e.g. picking up trash, removing invasive species, planting trees, maintaining trails). "Helping the environment" is probably a prerequisite for the individual's decision-making process for volunteering; the individual knows before participating that they want to do something for the environment and that by volunteering for a certain event or organization, that motive will be fulfilled. However, other

underlying factors cause this person to come back again and again. If the project is disorganized, this will be apparent after one or two events and the person will not come back if they feel their time is being wasted. If the person feels isolated during tasks, they will probably not come back again. But if a person meets new people and feels like their contributions are needed, they will be more likely to return to receive the social and ego enhancement benefits again (Clary et al., 1998). Furthermore, all of these studies found that "career advancement" was not a strong motivator. This is likely due to the demographics of volunteers: most of them are over 40 years of age and either employed or retired, so they are not looking for opportunities to network or enhance their skills. Additionally, all but one of these studies evaluated volunteers as a single group with no demographic variation. Although summaries of demographics are reported, there is no exploration of relationships between age and gender with motivations. Young people may have different motivations than older people while males and females may also have differing motivations. These are gaps in the literature that I explore in my study.

2.4 Motivations to Participate in Citizen Science Projects

In this section I review articles on volunteer motivations specific to citizen science projects. Recall that not all citizen science projects are oriented toward environmental stewardship, but water quality monitors are citizen scientists because they participate in the scientific process.

In a qualitative study conducted in Europe, researchers evaluated factors that influence recruitment, retention, and volunteer motivations to participate in nine biodiversity monitoring projects (Bell et al., 2008). In these projects, volunteers help

record observations and conduct surveys to assess the presence and distribution of species and habitat types (Bell et al., 2008). The authors used semi-structured interviews, focus groups, and participant observation and found that social experiences are important to volunteers. This is in line with many environmental stewardship studies from the previous section but contrasts with the findings from other citizen science studies (discussed later in this section; Nov et al., 2014; Raddick et al., 2010) in which the volunteers participate solely through an online platform, signifying that the type of activity performed by volunteers is an important factor for motivations to participate.

This study teases apart the nuances between recruitment, retention, and motivations to participate (Bell et al., 2008). Recruitment is achieved through visibility of the project, which is predominately executed via advertisement: a high degree of exposure can lead to a high degree of recruitment. Retention enables projects to build long-term expertise in their volunteer base and reduces recruitment costs. The authors found that sustained participation is dependent on "a combination of cognitive, social, and emotional drivers" (Bell et al., 2008, p. 3448).

Two important emotional motivators were revealed. Volunteers enjoyed the opportunity to socialize with like-minded people, and the opportunity to "be alone with nature" – away from the everyday toils of life (Bell et al., 2008, p. 3449). The authors found that social trust and bonding were critical elements in all projects, and projects lacking these social elements also lacked volunteer commitment. This correlates with the social function in the Volunteer Functions Inventory (VFI; Clary et al., 1998).

Volunteers associated positive feelings with being in nature and negative feelings with the working world. This implies that people find sanctuary and comfort in the act of

volunteering outdoors, which correlates with the findings from Bruyere and Rappe (2007) in the previous section. When volunteers go outdoors to work on a common task, they find a sense of fellowship; they are compelled to share the meanings they find in nature with each other. One volunteer informant clearly expressed this sentiment: "The thing with birdwatching is it cuts boundaries. It doesn't matter who you are… nobody cares what background you are from… You are there to birdwatch" (Bell et al., 2008, p. 3449).

Another strong motivator, found in other studies as well, was the desire to learn – new skills, knowledge, or the development of existing skills (Bell et al., 2008). This motivation was found to be particularly strong in cases where learning was cyclical and accompanied by social experience. For example, in many projects, the more experienced volunteers teach the less experienced. Volunteers also expressed excitement to learn from project leaders who are enthused to pass on their knowledge. Creating an atmosphere of social learning is a key factor in sustained participation (Bell et al., 2008).

The relationship between volunteers and employees within the organizations is an important factor in a couple of ways. One way is that recognition and feedback are vital to volunteer retention (Bell et al., 2008). The authors advise project leaders to communicate to volunteers the value and usefulness of the data they have collected because volunteers like feeling they have a purpose for their actions. Another way that relationships between professionals and volunteers influence participation is through mutual trust and respect. When project leaders think of volunteers as incapable of complex tasks, the tasks offered become limited and volunteers become frustrated by a

lack of interesting activities. However, when professionals treat volunteers as equals, the project sees greater stability and continuity (Bell et al., 2008).

In a pilot study conducted in 2010, researchers interviewed participants involved in the Galaxy Zoo project about their motivations to participate ("Galaxy Zoo 1," n.d.; Raddick et al., 2010). The Galaxy Zoo project asks participants to classify images of galaxies through an online platform (Raddick et al., 2010). Twelve motivation categories were identified (**Table 7**; Raddick et al., 2010).

Motivation Category	Description (used in survey instrument)
Contribute	I am excited to contribute to original scientific research.
Learning	I find the site and forums helpful in learning about astronomy.
Discovery	I can look at galaxies that few people have seen before.
Community	I can meet other people with similar interests.
Teaching	I find Galaxy Zoo to be a useful resource for teaching other people.
Beauty	I enjoy looking at the beautiful galaxy images.
Fun	I had a lot of fun categorizing the galaxies.
Vastness	I am amazed by the vast scale of the universe.
Helping	I am happy to help.
Zoo	I am interested in the Galaxy Zoo project.
Astronomy	I am interested in astronomy.
Science	I am interested in science.

Table 7. Motivation categories to participate in the Galaxy Zoo project. Colored lines added to show potential groupings (Raddick et al., 2010).

After identifying these categories through interviews, the researchers asked members of the Galaxy Zoo online forum to post their reasons for engaging. Frequencies of responses to each category are shown in **Table 8** below. The final column represents the percent of responses in all forum posts and all interviews combined. A pre-existing interest in astronomy is the strongest motivator with 46% frequency.

	Interviews				Forums				All			
	Initial responses		All responses		Initial responses		All responses		Initial responses		All responses	
Motivation	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Astronomy	7	35%	11	17%	86	46%	99	46%	93	39%	110	46%
Beauty	1	5%	4	6%	9	5%	35	16%	10	4%	39	16%
Community	0	0%	1	2%	3	2%	14	6%	3	1%	14	6%
Contribute	1	5%	6	9%	29	15%	46	22%	30	13%	52	22%
Discovery	1	5%	3	5%	4	2%	17	8%	5	2%	20	8%
Fun	3	15%	5	8%	14	7%	21	11%	17	7%	26	11%
Help	0	0%	6	9%	4	2%	10	7%	4	2%	16	7%
Learning	1	5%	3	5%	5	3%	21	10%	6	3%	24	10%
Science	0	0%	4	6%	2	1%	5	4%	2	1%	9	4%
Teaching	1	5%	1	2%	2	1%	3	2%	3	1%	4	2%
Vastness	1	5%	10	15%	25	13%	47	24%	26	11%	57	24%
Zoo	4	20%	11	17%	5	3%	8	8%	9	4%	19	8%
Non-pertinent					609	N/A			609	N/A		

Table 8. Frequency of motivations to participate in the Galaxy Zoo project. Colored lines added to show potential groupings (Raddick et al., 2010).

Using highly parsed categories likely helps the Galaxy Zoo projects managers better understand their volunteers; however, several of these categories are very similar and could be grouped together under broader terms for greater insight when applied to the general population of citizen scientists. For example, the categories of "learning," "beauty," "discovery," and "vastness" (green lines) are all related to learning something new or gaining a new experience and could be grouped together under the VFI function

"understanding." Collectively, these represent 58% of responses, revealing that the desire for new knowledge is a stronger motivator than a pre-existing interest in astronomy, even if "astronomy" and "science" (purple lines) are summed to 50% frequency. Similarly, the categories "contribute" and "help" (orange lines) could be joined and categorized under the values function of the VFI, bringing their total to 29% frequency, the third strongest motivator. In fourth place, "fun" (having fun completing tasks) is a relatively weaker motivator, but still garners 11% frequency.

Finally, the category "community" (meeting or interacting with others with similar interests) represents one of the weakest motivators with only 6 percent frequency. This number, although low, is likely an *overestimate* and unrepresentative of Galaxy Zoo's participants because only about seven percent of 160,000 volunteers are members of the forum and only eight percent of the forum members responded; additionally, the responses were conveniently collected, not randomly sampled. Thus, some volunteers belonging to the forum are motivated by the opportunity to be part of a community, but this is not likely a factor for the majority of volunteers due to the fact that participation takes place entirely online.

In a 2014 study published as a conference proceeding, participants in citizen science projects from three countries were interviewed about initial and long-term motivations to participate (Rotman et al., 2014). The projects were located in the United States, India, and Costa Rica. The projects are not described, so the type of activities performed by volunteers is unknown. Interviewees were selected based on purposeful and snowball sampling, wherein interviewees point to other potential interviewees, in order to create a rich portrait rather than a representative sample (Rotman et al., 2014).

The resulting themes from the interviews show that initial participation is highly motivated by self-interest (which could be considered ego enhancement under the VFI), whereas the motivation for long-term participation is more complex and de-motivators become a factor (Rotman et al., 2014).

Four factors strongly motivated initial participation: personal interests, self-promotion, self-efficacy, and social responsibility (Rotman et al., 2014). Interviewees expressed a desire to use their volunteer time to pursue personal interests, such as the opportunity to learn something new, to further an existing hobby, or to enhance relationships with friends and family through a shared experience. Self-promotion motivated one interviewee through the opportunity to gain experience and make an addition to his resume. The extent to which a project enhanced a volunteer's sense of self-efficacy, the belief in one's own ability to complete tasks ("Self-efficacy," n.d.), resulted in "feelings of equality and control over the scientific process" (Rotman et al., 2014, p. 115). Self-efficacy as a motivator resonated strongly in Costa Rican interviewees who enjoyed open access to their data. Feelings of "social responsibility toward natural resources" also motivated Costa Ricans on a moral level, but not Indians or Americans (Rotman et al., 2014, p. 115).

Rotman et al. found five motivators influencing long-term participation: trust, communication, acknowledgement, mentorship, and external relationships (2014). The authors found scientists and volunteers were more likely to develop interpersonal relationships and trust when the structure of the project was more centralized, allowing volunteers and scientists to work together; however, the authors failed to relate this issue back to how it influences long-term participation. It could be inferred that volunteers are

more likely to continue participation if they feel comfortable working with scientists and project leaders, but this is not clearly stated in the study. Communicating goals, expectations, outcomes, and upcoming events on a regular basis encouraged volunteers to participate for longer periods (Rotman et al., 2014). This relates best to "project organization" as a motivator found in other studies from the previous section (Bruyere & Rappe, 2007; Ryan et al., 2001).

Essential to promoting long-term participation is acknowledgement of the volunteers' contributions (Rotman et al., 2014). Acknowledgement can take almost any form, from a simple recognition to formal events showcasing volunteer work; however, more "scientifically valid" attributions were more highly valued. Volunteers who found their data published without attributions were disappointed (Rotman et al., 2014). Acknowledgement would probably best fit in the ego enhancement function of the VFI because it is a form of reward that enhances self-esteem.

Also contributing to long-term participation is mentorship (Rotman et al., 2014). Mentorship takes the form of education, training, and closeness with scientists. Volunteers appreciate opportunities to meet with scientists and to advance their knowledge and abilities. Mentorship also benefits the research because well-trained volunteers collect high-quality data and are more deeply committed to the project.

Finally, the external relationships developed by volunteers with community members were also found to play a role in long-term participation (Rotman et al., 2014). Many volunteers found that citizen science has the capacity to affect their immediate environment and were inspired to reach beyond the project by becoming a liaison between the local and scientific communities. By educating themselves through

participation, the volunteers were empowered to increase awareness and education about eco-social issues in their communities. Being able to see the project's "broader impact on scientific advancements and their own communities" motivated volunteers toward long-term and more complex involvement (Rotman et al., 2014, p. 119). Although not explicitly stated in the study, this motivator is more reflexive than others: long-term participation inspires outreach and reveals palpable impact, which causes a positive feedback motivating further participation.

Over time, participation rates were reported to drop, which could be due to a lack of motivational factors or the emergence of de-motivating factors, such as excessive time demands and poor use of technology (Rotman et al., 2014). Participation is curtailed when project leaders and volunteers have different expectations about how much time should be dedicated to a task. Some volunteers jump at the opportunity to participate in time intensive projects because their sense of self-efficacy is augmented; however most volunteers balk at time intensive tasks (Rotman et al., 2014). Inadequate or overly complex technologies can cause frustration and disenchantment among volunteers due to poor accessibility and poor usability. Projects that minimized technological barriers and enabled facile task completion were able to retain volunteers for longer periods (Rotman et al., 2014).

In a 2014 study focused on motivations of participants in online citizen science projects, the researchers assessed what drives the quantity and quality of contributions. In this study *quantity* "refers to the total amount of what is produced," or frequency of participation, and *quality* is "a degree of excellence of what is produced," or expertise (Nov et al., 2014, p. 2). A web-based survey was sent to volunteers of three

organizations, with a total of over 3,000 responses and a 28% response rate (Nov et al., 2014). This study has the largest number of responses by far of any study on volunteer motivations in citizen science. This study is the first so far in the literature on citizen science volunteers to conduct a quantitative survey.

The motivations were categorized into four groups: collective, intrinsic rewards, norm-oriented, and reputation (Nov et al., 2014). Collective motives relate to the value one ascribes to the aggregate goals of the project. Collective motives would fall into the values function of the VFI. Intrinsic reward comes from the enjoyment from or interest in the tasks done by the volunteers. Norm-oriented motives relate to "expected reactions of important others such as family and friends" (Nov et al., 2014, p. 3). Norm-oriented motives would fall into the social function of the VFI. Reputation motives relate to receipt of appreciation for contributions or recognition of status. Reputation motives would best fit in the ego enhancement function of the VFI.

The researchers asked participants to respond to statements by indicating their level of agreement on a Likert scale of one to seven (Nov et al., 2014). The results showed that frequency of participation (contribution *quantity*) was driven by the following motivators (mean score out of 7): collective (6.26), intrinsic (5.88), norm-oriented (4.56), and reputation (3.64). This indicates that volunteers care more about helping the project meet its goals than about personal gain, but enjoyment is almost as important as helping the project.

Contribution *quality*, on the other hand, had a positive correlation with only two of the motivators – collective and reputation – and a negative correlation with norm-oriented and intrinsic motivators (Nov et al., 2014). The authors suggest that reputation

motivates volunteers when a performance metric is made visible to the public. The authors also found that extrinsic motivators, such as reputation, reinforce intrinsic motivators. This happens particularly when there is a trusting, reciprocal relationship between citizens and professionals in the organization (Nov et al., 2014).

This study also considered age, gender, and level of computer expertise as independent variables, showing that researchers are starting to investigate demographics as possible explanatory variables for variations in motivators. Younger people were found to contribute more frequently (Nov et al., 2014); however no age range is defined for "young" or "old" in the paper. Gender had no significant effect. Computer expertise had no significant effects, except for in one project where the tasks were relatively more complex than the other projects (Nov et al., 2014).

The results of this study indicate that collective motivators (or the values function in the VFI) influence both quantity and quality of participation. Managers should emphasize collective motivators by encouraging commitment to the goals of the project, which can be accomplished by communicating the mission and achievements (Nov et al., 2014). Norm-oriented, intrinsic, and reputation motivators could be enhanced through social networks that recognize the quality of an individual's participation and through a structure that allows volunteers to increase their expertise and responsibility over time (Nov et al., 2014). Many online citizen science projects are limited in the latter capacity because they ask their participants to complete relatively simple, repetitive tasks; Embracing a structure that allows volunteers to progressively take on more responsibility both enhances the motivation to participate and allows the staff to delegate responsibilities, enabling the project to grow (Nov et al., 2014).

In summary, citizen science volunteers have many reasons for participating. Echoing the motives of environmental stewardship volunteers, citizen scientists are motivated by learning, socializing, and recognition. Unique motives to citizen science volunteers are the desire to contribute to scientific knowledge and the opportunity to work with scientists. It is important that the scientists and project leaders have good working relationships with the volunteers and treat them as equals in the process. Citizen scientists are discouraged from participation by mismatched expectations, time barriers, and poor use of technology.

2.5 The Overlap: Motivations to Participate in Water Quality Monitoring

The published literature specific to water quality volunteer motivations is extremely limited. Although there are many papers on general water quality monitoring topics, I was only able to find one study that empirically assessed volunteer motivations. In this study, the researchers utilized focus groups to inform the development of a survey that was sent to volunteers of Save Our Streams (SOS) in Virginia (Roggenbuck et al., 2001). The focus groups revealed nine motivational categories: "nostalgia, protect the environment, guard against local threats, be of service, teach, learn, be social, enjoy nature, and career growth" (p. xvii).

While most of these categories are self-explanatory, "nostalgia" merits a brief explanation. Many people who grew up active in the outdoors (hunting, fishing, camping, or playing) and have positive memories of those activities, perceived stream monitoring as an extension of their previous outdoor activity (Roggenbuck et al., 2001). Quotes from volunteers suggest that monitoring is a reason to go outside and it feels "like

a natural progression" from current interests (p.xvii). Negative memories also played a role in motivating some volunteers: One volunteer mentioned looking for "critters" in her backyard stream as a child and never finding any, but by being involved with SOS she could find them in other streams (p. xviii). "Nostalgia" did not appear in the survey.

The survey asked respondents to rate motivations on a five-point scale from "not at all important" to "very important" (Roggenbuck et al., 2001, p. xlii). Similar to other environmental volunteer studies, the average age of respondents was 41 years, most (78%) had completed at least a college degree, and most (70.9%) were employed. Motivation ratings mirrored those of environmental volunteers: the highest rated category was "protect the environment" and the lowest rated category was "career growth." Other important motivators revealed from the survey were "learning, "teaching," "to be of service," "for nature enjoyment," "to be social," and "to guard against local threats" (**Table 9**; Roggenbuck et al., 2001, p. xliii).

Motivation Factors	Mean Importance[1]
To protect the environment	4.63
Learning	4.00
Teaching	3.67
To be of service	3.65
For nature enjoyment	3.00
Social	2.76
To guard against local threats	2.64
For career growth	1.83

Table 9. Motivations to participate in Save Our Streams. Motivations are in order of highest to lowest mean score. Responses were weighted from 1 for "not all important" to 5 "very important" (Roggenbuck et al., 2001).

Roggenbuck et al. (2001) then categorized the volunteers by their level of involvement and calculated the means of the motivations for each type of volunteer (**Table 10**). The categories of volunteers were based on their duration of involvement with SOS and their participation frequency. The most significant difference in motivations among types of volunteer involvement was in "teaching." The longer and more frequently an individual had participated, the more likely they were to be motivated by teaching; this is mirrored in the study by Ryan et al. (2001). Overall, the differences between less involved volunteers and more involved volunteers seemed small (Roggenbuck et al., 2001). This is in line with the study by King and Lynch (1998), but it is contrary to Ryan et al.'s findings (2001) that volunteers' motivations change over time.

	Participation Level				
Motivations	**Rookies n ≅ 94**	**Fading Veterans n ≅ 108**	**Active Veterans n ≅ 43**	**All-Stars n ≅ 60**	**F-value**
Learning	3.61^{a}	3.77^{ab}	4.03^{b}	3.97^{b}	2.85*
To guard against local threats	2.50^{a}	2.51^{a}	2.74^{ab}	2.93^{b}	3.50*
Nature enjoyment	3.11	2.89	3.08	3.00	.99
Teaching	3.33^{a}	3.64^{ab}	4.04^{b}	3.91^{b}	5.35*
Social	2.78^{ab}	2.60^{a}	2.88^{ab}	3.01^{b}	2.21*
To protect the environment	4.58	4.54	4.72	4.76	1.98
Career growth	2.03	1.70	1.71	1.89	1.62
To be of service	3.55^{ab}	3.51^{a}	3.82^{bc}	3.97^{c}	5.35*

Table 10. Motivations to participate in Save Our Streams across distinct participation levels. "Rookies" are new and relatively inactive. "Fading veterans" have been involved a long time but are relatively inactive. "Active veterans" have been involved a long time and are mildly active. "All-Stars" have been involved a medium length of time and are highly active. Responses were weighted from 1 for "not all important" to 5 "very important" (Roggenbuck et al., 2001).

The survey also asked respondents to indicate their preferences about recognition of their contributions. Surprisingly, 63.7% indicated that they do *not* need recognition, contrary to common volunteer management recommendations (**Table 11**; Roggenbuck et al., 2001). However, almost 30% of "All-Stars" and 11% of "Rookies" indicated that some form of recognition was important, although the specific type of recognition did not matter. The response of the SOS volunteers may be indicative that volunteers may feel they are not supposed to want recognition for an activity that is often considered altruistic by society (Roggenbuck et al., 2001). This may also reflect a self-report bias and a limitation of the survey format. Volunteers may not be fully candid about this topic, but an interview may be able to better assess a volunteer's true feelings. Further, recognition may motivate some volunteers in a subtle way that the individual does not overtly recognize.

Type of Recognition	Percent[1]
Recognition certificates	9.9
A verbal or written "Thank You" from SOS leaders	9.0
Awards banquet	3.2
It doesn't matter how I am recognized, but it is important	15.4
I do not need to be recognized for my efforts	63.7

Table 11. Save Our Stream volunteer preferences for types of recognition. Respondents could select all that apply (Roggenbuck et al., 2001).

During the focus groups, volunteers expressed a strong desire for an increased use of citizen-collected data by government agencies and for more feedback about how the data is being used, specifically to protect streams (Roggenbuck et al., 2001). This is an

issue that has not been explored by any other study on citizen science motivations, but it is one that strongly influenced the topic choice for this thesis. In my previous research on water quality monitoring organizations, I found a substantial lack of data-use for regulation or protection enforcement, and this seemed like an issue that would discourage volunteers from continued participation. This also reinforces the imperative need for managers to communicate the results of the organization's efforts to their volunteers.

Volunteers also expressed a need for more effective leadership, in the form of a full-time staff member responsible for volunteer coordination (Roggenbuck et al., 2001). This need is related to the motive "project organization" in other studies. Volunteers noted that continuity is important, and when the entire program depends on volunteers, it has potential to collapse. They also expressed that being part of a team with a strong, organized leader was an important reason for their continued involvement with the program: "full-time paid regional coordinators would help substantially in retaining and satisfying current volunteers" (Roggenbuck et al., 2001, p. xxvi). This is supported by survey respondents who indicated they did not want to make decisions about the organization in the study by Ryan et al. (2001).

2.6 Summary

While the tasks asked of the volunteers are quite different between citizen science projects and environmental stewardship projects, both have similar end goals – to connect people with their environment and, in most cases, to enhance the environment in some capacity. Water quality monitoring projects share overlapping qualities with the two groups because they collect data and engage in environmental stewardship.

There are several overlapping themes between motivations for volunteers in citizen science projects and in environmental stewardship projects. The opportunity to socialize is a repeating theme, as well as the opportunities to learn, to teach, and to help. For environmental stewardship, the motive "to help" is specifically for the environment, but for citizen science projects, "to help" is also for the organization and for the accumulation of scientific knowledge.

Because water quality monitors are both citizen scientists and environmental stewards, they are likely to have motivations that are similar to both groups. The study by Roggenbuck et al. (2001) exemplifies the motivations for water quality monitors: to help the environment, to learn and teach, to socialize, to be of service, project organization, communication, and collection of useful data. Career growth was consistently rated as the least important motivator across all studies. The importance of recognition is inconclusive. Some researchers find recognition is very important while others find just the opposite.

More important than recognition may be sharing with the volunteers the impact of the volunteers' work. Volunteers want to know that their effort has had an effect. This is particularly important for water quality monitors, because, unlike environmental stewards who may see immediate results by pulling weeds or planting trees, monitors do not instantly see the results of the data they have collected. This is made evident by the desire of SOS volunteers to see an increased use of data by protection agencies – they want to see that streams are cleaned up because of their monitoring.

While "helping the environment" is rated as the highest motivation for all environmental stewardship volunteers, it is important to remember that this motivation is

not enough to *retain* volunteers. Each volunteer has multiple reasons for participating and they will only participate for as long as those motivations are fulfilled (Clary et al., 1998). Project managers might be able to hook a volunteer with environmental motivations, but the activities offered need to address a variety of motivations to enhance involvement over time. Frequent opportunities to participate are an excellent way to create social motivation – the more often events occur, the more likely volunteers will develop relationships, and the opportunity to see a familiar face will continue to motivate the volunteer.

Researchers and project coordinators would benefit from a more standardized method to assess volunteer motivations. The Volunteer Functions Inventory (VFI) developed by Clary et al. (1998) provides a useful starting point to develop a standard framework to assess volunteer motivations. However, the VFI is limited in some ways. Many motivators may fall into more than one functions category, and it is also limited in scope. For example, the VFI does not take into account extrinsic motivators such as project organization and communication from the staff to the volunteers. It also does not consider physical well-being as a motivator, although this could fit into ego enhancement if maintaining physical well-being enhances one's self-esteem. Finally, some intrinsic motivators, such as having fun or being a user of an area, also do not fit well in the VFI.

Overall, the strongest motivators from these studies fell into the values and ego enhancement functions, the weakest motivators fell into the career function, and the social function appears to have the most influence on long-term motivation. Project coordinators should remember that volunteers have multiple reasons for volunteering and they will only volunteer for as long as they continue to receive psychological benefits

(Clary et al., 1998; King & Lynch, 1998). Project managers should be wary of de-motivating factors, which include mismatched expectations, poor organization, and poor use of technology. Recognition may enhance volunteer retention, but the results are inconclusive. Further research is needed to determine how strongly this influences participation. Finally, more studies need to explore the relationships between demographics and motivators. If there are significant differences between differing demographics, this information will be extremely useful to project coordinators who want to tailor their recruitment and retention campaigns.

Chapter 3: Methods

3.1 Introduction

This chapter will describe the design of the study and the methods used to collect and analyze data. This study was approved by the Institutional Review Board of the Evergreen State College, Olympia, WA.

3.2 Study Design

The purpose of my thesis research is to gain an understanding of volunteer motivations to participate in citizen science projects that have a focus on environmental stewardship. To complete this research, I surveyed volunteers from eight organizations that monitor water quality because this activity reflects a unique characteristic of those volunteers who want to contribute both to environmental protection and the scientific process. I surveyed volunteers using a web-based questionnaire with multiple choice and Likert-type questions. Likert-type questions ask respondents to indicate their opinion with a five-point response format, which generally use words ranging on the continuum from "strongly disagree" to "strongly agree." I analyzed the results using quantitative descriptive statistics. The following sections in this chapter give more details of the survey and analyses.

I expect to find that motivations vary by demographics: age, gender, frequency of participation, and length of involvement with the organization. Motivational factors may be intrinsic or extrinsic. Intrinsic motivators come from within the individual and include personal interests, being outdoors, socializing, helping the environment, and learning

something new. Extrinsic motivators come from outside the individual, such as weather, training, and rewards.

To recruit organizations to participate in my study, I sent a call for research participants to several listserv groups based in the United States (**Appendix A: Recruitment Details**). I stated that I was looking for organizations with volunteers that monitor water quality. I purposely left out specific parameters, because I was hoping to capture a broad array of monitoring activities including, but not limited to, chemical tests, secchi disk clarity tests, and macroinvertebrate monitoring.

I asked staff members of participating organizations to send emails to their volunteer base with a link to an electronic survey. The staff members sent reminder emails roughly once per week. I provided optional material for staff members to use to promote the survey (**Appendix A: Recruitment Details**). The survey opened February 18, 2015 and closed March 13, 2015. Some organizations felt that once per week was too frequent and thus sent fewer emails. One organization also posted the survey to their webpage on Facebook.com (**Appendix B: Participating Organizations**). As a way of incentivizing participation, all respondents who completed the survey had the option to be entered in a random drawing for one of ten subscriptions to *National Geographic*.

3.3 Survey Design and Data Collection

Because I anticipated a large number of responses, I created a survey with quantitative responses. A qualitative survey with open-ended questions might provide a richer picture with unanticipated responses, but the main driver of my choice is that I wanted to survey hundreds of volunteers across several organizations, and given the time

limits, a quantitative study is more efficient. Further, many previous studies have conducted qualitative research and have revealed both the major and nuanced motivations, which I have incorporated into my survey. By surveying many volunteers from several organizations, the results will be useful and generalizable to a larger population.

The survey is comprised of an introduction, an informational letter detailing the project, a consent form, 27 questions, and a thank you page inviting respondents to enter the drawing for one of ten *National Geographic* subscriptions (**Appendix C: Survey**). The first section of the survey asked for demographics: age, gender, having children under 18, education, employment, personal income, and household income. Responses to these questions may give an indication of potential leisure time. For example, a person who has no children under 18, is unemployed or earns less than half of the household income, may be more able to volunteer than someone with young children and a full-time job.

The next section asked volunteers about their typical volunteering activities and habits. This allowed me to identify if the volunteers were actually participating in the scientific aspects of the project. Respondents also indicated in which year they began volunteering, how often, and how much time they usually spend at each volunteer event.

The remainder of the survey asked about motivations with Likert-type questions. Likert-type questions are often used in the social sciences to measure relative attitudes and opinions (Gliem & Gliem, 2003). Likert-type response alternatives may be weighted, which is helpful to quantify variables that are not directly measurable. Studies have shown that use of a 5-point or 7-point response format is the optimal choice to use

for reliability and validity; fewer points decrease reliability and validity while more points do not improve either any further (Dawes, 2008). I chose a 5-point response format for ease of use both for the respondents and for analysis. I describe using Likert-type questions in more detail in the next section.

The survey questions were crafted based on the information I gleaned from the literature review (see Chapter 2), my own ideas about volunteering, discussions with peers who have participated in citizen science projects, and feedback from my thesis advisor. Six people took my survey before it was finalized. In the creation of my survey, I strove to reflect what is known in the literature so that I could compare my results to the results of the literature, while also adding unique elements to gain new insights.

3.4 Using the Likert Scale and Likert-type Questions

The Likert scale and Likert-type questions are different concepts that need to be described for clarity. Carifio and Perla (2007) point out that many authors do not use the correct terms when discussing *Likert scales*, *Likert-type questions*, and *scales,* and that this has caused confusion and methodological error. The following is my attempt to help my reader understand, to the best of my ability, the concepts associated with the Likert scale.

The Likert Scale

The original Likert scale was developed by Rensis Likert in 1932 as a method to measure attitudes, opinions, and personality traits (Boone & Boone, 2012; Gliem & Gliem, 2003; Likert, 1932). The original Likert scale consists of a series of statements or

questions that are combined to create an index measurement of an attitude or trait (Boone & Boone, 2012; Gliem & Gliem, 2003; Likert, 1932). This is known as a *summated scale* (Clason & Dormody, 1994). Each question within the series of Likert's original scale has five response alternatives: strongly approve, approve, undecided, disapprove, and strongly disapprove (**Table 12**; Boone & Boone, 2012; Clason & Dormody, 1994). The five response alternatives are collectively called the *response format*, which is commonly – but incorrectly – called a *scale* (Carifio & Perla, 2007). This is where much of the confusion sets in because the Likert scale is a series of questions with a set of response alternatives that may also be scalar (e.g. "strongly agree" is greater than "agree," which is greater than "disagree" and so on; Carifio & Perla, 2007).

Example of a Likert Scale with Labeled Parts					
	Response Format				
	Response Alternative	Response Alternative	Response Alternative	Response Alternative	Response Alternative
Series of Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I eat healthy foods on a regular basis.	SD	D	N	A	SA
2. When I purchase food at the grocery store, I ignore "junk" food.	SD	D	N	A	SA
3. When preparing meals, I consider the fat content of food items.	SD	D	N	A	SA
4. When preparing meals, I consider the sugar content of food items.	SD	D	N	A	SA
5. A healthy diet is important to my family.	SD	D	N	A	SA

Table 12. Example of a Likert scale with labeled parts. These five questions are designed to create a "Healthy Eating" Likert scale. Labels added (Boone & Boone, 2012).

The wording of the response alternatives, the number of response alternatives, and the inclusion of a neutral alternative are at the discretion of the researcher (Clason & Dormody, 1994). For analysis, only the composite score from the series of questions is used – the individual responses are not analyzed (Boone & Boone, 2012).

Likert-type Questions

Since the creation of the Likert scale, researchers in many fields commonly use individual Likert-type questions, which are not summated as the Likert scale questions are (Boone & Boone, 2012; Clason & Dormody, 1994; Gliem & Gliem, 2003; Jamieson,

2004). Likert-type questions are single items with response alternatives similar to those of the original Likert scale, and these items are analyzed separately (**Table 13**; Boone & Boone, 2012; Clason & Dormody, 1994). Some authors criticize the use of single-item questions to measure psychological attributes, claiming that they are unreliable due to measurement error (Gliem & Gliem, 2003). Single-item questions also lack the ability to measure a fine degree of differences and to represent complex concepts (Gliem & Gliem, 2003).

Example of Likert-type Items with Labeled Parts					
	Response Format				
	Response Alternative	**Response Alternative**	**Response Alternative**	**Response Alternative**	**Response Alternative**
Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. 4-H has been a good experience for me.	SD	D	N	A	SA
2. My parents have provided support for my 4-H projects.	SD	D	N	A	SA
3. My 4-H involvement will allow me to make a difference.	SD	D	N	A	SA
4. My 4-H advisor was always there for me.	SD	D	N	A	SA
5. Collegiate 4-H is important in the selection of a college.	SD	D	N	A	SA

Table 13. Example of Likert-type items with labeled parts. Labels added (Boone & Boone, 2012).

Analysis

The response alternatives for Likert-type questions are considered ordinal data because the responses are ordered, but the interval between responses are immeasurable and not necessarily equal (Allen & Seaman, 2007; Boone & Boone, 2012; Jamieson, 2004). To clarify, "strongly agree" is greater than "agree," but there is no measurement of *how much* greater (Boone & Boone, 2012).

In contrast, Likert scale data are considered interval data because the results are acquired from a composite score (sum or mean) of several questions (Boone & Boone, 2012). The composite scores can be analyzed as interval data because they reflect order *and* a measurable distance between scores (Allen & Seaman, 2007; Boone & Boone, 2012). For example, four units are greater than three units by one unit.

Ordinal data and interval data require different types of analyses: means may used for Likert scale data, and modes (not means) should be used for Likert-type data (**Table 14**). Only non-parametric tests should be used for ordinal data; however, many authors ignore the rules and use ANOVA or t-test for Likert-type data, which continues to be controversial (Allen & Seaman, 2007; Jamieson, 2004). Likert scales should be analyzed with parametric tests if assumptions of normality are met (Allen & Seaman, 2007). However, Clason and Dormody (1994) argue that analyzing Likert-type data is not a matter of right or wrong; it is a matter of meaningfully answering the research question. Thus many researchers use the mean and the mode for Likert-type items.

Appropriate Analyses for Likert-type and Likert Scale Data			
	Likert-type (ordinal) Data	Likert Scale (interval) Data	Sources
Central Tendency	Median or mode	Mean	(Allen & Seaman, 2007; Boone & Boone, 2012; Jamieson, 2004)
Variability	Frequencies or percentages	Standard deviation	(Allen & Seaman, 2007; Boone & Boone, 2012; Clason & Dormody, 1994; Jamieson, 2004)
Associations	Kendall's tau b or c	Pearson's *r*	(Boone & Boone, 2012; Clason & Dormody, 1994)
Other Statistics	Non-parametric tests: Chi-square, Spearman's rho, Mann-Whitney *U*-test	ANOVA, t-test, regression	(Allen & Seaman, 2007; Boone & Boone, 2012; Clason & Dormody, 1994; Jamieson, 2004)
Reliability and validity		Cronbach's alpha, Kappa test	(Allen & Seaman, 2007; Gliem & Gliem, 2003)

Table 14. Appropriate analyses for Likert-type and Likert scale data.

3.5 Data Analysis

All complete surveys were included in the dataset. Incomplete surveys were included if the respondent answered most of the demographic questions and at least some of the motivation questions. Incomplete surveys were excluded if the respondent did not answer any motivation questions. Surveys were excluded if the respondent failed to indicate their membership of a participating organization. All responses were aggregated for analysis.

I found the percent of total for demographic responses and I found the percent of responses and modes for Likert-type responses. Because the mean is often used in

practice for Likert-type items, I also used the mean in some cases to find patterns of preferences across different types of volunteers based on age, gender, and length of involvement.

Likert-type responses were weighted for analysis from 1, representing "never," "not at all likely," "strongly disagree," or "not at all meaningful" to 5, representing "always," "extremely likely," "strongly agree," or "very meaningful." Most questions also had a response option of "N/A" (or not applicable), which was given no weight.

Chapter 4: Results and Discussion

4.1 Participating Organizations

A total of eight organizations participated in this study (**Table 15**). The survey was emailed to 1,045 volunteers across the eight organizations. The total number of responses was 271 and the overall response rate was 25.9%. One organization, Maine Volunteer Lake Monitoring Program, represented 48% of the total responses, which may be a source of bias (**Figure 2**). Another organization, University of Rhode Island Watershed Watch Program, comprised 27% of the total responses. A third organization, South Yuba River Citizens League, constituted 11% of the responses while the remaining five organizations comprised less than 4% each. (See **Appendix B: Participating Organizations** for more details about each organization including websites and types of monitoring activities.)

Participating Organizations				
Organization	**Location**	**Number of volunteers who were sent the survey via email**	**Number of responses received**	**Response rate**
South Yuba River Citizens League (SYRCL)	California: Nevada City	57	30	52.6%
Maine Volunteer Lake Monitoring Program (VLMP)	Maine: statewide	466	130	27.9%
North Pond Association of Maine (NPA)	Maine: Mercer, Smithfield, and Rome	15	10	66.7%
Boquet River Association (BRASS)	New York: Elizabethtown	4	5[3]	125.0%
University of Rhode Island Watershed Watch Program (URIWW)	Rhode Island: statewide	360	74	20.6%
Nisqually River Education Project (NREP)	Washington: Thurston County	49	10	20.4%
South Sound Global Rivers Environmental Education Network (GREEN)	Washington: Thurston County	24	7	29.2%
Stream Team	Washington: Thurston County	70	5	7.1%
	Total:	1045	271	***Overall Response Rate:* 25.9%**

Table 15. Participating organizations and corresponding response rates.

[3] For unknown reasons, Boquet River Association returned more responses than were emailed.

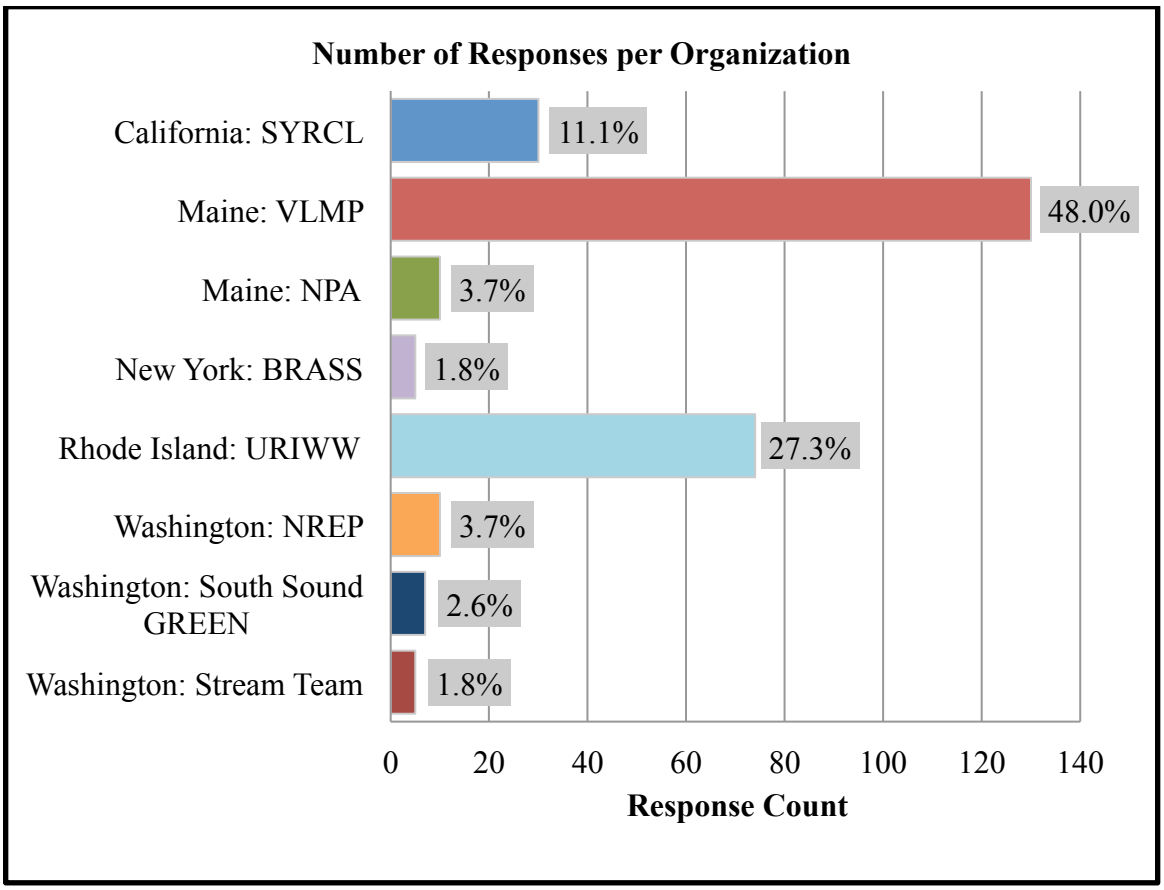

Figure 2. Number of responses per organization and percent of total responses.

4.2 Demographics

Most survey respondents were over age 50 (86%), the age group with the most responses was 60-69 (37%), and thirteen respondents were over age 80 (5%; **Figure 3**). The respondents were split fairly evenly between male (55%) and female (44%); 1% preferred not to answer. Most were well educated (35% with a bachelor's degree and 45% with a graduate degree). Respondents that reported income were not necessarily affluent; however, about one-fifth of respondents chose not to answer the question. Respondents reported both personal income and household income. For personal income, about 21% of respondents earned less than $25,000, 23% earned between $25,000 and $50,000, while 16% earned over $75,000. The household income was

slightly different, although 25% did not report: only 8% of households earned less than $25,000, 28% earned between $25,000 and $50,000, and 40% earned over $75,000. (See **Appendix D: Demographics** for complete demographic details and graphs).

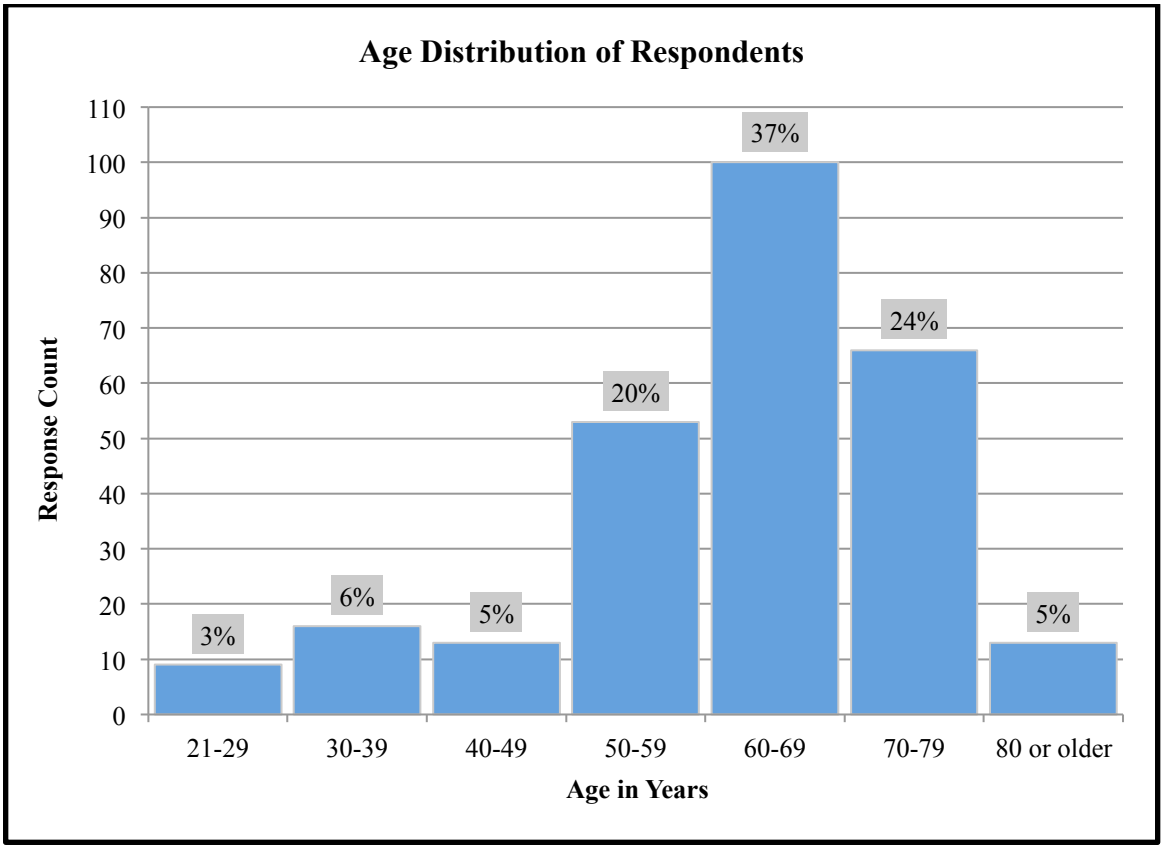

Figure 3. Age Distribution of Respondents.

Some demographic questions were aimed at assessing potential leisure time because individuals that have ample leisure may be more enabled to spend time volunteering (Einolf & Chambré, 2011; Mutchler, Burr, & Caro, 2003). I made some assumptions about demographics that might give an indication of leisure time. For example, people who do not have young children may have more free time than people

that do have young children, or individuals who are not responsible for earning the majority of the household income may have more free time than the significant income earner of the house. Employment or student status may also affect potential leisure time.

I found that some of the assumptions held up, while others did not. Factors indicating that respondents may have more leisure time than other adults include: not having young children, not being a full-time student, and being retired. A large majority of respondents did not have children under 18 years old (89%) and were not students (97%). As expected from previous research, a large portion of respondents was retired (45%; **Appendix D: Demographics**).

There were also factors indicating that respondents do not necessarily have more leisure time than other adults. About one-third was employed full-time (32%) and one-sixth was employed part-time (17%). Of the respondents that reported income, most earned at least half of the household income (84%) and 38% earned all of the household income. However, because such a large portion of respondents were retired, it is likely that that many of the respondents who earned at least half of the household income are now retired. Thus this variable may be confounded with other factors.

4.3 Volunteer Activity and Performance

To gain a deeper understanding of volunteer activities and preferences, I asked several questions related to activity and performance. First I wanted to ensure that most of the respondents to my survey were citizen scientists, so I asked respondents to choose tasks from a list that they perform when volunteering (respondents could select all that apply). Many options described roles of citizen scientists (e.g. "collect data or record

observations," "analyze data," or "validate data") and some options described tasks that volunteers may perform but are not roles of citizen scientists (e.g. "train new volunteers," "perform administrative tasks," or "serve on board of directors"). Because 95% of respondents reported "collect data or record observations" as a task that they perform when volunteering, all respondents were considered citizens scientists for the purpose of this study (**Figure 4**). Many respondents chose multiple tasks, but the next most frequent task performed – "train new volunteers"—only accounted for 13% of responses. This was closely followed by "analyze data" (11%) and "perform administrative tasks" (11%).

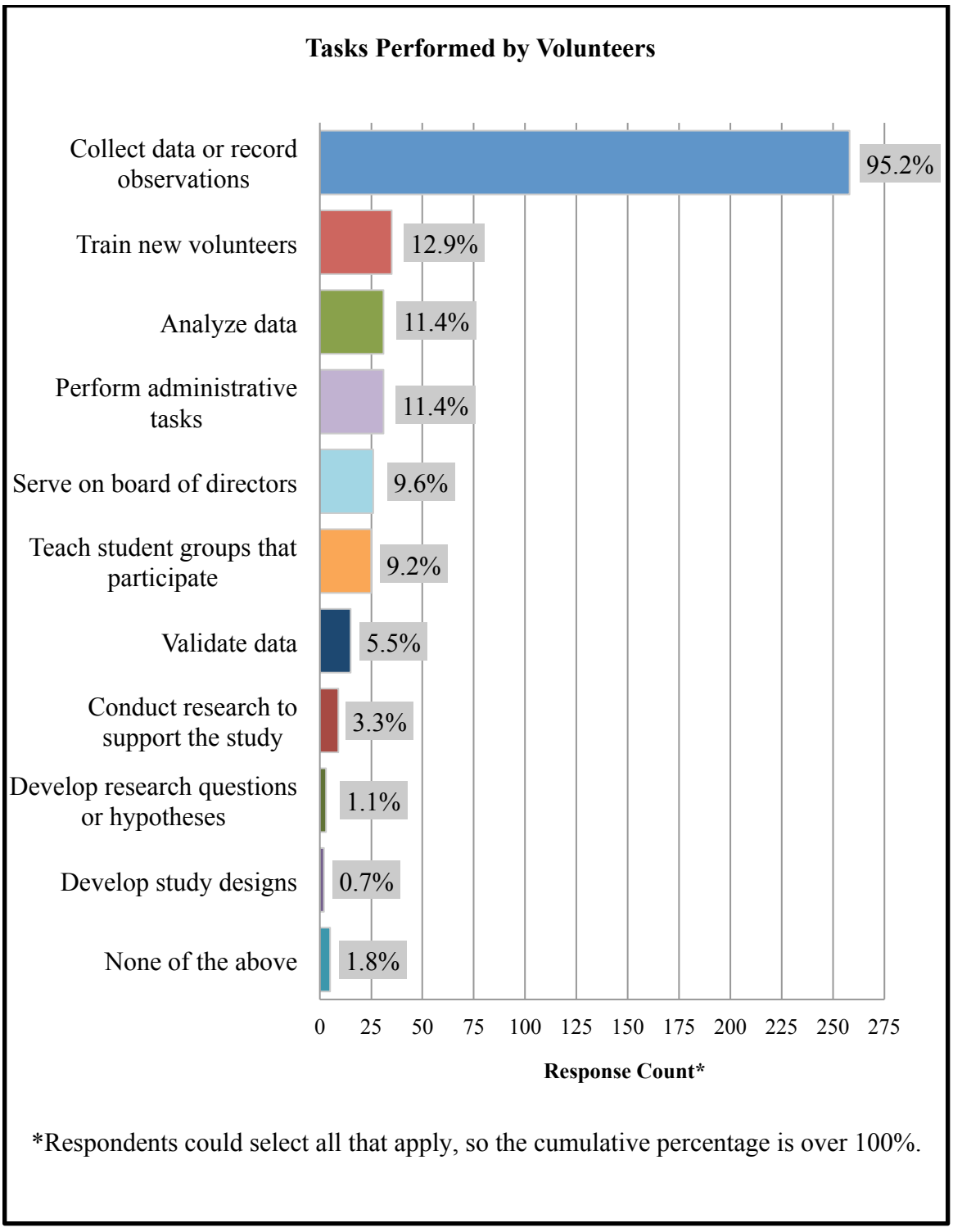

Figure 4. Tasks performed by volunteers.

In order to assess differences in motivations for long-term and short-term volunteers, I asked respondents to indicate which year they began volunteering for their organization. Looking at the distribution of the number of volunteers starting in each year, the curve appears as expected – skewed towards the present – with only a couple of exceptions (**Figure 5**). Most volunteers began within the past few years, but in 2000 there is a spike in the number of volunteers. There is also a dip in numbers from 2010 to 2011. These variations may correlate with specific organization activities – such as a large recruitment campaign or a new project launch – but the explanation was not pursued. Ignoring the year 2000, initiation is relatively steady beginning in 1980 with less than 5 respondents per year, and the number begins to increase in the year 2003. Since 2003, the number of starting volunteers continues to increase overall with some variation year to year, notably the dip from 2010 to 2011.

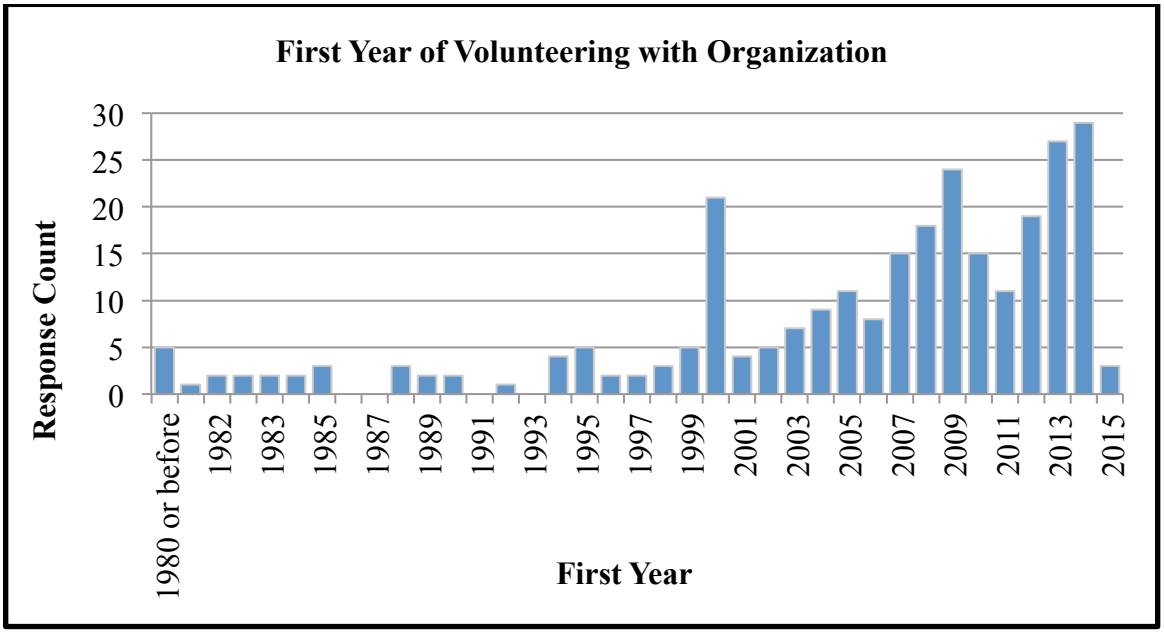

Figure 5. First year of volunteering with organization. The youngest organization was founded in 1992.

For purposes of analysis and comparison, I grouped the start years into bins that mirror the bins used by Roggenbuck et al. (2001). Roggenbuck et al. (2001) found that most volunteers had been involved with the program for up to three years (25% were involved up to one year and 55% were involved one to three years). The number of people involved four or more years was much less and decreased over time. I found a very different pattern in my study population. A smaller portion of volunteers have been involved up to one year[4] (12%), while an equal number of people have been involved for both one to three years and four to six years (21% each; **Figure 6**). Respondents involved seven to ten years represent 16% of the population. The largest diversion from the pattern in Roggenbuck et al. (2001) is in the group with the most longevity. In the Roggenbuck et al. (2001) study, only 6% were volunteers for more than ten years, but in my population 30% were volunteers for more than ten years. This may indicate a response bias: the volunteers who have been dedicated to their organization for more years may also be more likely to respond to surveys from the project coordinators. For the remainder of this study, I will refer to volunteers as "new" and "veteran" on the continuum of involvement from "up to one year" (newest) to "more than 10 years" (most veteran). I will use the term "longevity" to refer to a volunteer's length of involvement with the organization.

[4] Respondents took the survey in February and March of 2015. Some respondents began volunteering in 2015, and since there were less than three months of 2015 at the time of the survey, I joined those volunteers with respondents who began in 2014. Thus, the group "up to one year" actually reflects up to 15 months of involvement.

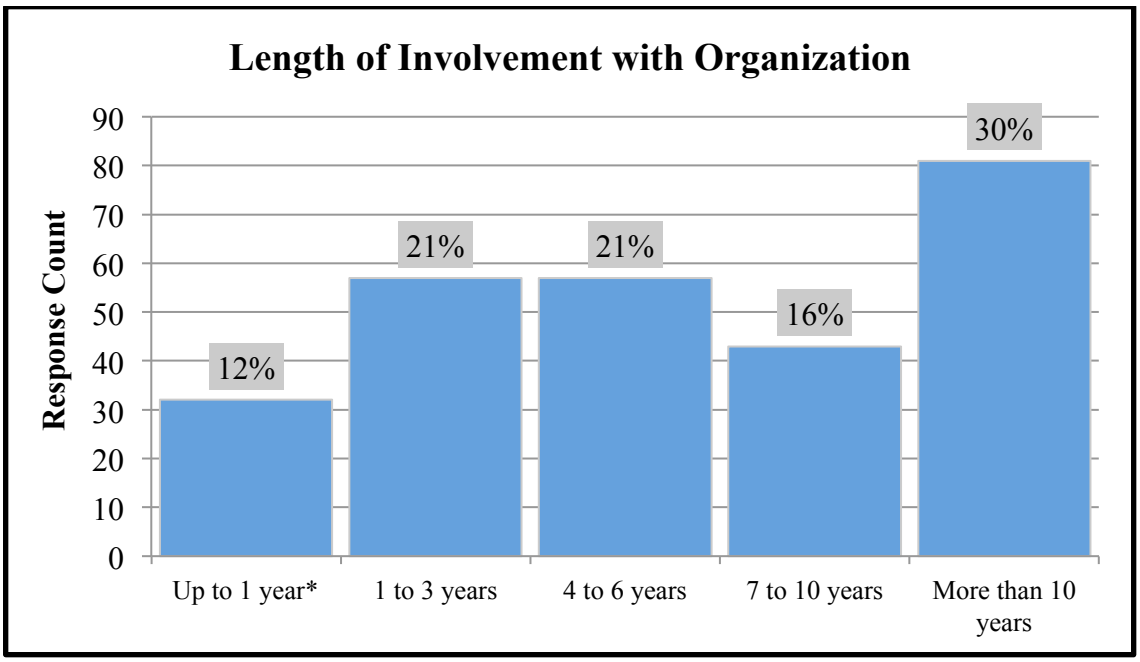

Figure 6. Length of involvement with organization. *"Up to one year" actually reflects up to 15 months of involvement.

To see if newer volunteers are also younger in age, I created a distribution of ages within each group of longevity (**Figure 7**). The percentage of the two youngest age brackets (21-29, and 30-39) is greater in the groups of newer volunteers (up to one year and one to three years) and decreases with length of involvement. This is expected, as younger people have not lived as many years. The age groups are more evenly distributed within the group of newest volunteers (up to one year).

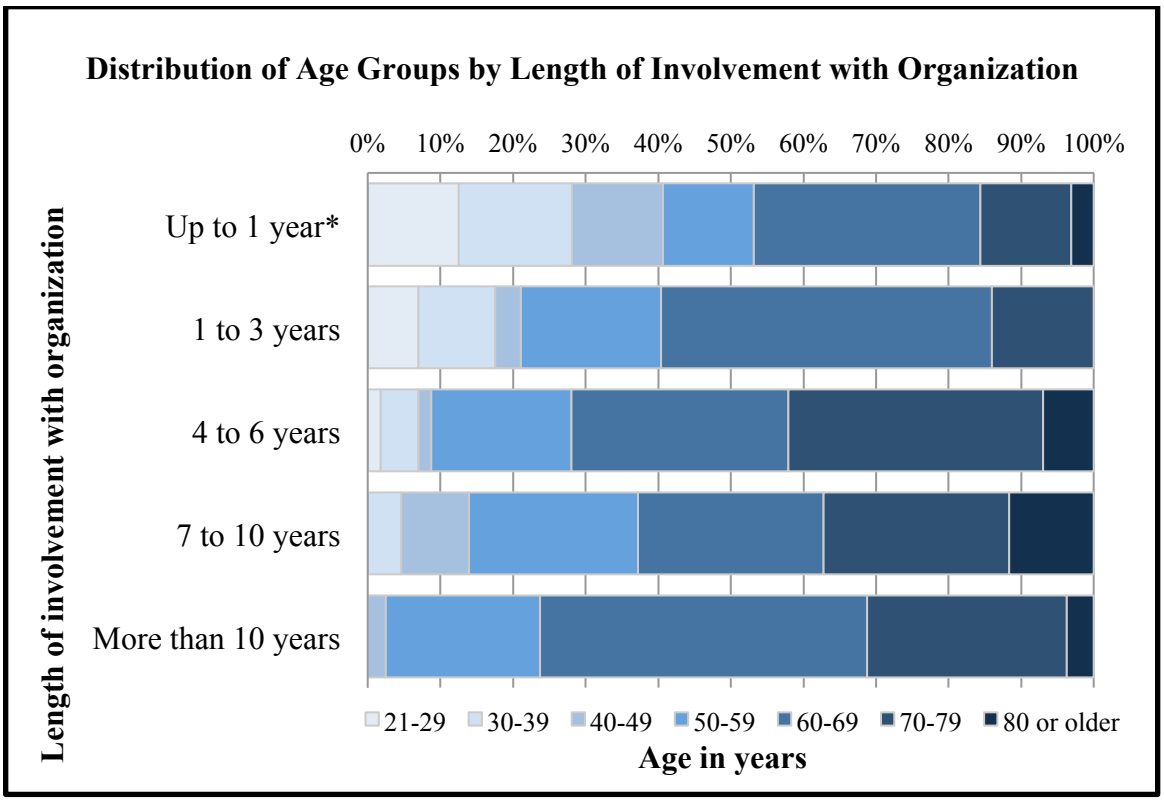

Figure 7. Distribution of age groups by length of involvement with organization. Lighter shades represent younger volunteers, darker shades represent older volunteers. *"Up to one year" actually reflects up to 15 months of involvement.

I gathered information about frequency and duration of volunteer activities. Nearly half of respondents (42%) volunteer about two times per month and 18% volunteer at least once per week (**Figure 8**). One-quarter of volunteers (24%) spend between 30 minutes and one hour each time they volunteer, nearly one-third (29%) spend between one and two hours, and one-third (33%) spend between two and four hours (**Figure 9**).

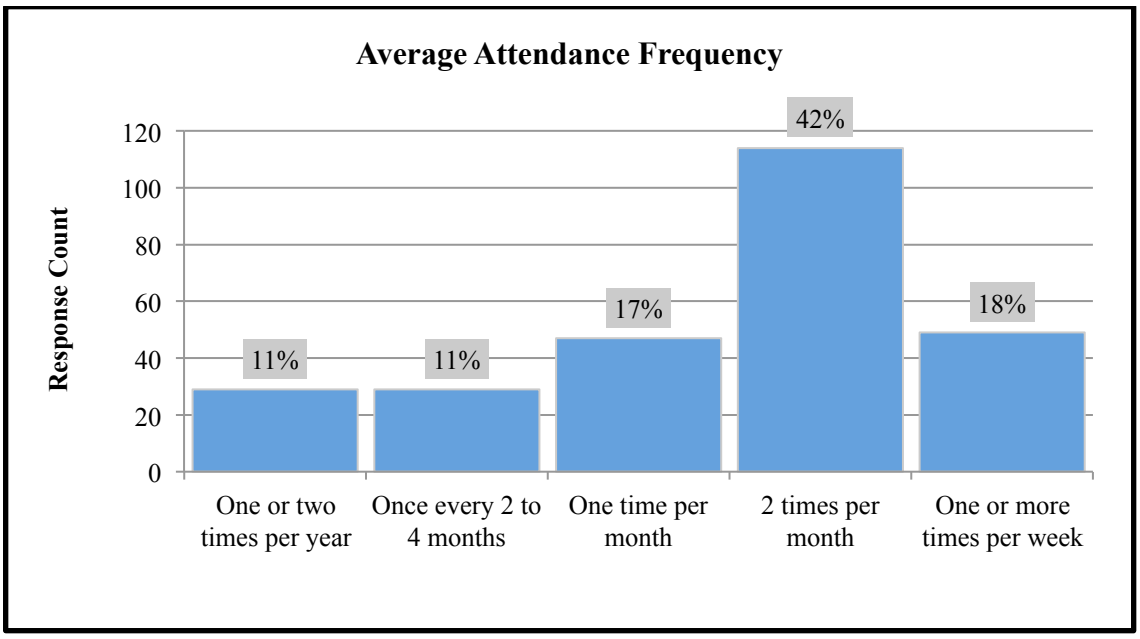

Figure 8. Average attendance frequency.

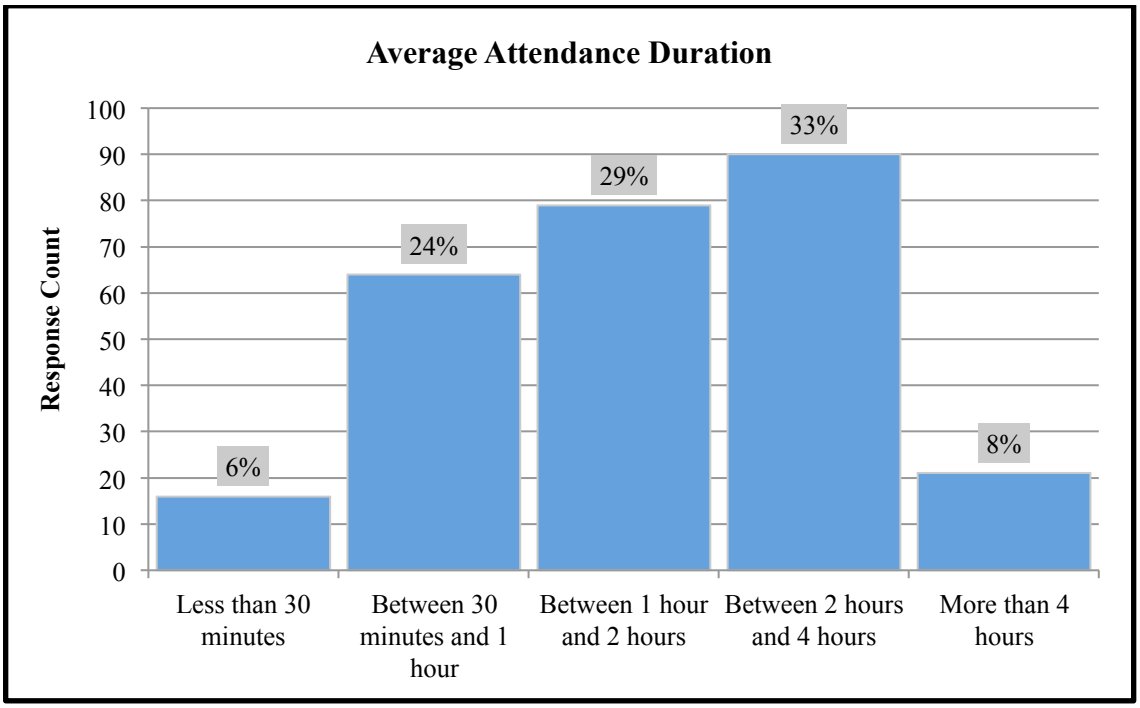

Figure 9. Average attendance duration.

While I was not surprised that the most popular attendance frequency was two times per month, I was surprised that the most popular time spent per event was between two and four hours. To better understand how volunteers allocate their time, I created a visual representation of the responses using a heat map – darker squares represent more responses than lighter squares (**Figure 10**). Volunteers who attend events twice per month most frequently spend between 30 minutes and one hour, which is closer to what I expected. In addition, the number of volunteers who attend twice per month decrease with increasing time spent per event.

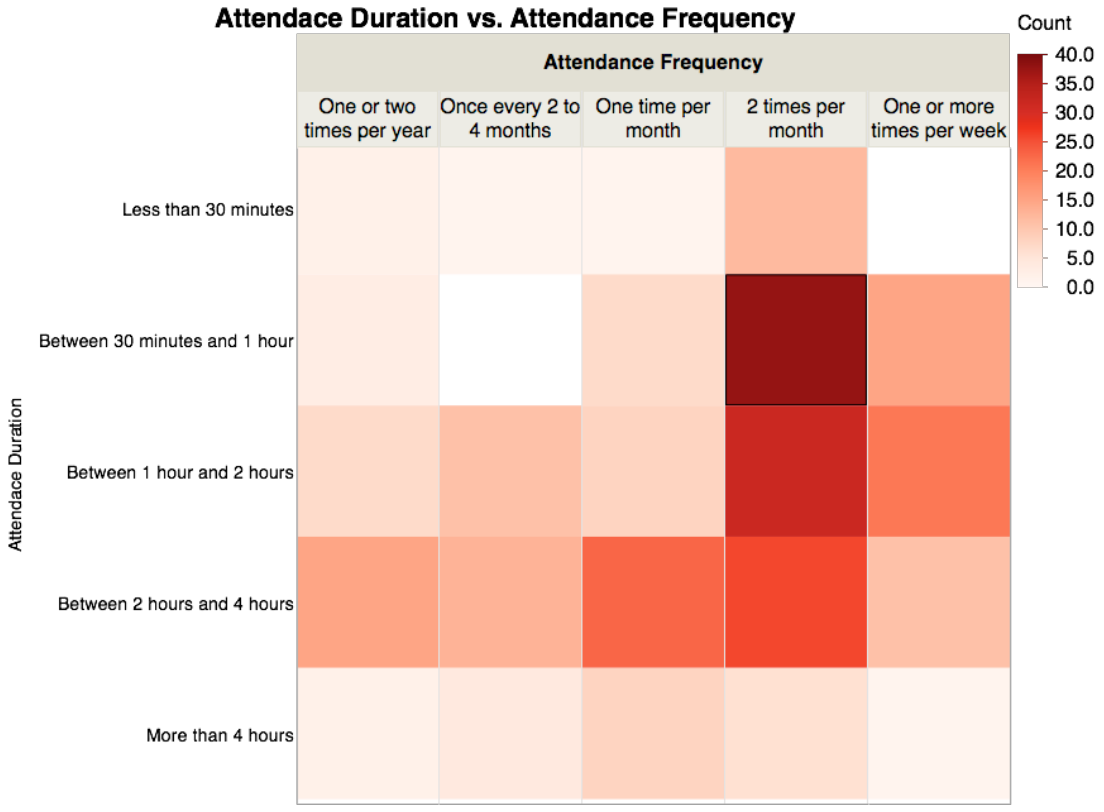

Figure 10. Attendance duration versus attendance frequency. Heat map indicating response counts for attendance frequency (horizontal axis) versus attendance duration (vertical axis). Darker colors represent more responses than lighter colors.

One topic that is missing from the literature is how weather affects attendance. Over half of respondents (57%) *always* perform tasks outdoors, and nearly one-third of respondents (29%) *usually* perform tasks outdoors. Over half of respondents (52%) indicated that unfavorable weather would not deter them from completing tasks. Almost half (44%) of respondents reported they would go out in weather that is somewhat unfavorable, while nearly one-third (29%) would only be stopped by a severe storm. Coordinators might benefit from knowing if protective clothing is a barrier to those who would perform tasks outdoors but do not have appropriate gear. I found that only 2% of respondents wanted or needed to borrow outdoor clothing. (See **Appendix E: Outdoor Activity** for complete details and graphs on outdoor activity.)

Finally, I assessed volunteer satisfaction by asking a few questions about their future plans for volunteering. The overwhelming majority of volunteers plan to continue volunteering with their organization (92%; **Figure 11**). They do not feel very strongly about *increasing* the amount of time they spend volunteering, but overall they do not plan to *decrease* the amount of time spent. Lastly, most volunteers (89%) are likely to recommend their projects to others, which is a good indicator that the respondents are happy with their organizations and enjoy being part of them.

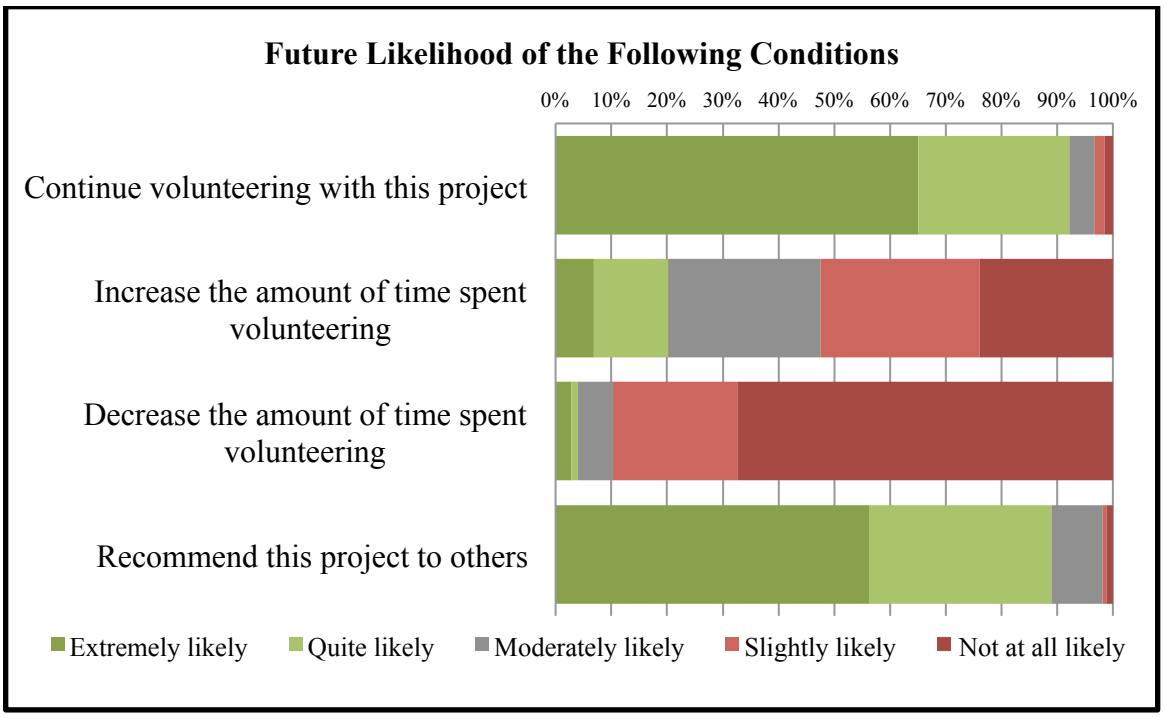

Figure 11. Future likelihood of continued engagement with organization. Measure of volunteer satisfaction by future intentions to continue participating and to recommend the project to others. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree").

4.4 Motivations to Participate

Respondents were asked to indicate their level of agreement with a series of 12 statements about reasons for volunteering (**Figure 12**). The results are very similar to the literature with "helping the environment" as the choice with the strongest level of agreement and "advancing one's career" as the weakest. The social motivation "engage with other people" fell relatively low on the list, which is consistent with previous studies. The wording may not have captured how an individual reacts to social motivations, but I included another set of questions about social motivations to address this issue and to gain a better understanding of this category (discussed later in 4.8 Social

Interactions). Most of these motivational statements reflect those in the literature, but one that is largely missing from the citizen science literature is "to contribute to scientific knowledge," which turned out to be the fourth strongest motivator. This shows that being part of the scientific process is an important aspect of both being a water quality monitor and a citizen scientist.

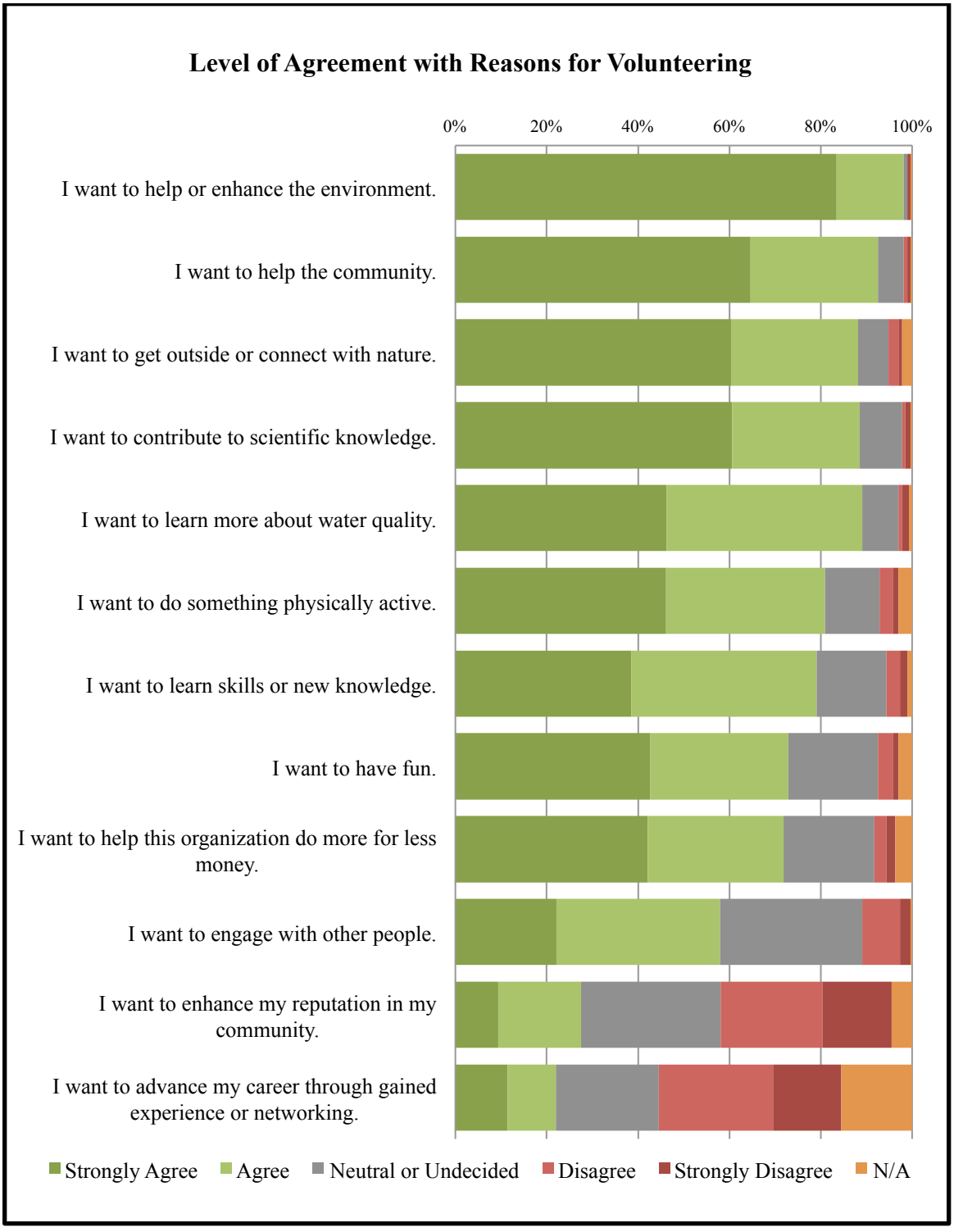

Figure 12. Level of agreement with reasons for volunteering. Distribution of responses for each motivation in order of strongest to weakest agreement. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

In practice, many researchers use the mean for individual Likert-type items. For certain analyses, I have chosen to report the mean for ease of comparison. For example, respondents were asked to indicate how strongly they feel motivated by 12 different statements. The mode reveals that many motivations carry the same weight and is not very useful for interpretation (e.g. the mode response for seven of the 12 motivations is "strongly agree"). However the mean reveals slight variations in the frequency of response to each of the five options when weighted. Responses were weighted from 1, strongly disagree, to 5, strongly agree.

The mean score for each motivational statement was found and statements were then categorized by the Volunteer Functions Inventory (VFI) to show which overarching types of motivations are most important (**Table 16**; see Section 2.2). When the motivations are organized this way and the means are combined, the strongest motivations are those that serve the values function and ego protective function, followed by understanding, ego enhancement, social, and last is career.

Motivations Organized by Function			
VFI Function	**Motivation**	**Mean**	**Combined Mean**
Values	I want to help or enhance the environment.	4.81	4.50
	I want to help the community.	4.55	
	I want to help this organization do more for less money.	4.12	
Ego Protective	I want to get outside or connect with nature.	4.48	4.48
Understanding	I want to contribute to scientific knowledge.	4.47	4.31
	I want to learn more about water quality.	4.33	
	I want to learn skills or new knowledge.	4.13	
Ego Enhancement	I want to do something physically active.	4.25	4.19
	I want to have fun.	4.13	
Social	I want to engage with other people.	3.68	3.27
	I want to enhance my reputation in my community.	2.84	
Career	I want to advance my career through gained experience or networking.	2.75	2.75

Table 16. Motivations organized by function. Categorized by function according the Volunteer Functions Inventory (Clary et al., 1998) in order of highest to lowest mean score. Responses were weighted from 1 for "strongly disagree" to 5 for "strongly agree."

I developed my survey before fully understanding the usefulness of the VFI, so I organized the motivations by function after writing the survey statements. Thus, the motivations are not a perfect fit for the functions, as is the case in most of the literature. The motivations I placed in the ego enhancement function ("to do something physically active" and "to have fun") do not match the wording used in other studies and may not be a perfect fit for this function, but they most closely relate to feeling good about oneself. I placed "to get outside or connect with nature" in the ego protective function because it most closely relates to feelings of escapism (i.e. from daily life), which helps reduce negativity. Because individuals have multiple and overlapping motivations, the motivations are not a perfect fit for the functions of the VFI. For example, "to contribute to scientific knowledge" may fit in both the "understanding" function and the "values" function because it implies that volunteers are both seeking knowledge and donating their time for a purpose beyond themselves.

Organizing the motivations by function allows coordinators to generalize the motivations to a broader category. For example, instead of focusing campaign messages specifically on "helping the community," messages can appeal to any value that expresses altruism within the goals and mission of the organization. Likewise, a coordinator for a project that does not monitor water quality can focus on the understanding function in a way that fits their organization's goals.

Because volunteer retention is important to environmental stewardship organizations, I wanted to determine if motivations change over time so that coordinators will know if they should use different recruitment messages for different audiences. I found the mean rating for each group of longevity with the organization: up to one year,

one to three years, four to six years, seven to ten years, and over ten years. If veteran volunteers have different motivators than newer volunteers, this would be valuable information to incorporate in recruitment and retention campaigns.

For most motivations, I found very few differences between the newer and more veteran volunteers (**Figure 13**). However, there are some differences in the last three categories: "engage with other people," "enhance my reputation," and "advance my career." The newest volunteers (up to one year) felt more strongly about these three motivations than the veteran volunteers, although these are still the lowest rated motivations of all the motivations for new volunteers. One possible explanation is that the newer volunteers might be new to their community and they want to establish themselves or make new friends. Another possibility is that the newer volunteers are also younger in age and are trying to develop their careers.

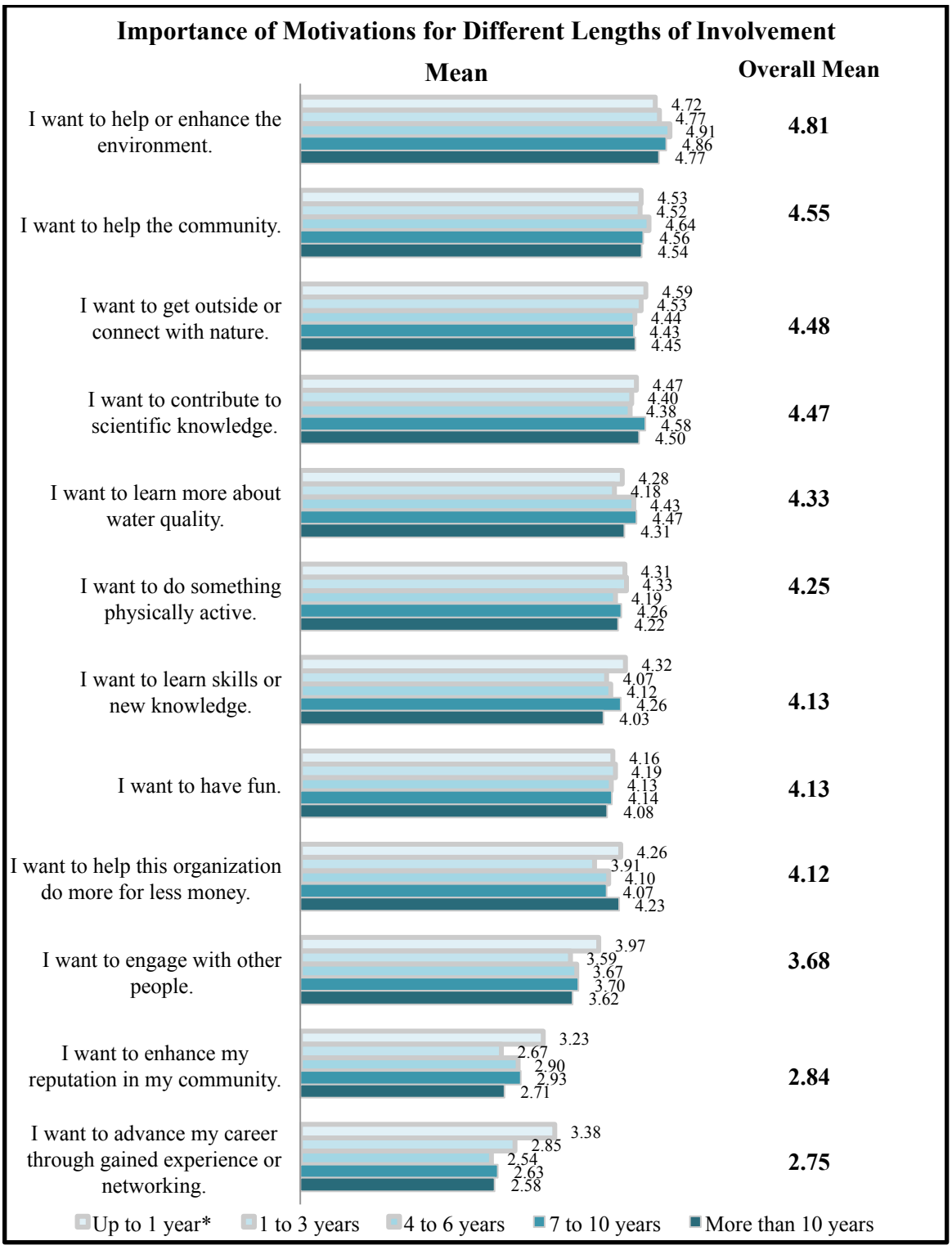

Figure 13. Importance of motivations for different lengths of involvement. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A." *"Up to one year" actually reflects up to 15 months of involvement.

To see if age influences the importance of motivators, I found the mean rating of motivations for each age group (**Figure 14**). I found that the youngest age group of volunteers (20-29) explains the higher ratings for newer volunteers in the last three categories ("engage with other people," "enhance my reputation," and "advance my career"). I found that the younger volunteers rated the "career" motivation much higher than the other age groups. The mean ratings of "career" for the two youngest age groups (20-29 and 30-39) were 4.33 and 3.56, while the overall mean for "career" was only 2.75. The "career" motivation is the sixth strongest motivator for the two youngest age groups, as opposed to the 12th and weakest motivator for respondents overall. Furthermore, the mean scores for the "career" motivation decrease with increasing age.

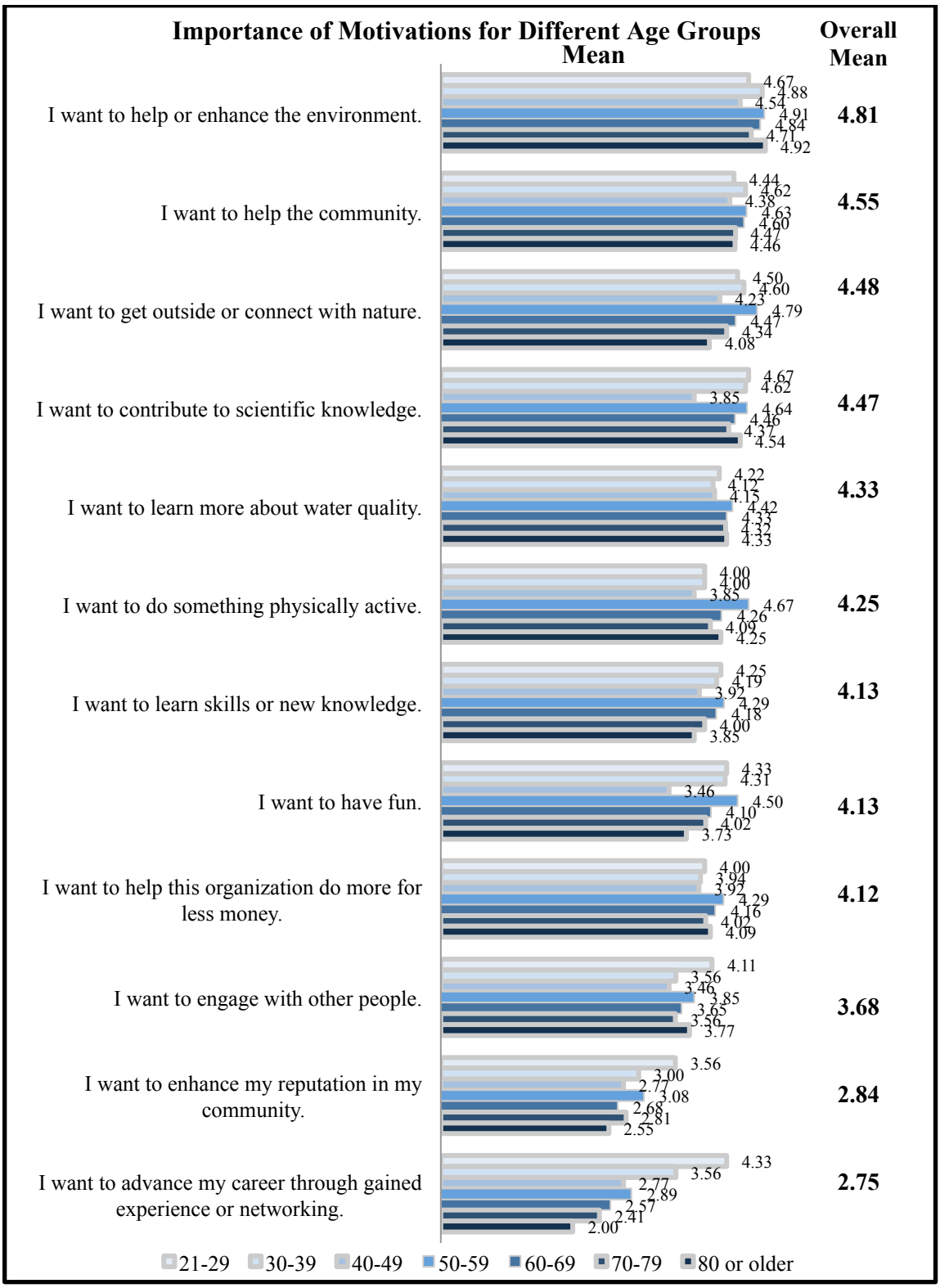

Figure 14. Importance of motivations for different age groups. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A."

This validates the assumptions made in the literature about younger volunteers being more motivated than older volunteers by career advancement. It also suggests that coordinators may want to recruit younger people with different messages than they would use to recruit older people, and they will need to change their messages over time as the new recruits age to enhance retention. While the differences are important to coordinators who want to recruit certain age groups, coordinators will also want to meet the needs of their most common volunteer. The largest age group is 60-69 and the mean ratings for this age group are very close to the overall ratings. Coordinators should keep this in mind when developing activities.

To see if gender influences the importance of motivators, I found the mean ratings of motivations for males and females (**Figure 15**). There is very little difference in the means between males and females. Females rated the "career" motivator somewhat higher (2.92) than males (2.64), but both were close to the overall mean (2.75). This suggests that gender explains very little of the variation in motivators.

Figure 15. Importance of motivations for different genders. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A."

4.5 Use of Volunteer Collected Data

Because many citizen science projects and water quality monitoring projects are data intensive, I wanted to explore volunteers' feelings about how their organizations use volunteer collected data. Volunteers who participate in these types of programs might be motivated to participate by the use of data for ecosystem management or scientific publications. For example, in the study by Roggenbuck et al. (2001), volunteers stated that they wanted an increase in the use of data by government agencies and more feedback from coordinators about how the data is used.

Many of the participating organizations use data to inform the public or state agencies about the health of water bodies. To provide more details on how organizations use volunteer-collected data, the focus is narrowed to the organizations with the most survey respondents: (1) Maine Volunteer Lake Monitoring Program (Maine VLMP), (2) University of Rhode Island Watershed Watch (URIWW), and (3) South Yuba River Citizens League (SYRCL). These three groups combined contributed 86.4% of the total survey responses.

The data collected by Maine VLMP is considered the "primary source of lake data in the state of Maine" (Maine Volunteer Lake Monitoring Program, 2013). Maine VLMP produces an annual report (available online) that summarizes lake water quality and the status of invasive plants ("Maine Lakes Report," n.d.). The report includes an appendix with a list of all volunteers, several photos, and a separate list recognizing those volunteers with 10 or more years of service (Maine Volunteer Lake Monitoring Program, 2013). The organization also publishes near real-time water quality data for eleven lakes

online to provide the public with an overview on state lake health ("Near Real-Time Lake Data," n.d.).

The data collected by URIWW is used to assess and manage state water bodies by the Rhode Island Department of Environmental Management, "municipal governments, associations, consulting firms and residents" ("URIWW Data and Results," n.d.). Data is available online or by request and updates on bacteria are posted within one week of sampling ("URIWW Data Available Online," n.d.).

Data collected by SYRCL volunteers is used to inform SYRCL's restoration projects and advocacy campaigns about salmon habitat, dams, and hydropower ("River Science," n.d.). The data was used to produce a report assessing the state of the Yuba River Watershed in 2006 (Shilling, 2006). Data is also contributed to an ongoing project called Yuba Shed, which makes data, photos, maps, and tools available to the public online ("Yuba Shed," n.d.).

I found that while nearly all respondents agree or strongly agree that the data is used appropriately, about one-third agree or strongly agree that more should be done with the data (**Figure 16**). A little more than half agree or strongly agree that the data should be used for scientific publications. Nearly all respondents indicated feeling good when data and/or results are shared with them and when environmental problems are identified and addressed because of the data collected.

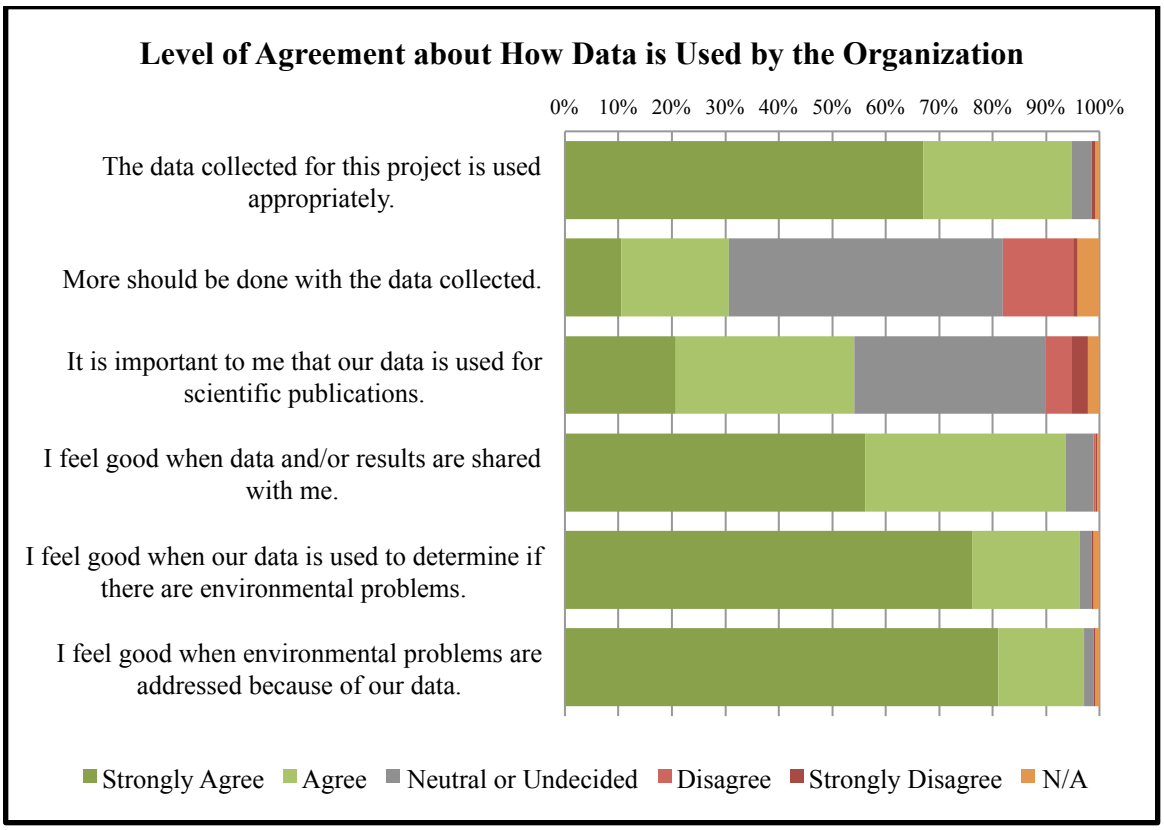

Figure 16. Level of agreement about how data is used by the organization. Distribution of responses for each statement about how data is used by the organization. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

Because the fourth highest of the 12 motivators to participate is "I want to contribute to scientific knowledge" (see Section 4.4), I compared this motivator to feelings about how the data is used. Many respondents who are strongly motivated by contributing to scientific knowledge also think it is very important that the data is used for scientific publications (**Figure 17**). However, there are also a number of respondents strongly motivated by contributing to scientific knowledge that feel neutral or undecided about using the data for scientific publications. This raises a question for further research: how do volunteers define scientific knowledge? Perhaps contributing data to

public databases or management of specific ecosystems is more important than scientific publication. Considering the high level of activism by the three groups contributing the majority of the responses for this survey, it would appear that volunteers value public data, ecosystem management, and environmental stewardship over scientific publications.

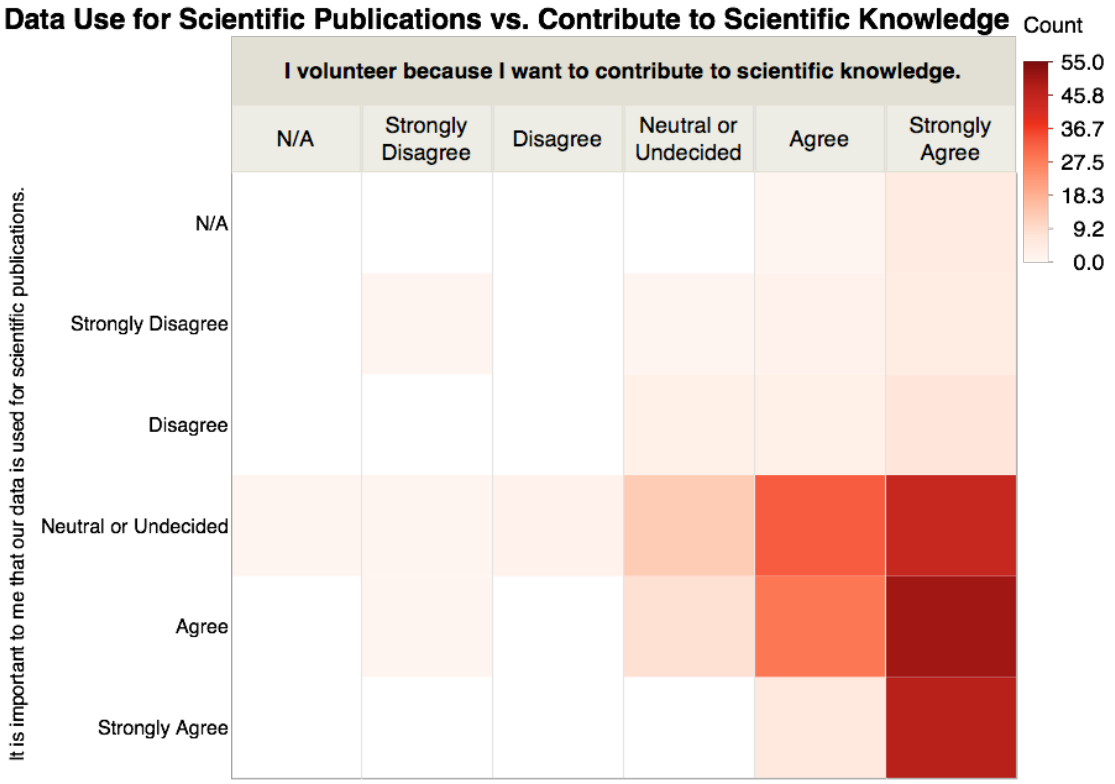

Figure 17. Data use for scientific publications versus contribute to scientific knowledge. Heat map indicating response counts for level of importance that data is used for scientific publications (vertical axis) versus the participation motivator "I want to contribute to scientific knowledge" (horizontal axis). Darker colors represent more responses than lighter colors.

Most volunteers who are strongly motived by contributing to scientific data felt neutral about the statement "more should be done with the data collected" (**Figure 18**). This may indicate that these volunteers are satisfied with how the organization uses data and thus supports the idea that appropriate use of data is a strong motivator for participation.

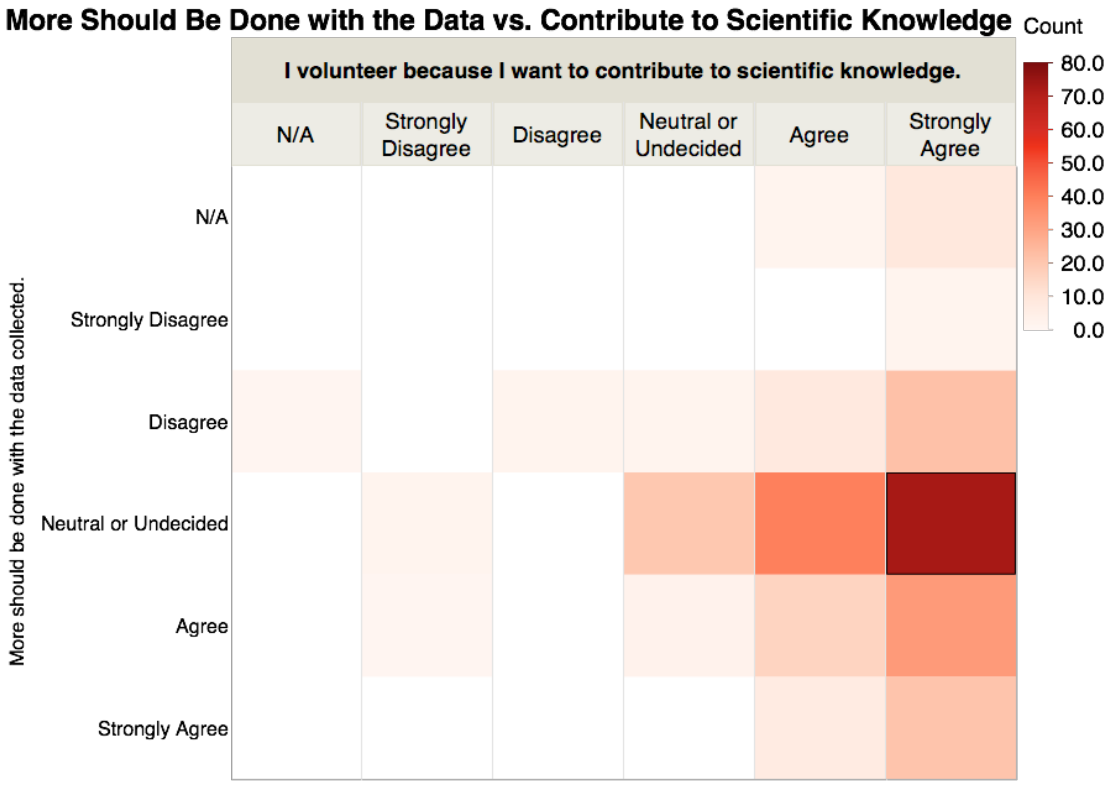

Figure 18. More should be done with the data versus contribute to scientific knowledge. Heat map indicating response counts for level of importance that more should be done with the data (vertical axis) versus the participation motivator "I want to contribute to scientific knowledge" (horizontal axis). Darker colors represent more responses than lighter colors.

These results support the findings by Roggenbuck et al. (2001) and also show that volunteers want the outcomes of their labor to directly affect the issue they are monitoring. More importantly, they want to know how their efforts have made an impact. Volunteers felt more strongly about the results being shared with them than about the data being used for scientific publication. This reinforces claims made by other researchers that coordinators need to share results with their volunteers (Knoke, 1981; Nov et al., 2014; Roggenbuck et al., 2001; Rotman et al., 2014). Further research could be done to explore the best or preferred methods for communicating results with volunteers.

4.6 Training

Citizen science and monitoring projects usually require volunteers to undergo some level of training in order to participate because collection methods with good protocol will yield rigorous data that can be used to inform management decisions. Training requires time and resources on behalf of the organization, so understanding how volunteers want to receive training will help reduce costs. Training requirements may also act as a barrier to participation if the training intensity is too high. I found that most respondents (over 75%) prefer single training events to sequential training events, but more than half also like sequential training to improve their expertise (**Figure 19**).

Many organizations offer tokens or certificates to volunteers who complete training activities. I found that most volunteers do not feel strongly about this type of reward; at least one-third indicated that they do not want recognition for training (**Figure 19**). This may be an area that requires a more in-depth interview process to fully

understand. My intent was to explore how volunteers respond to incentives to continue or further training to increase their expertise; however, I do not think that the statement I used in the survey expressed this idea fully. For example, volunteers with Reef Environmental Education Foundation can increase their rank by completing a certain number of fish surveys and certain levels of training. As their rank increases, their data is considered more rigorous by researchers. When volunteers reach the highest rank, they are invited on a special dive trip with researchers. Some volunteers might find this incentivizing to enhance their quality of participation and to continue their involvement over time.

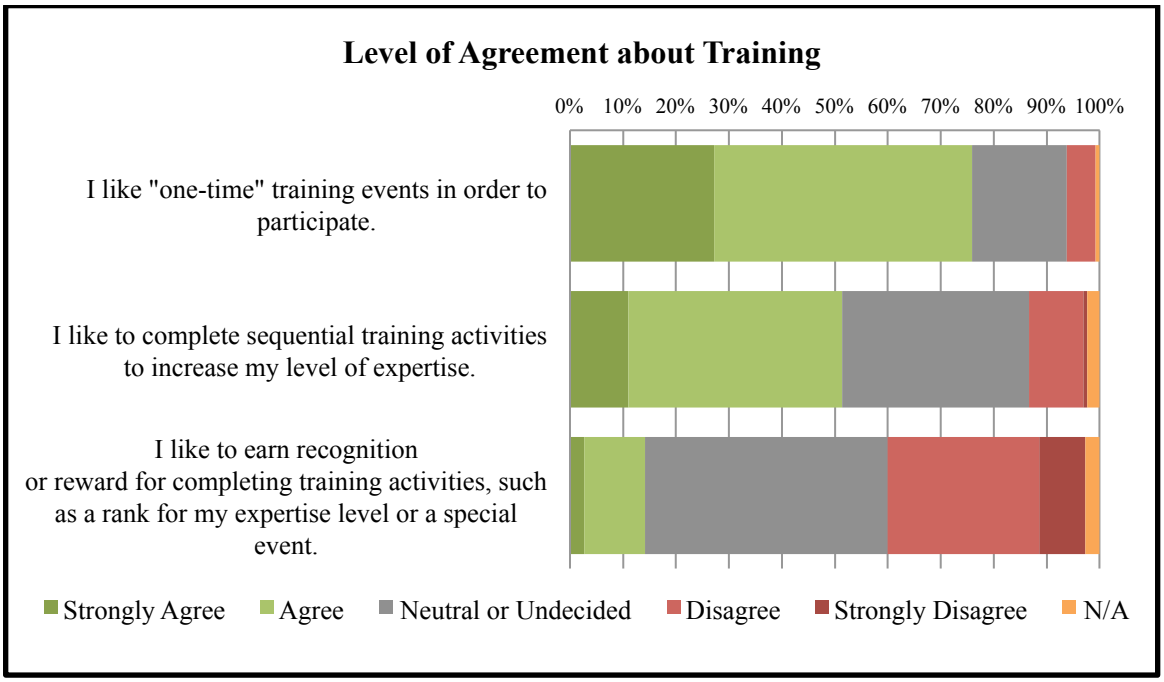

Figure 19. Level of agreement about training. Distribution of responses for each statement about volunteer training. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

4.7 Responsibility

Some researchers suggest that giving a volunteer more responsibility makes them feel valued and thus motivates continued participation (Knoke, 1981). However, Ryan et al. (2001) found that volunteers were not very interested in making decisions about the organization (mean 2.10 out of 5), and Roggenbuck et al. (2001) also found that volunteers want a leader who is in a full-time paid staff position (expressed numerous times in a focus group). I found that the opportunity to advance one's role in the organization was important to only about 20% of respondents and roughly 30% considered it unimportant (**Figure 20**). Despite the lack of desire to take on more responsibility, over 80% of respondents felt that they would be supported by the staff if they chose to do so. This indicates a positive working relationship exists between staff members and volunteers in the participating organizations.

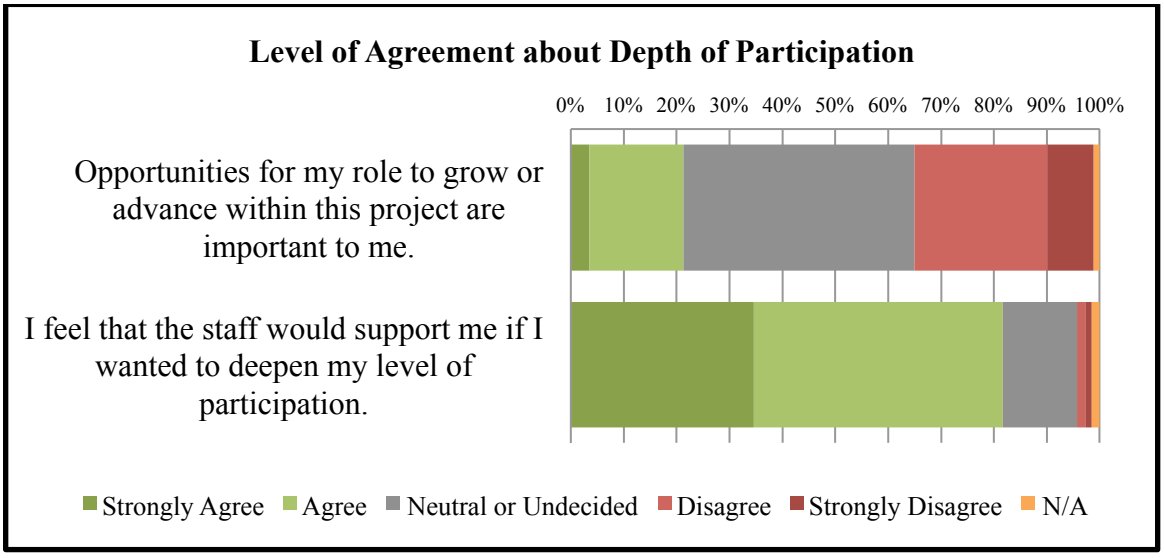

Figure 20. Level of agreement about depth of participation. Distribution of responses for each statement about depth of participation. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

To see if the importance of the opportunity to advance was different for different types of volunteers, I used the mean to compare newer to veteran volunteers. While the mean was close to neutral for most, the newest volunteers (those who have been volunteering for up to one year) did rate this factor slightly higher than the other volunteers (**Figure 21**). The mean for the newest volunteers was 3.13 while the mean for all other groups of volunteers was 2.82 or below.

Although some researchers suggest giving volunteers more responsibility as a reward, this may be something that coordinators should consider on an individual basis. For example a simple survey asking volunteers if they would like to take on a certain role with a specified job description might be a good way to target those few volunteers who want the opportunity. This could be included in the paperwork when new volunteers sign up, since it appears that it is more important to new volunteers than veterans.

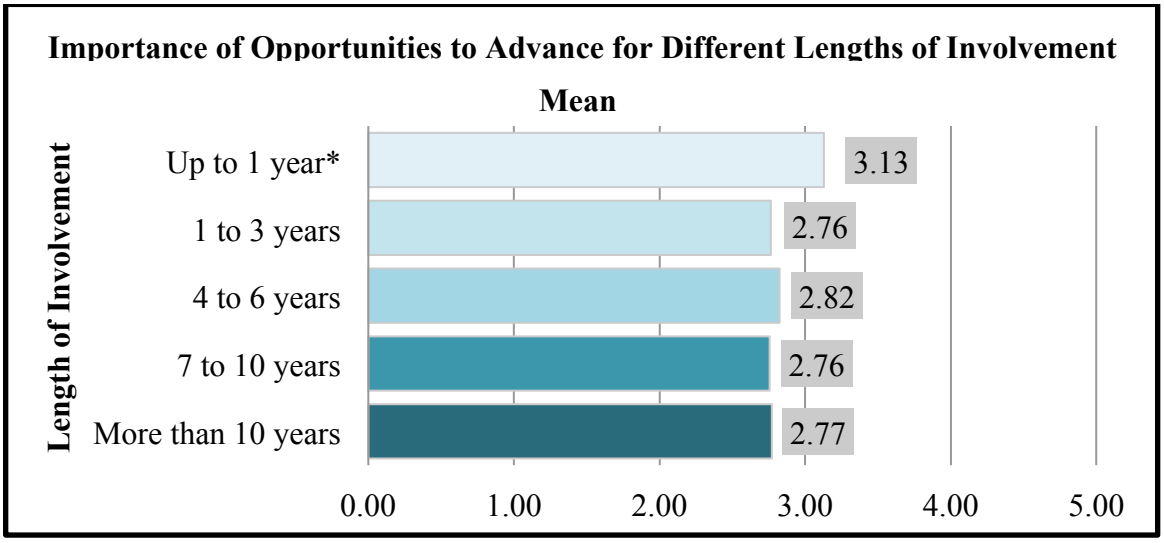

Figure 21. Importance of opportunities to advance for different lengths of involvement. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A." *"Up to one year" actually reflects up to 15 months of involvement.

4.8 Social Interactions

Roggenbuck et al. (2001) and Ryan et al. (2001) discuss the importance of social opportunities for continued volunteer commitment and point out that those who volunteer more frequently are motivated by social reasons. To gain a more thorough understanding of social interactions and social motivations, I asked respondents several questions about this category. I compared their responses to age, gender, and longevity to see how different types of volunteers feel about social factors. This will allow coordinators to customize activities based on the demographic makeup of their volunteers.

I analyzed group size preference because this will help coordinators set up activities that allow volunteers to participate in a group of their preference. I found that the most common response (41%) for group size preference was to perform tasks with a partner and the second most common preference (34%) was to perform tasks alone (**Figure 22**). A small group (three to five people) was the third most common response (17%), and groups larger than five were seldom preferred.

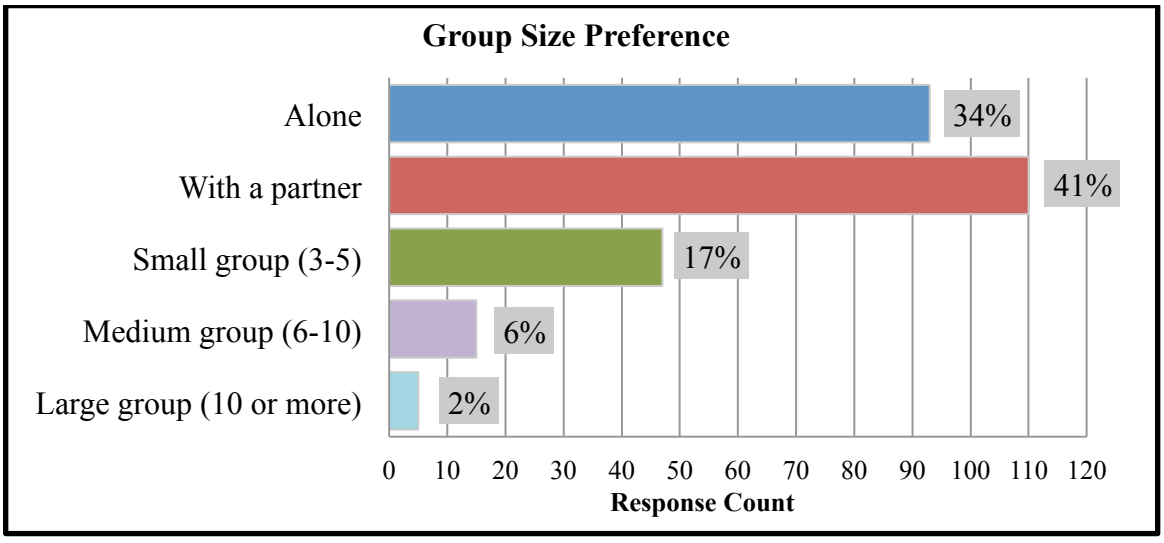

Figure 22. Group size preference.

Volunteers of different ages may have different group size preference. I did not find an overall pattern, but there was a larger portion of younger volunteers that preferred small and medium groups (**Figure 23**). Volunteers in the age bracket 60-69 most commonly preferred to work with a partner.

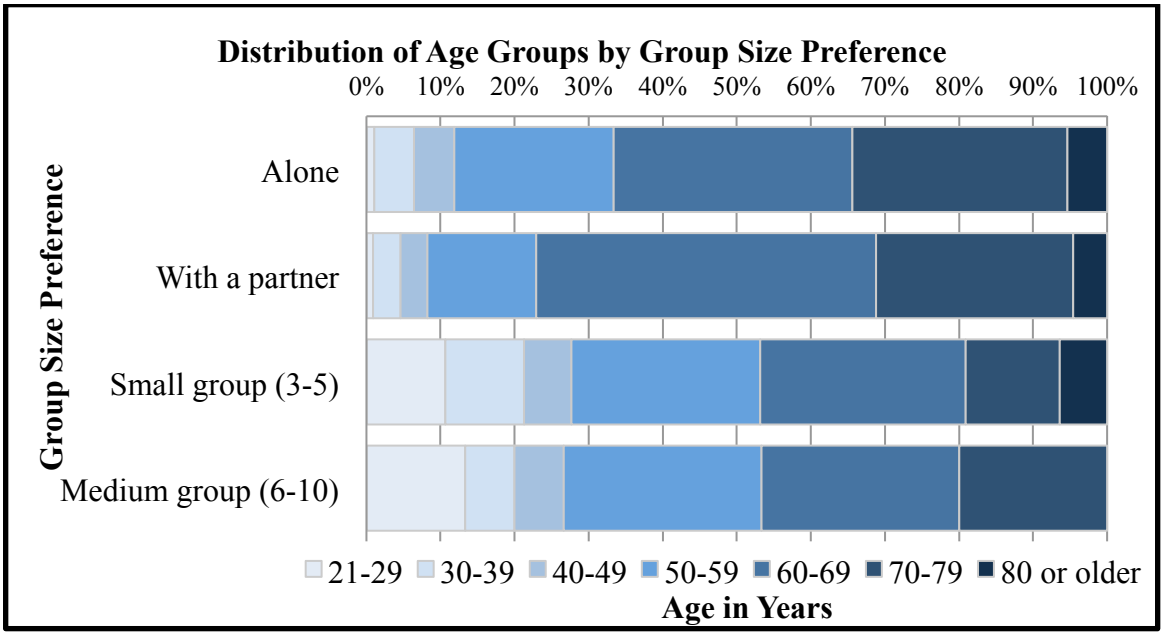

Figure 23. Distribution of age groups by group size preference. Lighter shades represent younger volunteers, darker shades represent older volunteers. Large group size (more than 10) was excluded because only 5 respondents chose this option.

Volunteers of different genders may have different group size preference. I found that males and females were evenly split across three of the group sizes: with a partner, small group, and medium group (**Figure 24**). However, males preferred to work alone (71%) more than females (29%). Coordinators may consider offering activities that allow volunteers to choose if they want to work in groups or alone.

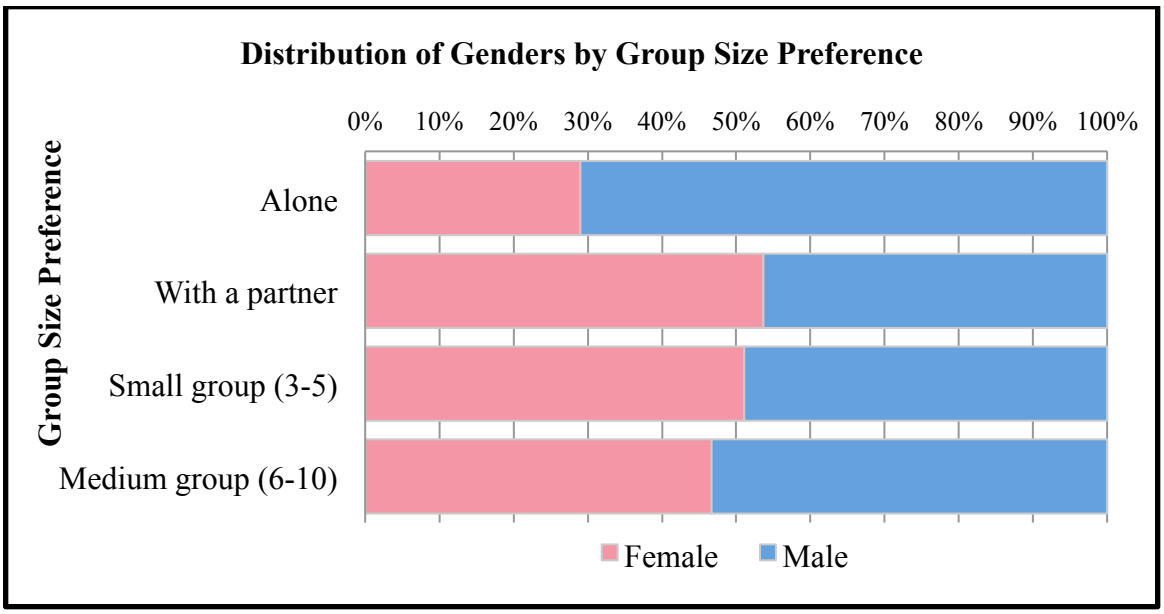

Figure 24. Distribution of genders by group size preference. Large group size (more than 10) was excluded because only 5 respondents chose this option.

Respondents were asked to indicate their level of agreement with five statements that completed the sentence "I volunteer because _____." These statements all relate to social interactions. The social reason to volunteer with the highest level of agreement was "I like learning from others with more experience than me;" this was closely followed by "I like sharing my experience, knowledge, or expertise with other volunteers" (**Figure 25**). Third highest was "I want to interact with like-minded people." The top three reasons each had at least 70% agreement.

The two reasons with the lowest level of agreement were "I want to spend time with family or friends" (43%) and "I want to meet new people" (42%). Further research may benefit from asking volunteers if they have made friends in the organization and if those friendships offer motivation to participate. Although most respondents indicated that spending time with friends is not a reason for volunteering, they may have

friendships in the organization, which may provide a subtle layer of motivation. For example, a person with a lower level of commitment to the organizations may be persuaded to attend an event if one of their friends is going or if one of their friends persuades them to attend.

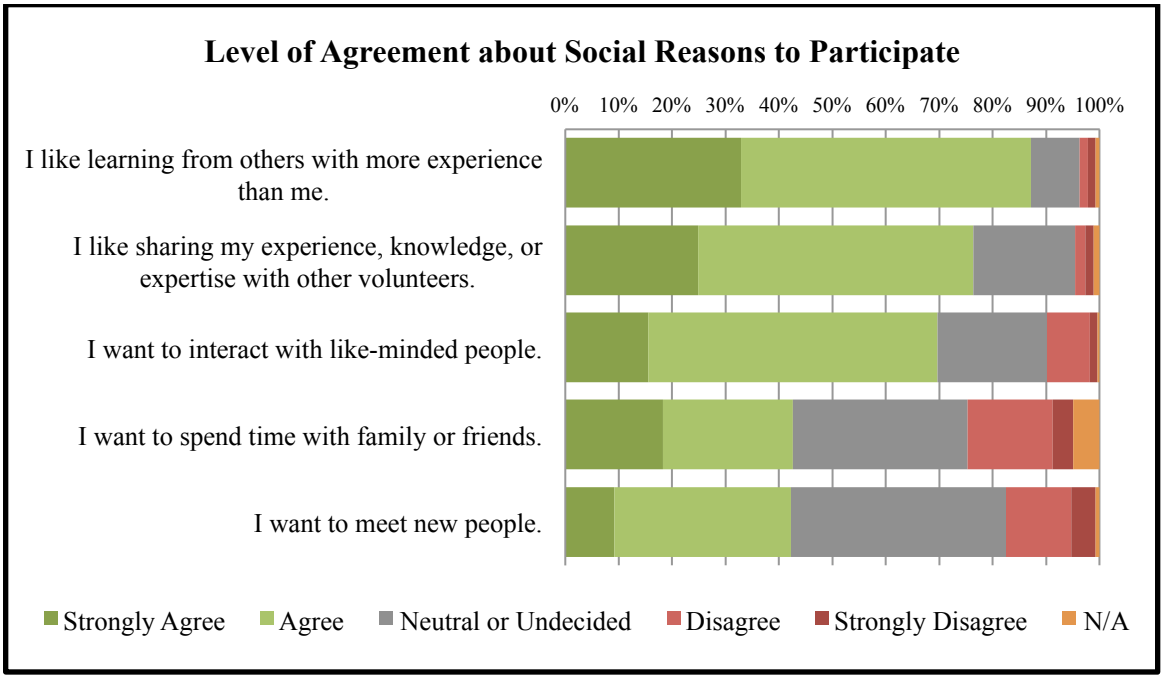

Figure 25. Level of agreement about social reasons to participate. Distribution of responses for each statement about social interactions in order of strongest to weakest agreement. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

Social motivations may change over time, so I compared the means for each motivator across different lengths of involvement (**Figure 26**). The differences are small, but the newest volunteers (up to one year involvement) rated all of the social motivators higher than veteran volunteers. However, the most veteran volunteers (more than ten years involvement) tended to rate these motivators second highest.

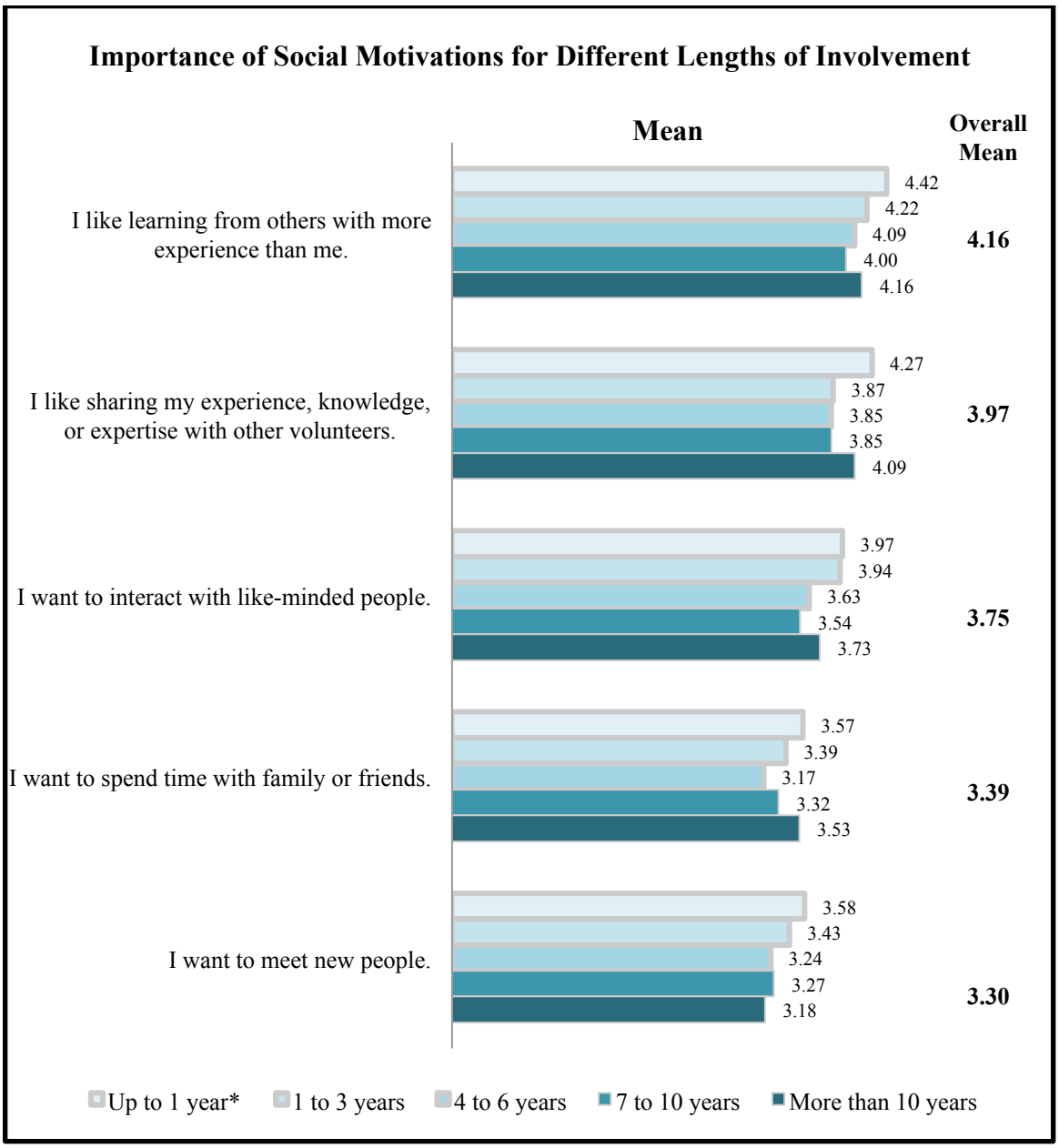

Figure 26. Importance of social motivations for different lengths of involvement. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A." *"Up to one year" actually reflects up to 15 months of involvement.

I also compared the means for each motivator across different age groups and gender. The most notable difference is in the last reason "I want to meet new people," which is rated higher by younger respondents than older respondents (**Figure 27**). Females rated all of the motivators higher than males, but only slightly (**Figure 28**).

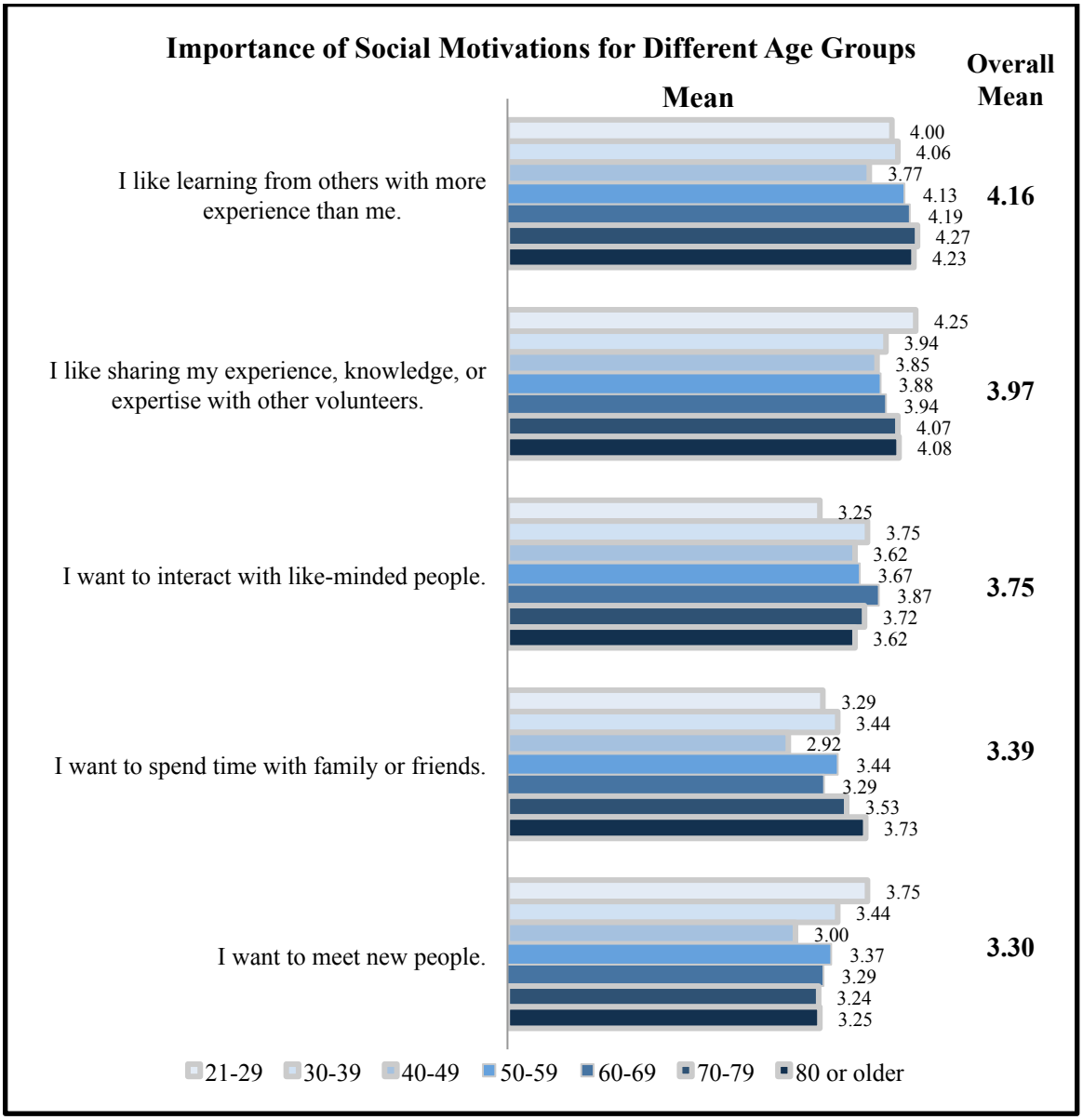

Figure 27. Importance of social motivations for different age groups. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A."

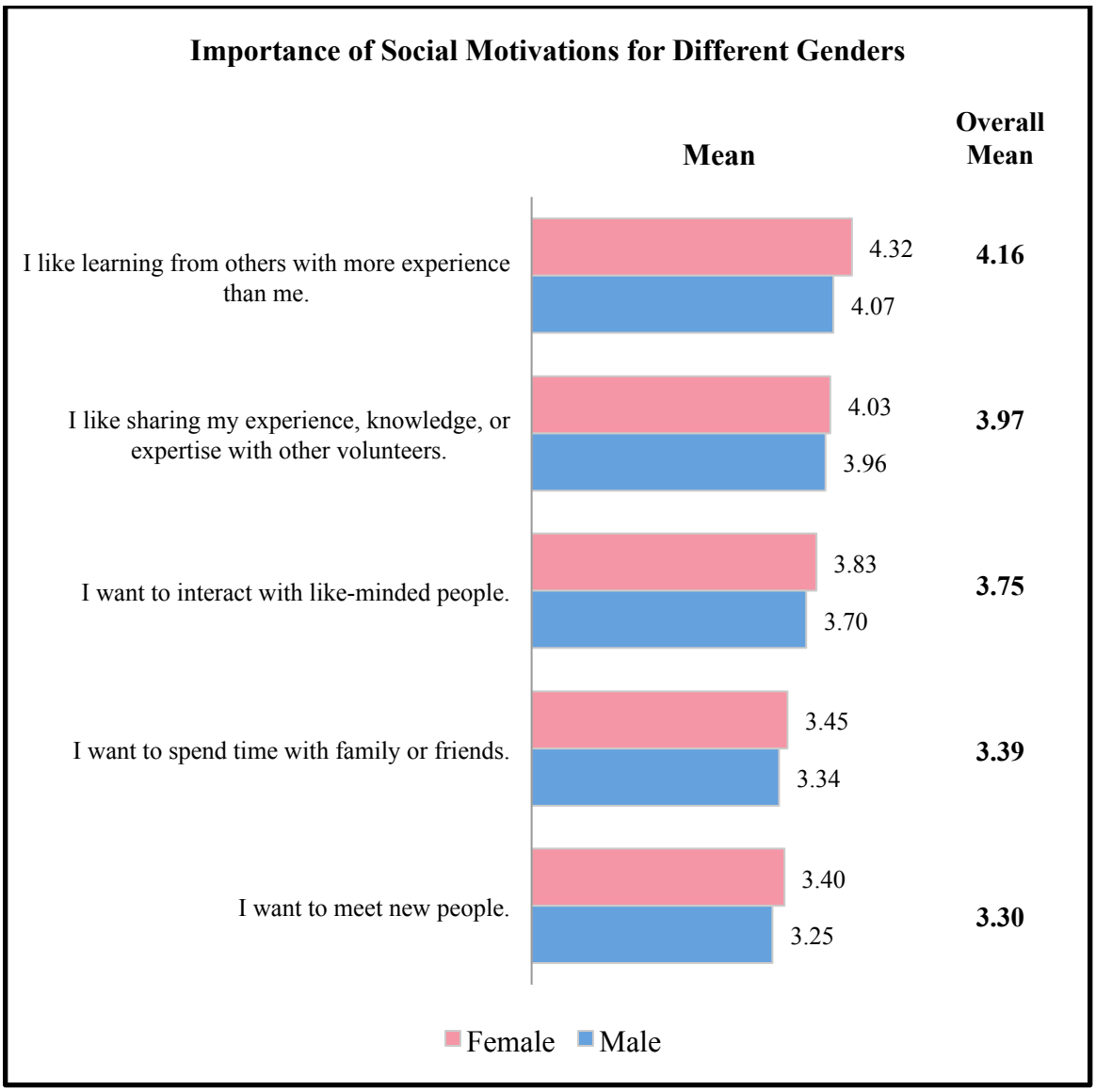

Figure 28. Importance of social motivations for different genders. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A."

4.9 Recognition and Appreciation

Much of the research on voluntarism advises coordinators to recognize the efforts of their volunteers and show them appreciation in some form. However, quantitative studies are limited that assess what types of recognition are most meaningful to

volunteers. Most respondents (84%) reported having received some form of recognition (**Appendix F: Recognition**), however they do not indicate strong feelings (only 40% agreement) about the importance of receiving recognition (**Figure 29**). The most common response to this question was "neutral or undecided." Some studies have found that some volunteers would prefer *not* to receive any recognition. My results do not support this claim very strongly; less than 10% of respondents agree. I also found no differences across length of involvement, gender, or age.

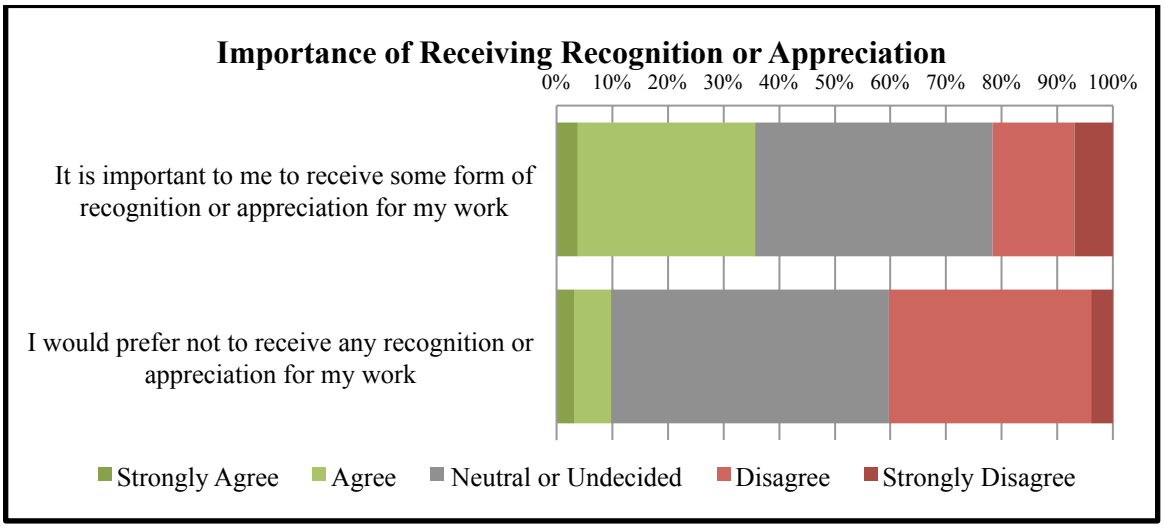

Figure 29. Importance of receiving recognition or appreciation. Distribution of responses for each statement about receiving recognition or appreciation. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

Respondents were asked to indicate how meaningful different forms of recognition were to them on a scale from "not meaningful at all" to "very meaningful." The highest rated form of recognition was a hand-written card (over 60% found this moderately meaningful or very meaningful); this was followed closely by a personalized

email, a volunteer appreciation event, and name recognition in their organization's newsletter (**Figure 30**). The lowest rated type was name recognition in social media, such as Facebook or Twitter (about 20% found this moderately meaningful or very meaningful). Coordinators should consider making the top four types of recognition their priority so they do not waste time or resources on things that volunteers do not care about.

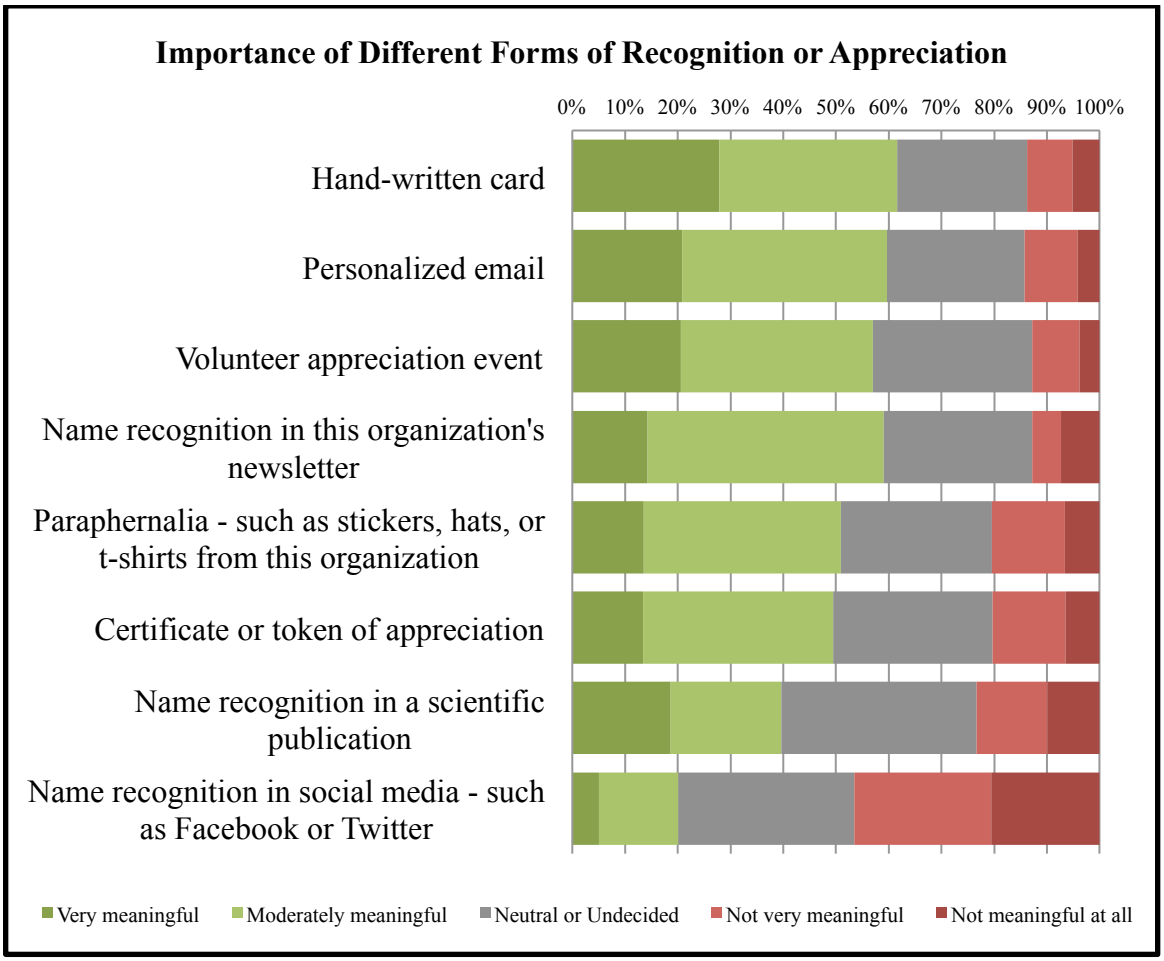

Figure 30. Importance of different forms of recognition or appreciation. Distribution of responses for each form of recognition or appreciation in order of strongest to weakest agreement. Green indicates agreement (darker green for "strongly agree"), gray represents "neutral or undecided", and red indicates disagreement (darker red for "strongly disagree"). Orange represents "N/A" (not applicable).

Younger and older volunteers expressed different views about preferred forms of recognition. Younger respondents scored all forms of recognition higher than older respondents (**Figure 31**). Young people rated name recognition in both scientific publication and social media much higher than older people. Because younger volunteers care more about advancing their career and enhancing their reputation than older volunteers, younger volunteers may care more about name recognition. The youngest age group rated name recognition in a scientific publication higher than all other forms (4.62). This may indicate that younger volunteers have different priorities than older volunteers, which may represent a generational shift. I found very little difference between genders (**Appendix F: Recognition**).

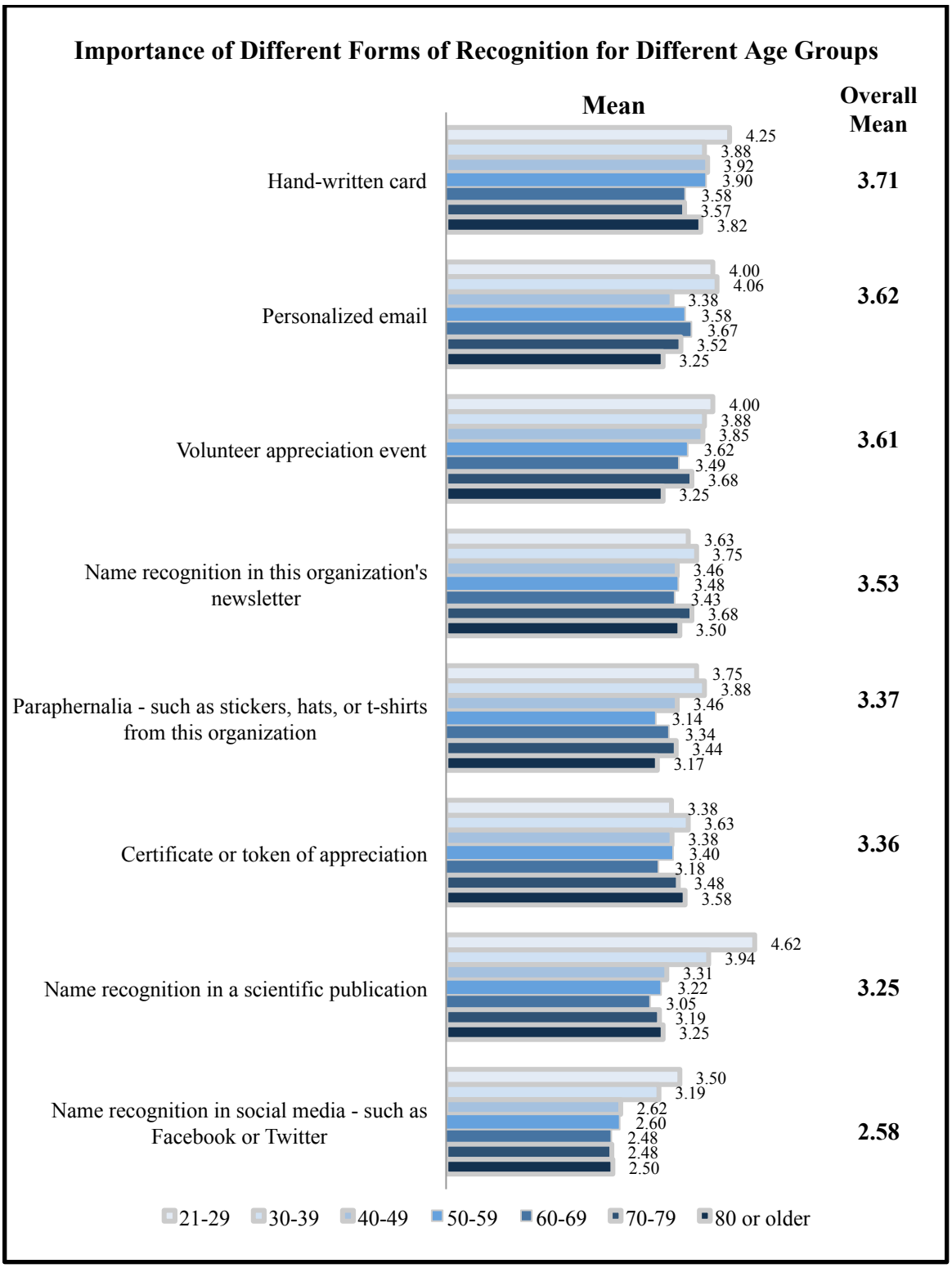

Figure 31. Importance of different forms of recognition for different age groups. Responses were weighted accordingly: 1 = "strongly disagree," 2 = "disagree," 3 = "neutral or undecided", 4 = "agree," and 5 = "strongly agree", no weight was assigned to "N/A."

Chapter 5: Conclusion

5.1 Key Findings and Applications

Volunteer Profile

This research collected survey response from 271 volunteer water quality monitors from eight organizations across the United States. Respondents were almost equally divided between male and female. Most survey respondents were over age 50 (86%) and the age group with the most responses was 60-69 (37%). Most were well educated, almost half were retired, and one-third were employed full-time.

I expected a normal distribution for length of involvement with the organization, with more people being involved for mid-term ranges (one to six years) and fewer involved for long-term ranges (more than seven years), but surprisingly, 30% of respondents (and the mode response) have been involved more than 10 years. This may indicate a response bias and a limitation of the study: those who are more dedicated to the organization are more likely to respond to a survey.

Most respondents volunteer twice per month for an average duration of 30 minutes to one hour. They usually perform tasks outdoors and they are not deterred by bad weather. Most respondents prefer one-time training events in order to participate, but over half also like sequential training to increase their expertise. Most prefer to work in small groups (5 or less) or alone to larger groups. Of those who like to work alone, 70% are male. When developing activities for volunteers, coordinators should consider these preferences and create options for volunteers to choose from. For example, at one event,

multiple activities could occur at once – some that require only one person or optionally working with a partner and some activities that engage three to five people.

Motivations

Motivations that serve the values function of the Volunteer Functions Inventory (see Section 2.2; Clary et al., 1998) are the strongest (to help the environment and community); closely followed by motivations serving the ego protective function (to get outside or connect with nature) and the understanding function (to contribute to scientific knowledge, to learn about water quality, to learn new skills or knowledge).

There was no difference in the importance of motivations based on gender. However, age and being a new volunteer played a role in the career motivation. The career motivation is the weakest motivator overall. However, younger and newer volunteers rate career higher than older or veteran volunteers. The career motivator decreases in importance with increasing age. Even though the career motivator is rated lowest out of 12 for the population as a whole, it is the 6th strongest for younger volunteers. Coordinators who want to recruit new volunteers or younger volunteers should consider this when crafting their messages.

Because volunteers found "learning from others" and "sharing experiences with others" very important, coordinators should strive to create activities that are suitable for a range of experience and expertise levels. Creating an atmosphere of social learning can be achieved, while incorporating group size preference, by pairing or grouping more experienced volunteers with less experienced volunteers. Allowing the veteran

volunteers to train the new volunteers is another option. Coordinators should note that younger and newer volunteers rated social motivations slightly higher than other groups.

Communication and Recognition

Respondents overwhelmingly indicated feeling good when results are shared with them and even more so when environmental problems are identified and addressed because of their data. Most respondents were neutral about receiving recognition for their work, although it is important to at least 30%. This indicates that *tangible results* derived from the efforts of the volunteers are more important than any form of reward. It also shows that *communicating* results to the volunteers is equally important. However, because other studies have revealed divergent results on the importance of recognition, this may be better explored through focus groups. In addition, individual personality may play a large role in whether recognition is desired and in what form (Trachtman, 2015).

A hand-written card was perceived as the most meaningful form of recognition. Younger respondents rated all forms of recognition higher than older respondents, and the most important form of recognition to younger people was name recognition in a scientific publication, whereas this was the second least meaningful to the respondents overall. This may be indicative of either a generational or maturational shift. It could be that as people age, they care less about name recognition. However, it could indicate that the younger generation has different priorities, which may or may not change as they age.

Coordinators should pay close attention to the pattern across age groups. When coordinators recruit young people, they should consider ways that their data can be published and make it known to the volunteers that they will receive acknowledgement in

the publications. Coordinators also need to pay attention to the body of volunteers that are currently participating and make sure that they cultivate the motivations of those volunteers as well. Since most respondents are over 50 years of age and place little importance on name recognition, coordinators will need to reward them differently, such as with a card or an appreciation event.

5.2 Limitations

Because the survey was quantitative, this study was limited by an inability to ask respondents about topics at a deeper level. When analyzing Likert-type data with means, there is an assumption of equal distance between the response alternatives on a 5-point scale. Whereas in reality, there is no unit of measure between feelings of "agree" and "strongly agree." Finally, the aggregated results of this study are biased toward Maine VLMP volunteers because they represent nearly half of the respondents.

5.3 Further Research

Although the fourth highest of the 12 motivators to participate is "I want to contribute to scientific knowledge," many respondents feel neutral about data being used for scientific publications. This set of responses raises interesting questions and avenues for further exploration: How do citizen scientists perceive or define scientific knowledge? Why are publications relatively unimportant to the volunteer and what form of scientific knowledge should the data take? This could be explored by asking volunteers their opinion on how their data should be used. Volunteers may perceive scientific publications as somewhat inaccessible, and, since they value tangible results, perhaps the

issue is more about the data being made publicly available so that it may be used to solve problems.

Volunteers place great value on results being shared with them, so the next step would be to elicit the best methods to communicate this information. Volunteers may prefer to receive updates via email or newsletters, or they might prefer a presentation that interprets the results. This would fulfill the understanding motivation and some volunteers may take this information and act as ambassadors by teaching other non-participants about stewardship.

Conflicting responses about social motivators indicate that this topic is difficult to address in a closed-ended questionnaire. The motivators "I want to engage with other people" was important to 60% of respondents, and "I want to interact with like-minded people" was important to 70%, but "to spend time with family and friends" and "to meet new people" were only important to 40%. Individuals may be more motivated than they report by interpersonal relationships within the organization. For example, when friendships are developed, an individual may become more motivated to attend events knowing that they might see their friends there. However, this force may act on a level that is too subtle for an individual to be very conscious of when taking a survey. Understanding how social interactions influence participation may require focus groups or participant observation.

Finally, coordinators would benefit greatly from more specific knowledge about how to acknowledge their volunteers. The most meaningful form of reward to respondents was a hand-written card (60%). There could be a form of reward that is meaningful to more than 60% of volunteers that could be elicited from an open-ended

survey question. However, individuals may feel uncomfortable naming a specific reward because they are contributing their efforts mostly from a function of altruism and thus they feel that should not need a reward. Like social interactions, reward may act on a subtle level of consciousness, wherein receiving a reward makes the volunteer feel good, but this feeling may not arise to a level of awareness when the individual is taking a survey.

This study raises interesting questions for future research while providing clear directions for project coordinators which can be incorporated into the activities they plan, how they show appreciation to their volunteers, and how they craft messages to recruit and retain volunteers. Volunteer water quality monitors provide a vital resource to society by identifying sources of pollution and unhealthy water bodies, yet these volunteers have been understudied. Because water quality monitors represent a cross section between citizen science and environmental stewardship, this study will help coordinators in both fields to improve retention.

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Appendices

Appendix A: Recruitment Details

Call for Research Participants

To recruit organizations to participate in my study I sent a call for research participants to several listserv groups: Association for Environmental Studies and Sciences (AESS), Cornell Citizen Science Discussion, Thurston Eco Network (formerly EETAC), and EPA Volunteer Monitor. I also sent a request to three listserv managers to post my call for participants, but they either did not respond or failed to follow through. In my call for participants, I stated that I was looking for organizations with volunteers that monitor water quality. I purposely left out specific parameters, because I was hoping to capture a broad array of monitoring activities including, but not limited to, chemical tests, secchi disk, and macroinvertebrate monitoring. Of the organizations that contacted me with expressed interest in participating, one opted out due to lack of time and another I excluded because the volunteers collected wildlife data and not water quality data. I also contacted three organizations directly via email, but these organizations did not respond.

Promotional Material

We want to hear from you! Our organization has been asked by Bethany Alender, Master of Environmental Studies Candidate with The Evergreen State College, to participate in her graduate study about what motivates people to participate in volunteer water quality monitoring. Your participation in the study will help us better understand volunteer motivations and will help us tailor our program to better serve

our volunteers. Please click on the link below to participate in a brief survey (about 10 minutes). For questions about the survey, you may contact Bethany at alebet17@evergreen.edu.

Participants who fully complete the questionnaire will be entered in a random drawing for 1 of 10 one-year subscriptions to National Geographic!

Please complete the survey by Friday, March 13th.

Appendix B: Participating Organizations

Organization	Location	Water quality measurements	Website	Year Founded	Total number of volunteers	Number of volunteers that this survey applied to	Number of volunteers who were sent the survey via email	Number of responses	Response rate	Percent of all responses	Notes
South Yuba River Citizens League (SYRCL)	California: Nevada City	water temperature, air temperature, conductivity, dissolved oxygen, pH, chloride, turbidity	http://yubariver.org/river-monitoring/	1983	600	57	57	30	52.6%	11.1%	Only one volunteer did not use email.
Maine Volunteer Lake Monitoring Program (VLMP)	Maine: statewide	water clarity (Secchi disk), total phosphorous, chlorophyll a, alkalinity, pH, apparent color, specific conductance, trophic state index, dissolved oxygen, temperature	www.mainevolunteerlakemonitors.org	1971	1200	624	466	130	27.9%	48.0%	The initial email sent had a broken survey link. VLMP sent out a corrected link within a few hours. The coordinator chose to send only two emails with the survey link because their volunteers do not like receiving many emails.
North Pond Association of Maine	Maine: towns of Mercer, Smithfield, and Rome	water clarity (Secchi disk)	http://www.northpond.net/home	1985	unknown	15	15	10	66.7%	3.7%	Fifteen board members received the survey via email. One board member posted the survey link to the NPA Facebook page which has 300 "likes," of which 100 were members and some were volunteers.
Boquet River Association (BRASS)	New York: Elizabethtown	phosphorous, bacteria, heavy metals	http://boquetriver.org/completed-projects/monitoring/	1984	unknown	4	4	5	125.0%	1.8%	Four board members received the survey via email. The survey was not shared with other volunteers or members of BRASS. The reason for the fifth response is unknown.
University of Rhode Island Watershed Watch Program (URIWW)	Rhode Island: statewide	water clarity (Secchi disk), algal density (chlorphyll a), dissolved oxygen, water temperature, alkalinity, pH, total and dissolved nutrients (phosphorous, ammonia, and nitrate-nitrogen), bacteria in marine water	www.uri.edu/ce/wq/ww	1988	400	400	360	74	20.6%	27.3%	Three volunteers did not use email. Some recipients were not volunteers and were instructed to ignore the survey, so the response rate is inaccurate.
Nisqually River Education Project (NREP)	Washington: Thurston County	dissolved oxygen, fecal coliform, total solids	http://nrep.nisquallyriver.org/	1991	unknown	49	49	10	20.4%	3.7%	
Stream Team	Washington: Olympia, Lacey, Tumwater, and Thurston County	macroinvertebrates	http://www.streamteam.info	1990	unknown	118	70	5	7.1%	1.8%	Stream Team has several water quality monitoring programs. The coordinator chose to send the survey via email once and only to volunteers who had surveyed macroinvertebrates within the past year.
South Sound GREEN (Global Rivers Environmental Education Network)	Washington: Olympia, Lacey, Tumwater, and Thurston County	dissolved oxygen, fecal coliform	www.thurstoncd.com/south-sound-green.html	1992	100	24	24	7	29.2%	2.6%	South Sound GREEN is comprised mostly of high school students. The coordinator sent this survey to teachers who voluntarily participate with their classes.
				Totals:	over 2300	1291	1045	271		100.0%	
							Overall Response Rate:	25.9%			

Appendix C: Survey

Understanding Volunteer Motivations

Introduction

Dear Volunteer,
Thank you for volunteering with our organization. You are receiving this questionnaire because your email address is in our volunteer database.

Our organization has been asked by Bethany Alender, Master of Environmental Studies Candidate with The Evergreen State College, to participate in her graduate study about what motivates people to participate in volunteer water quality monitoring. Ms. Alender provides more information about her study on the following page. Your participation in the study will help us better understand volunteer motivations and will help us tailor our program to better serve our volunteers. This study is completely optional, and only Ms. Alender will see your confidential responses to the survey. The questionnaire should take about **10 minutes** to complete.

Thank you for your participation!

Page 1

Understanding Volunteer Motivations

Informational Letter from the Researcher

Dear Participant,

I am a graduate student at The Evergreen State College earning my Master of Environmental Studies. As part of my thesis research, I am studying volunteer motivations to participate in water quality monitoring. The purpose of my project is to gather information about what motivates volunteers and produce a thesis research paper and presentation about my findings.

I hope that your participation in the study may provide insight into volunteers' reasons for long-term participation. This information will help project coordinators tailor their programs to better serve their volunteers. It will also help project coordinators maximize resources by reducing costs associated with the recruitment and retention of volunteers, overall enabling the program to better meet its goals.

Your participation is completely voluntary and I appreciate your time. As a way of thanking those who participate, **all participants who fully complete the questionnaire will be entered in a random drawing for one of ten one-year subscriptions to National Geographic** (your choice of print or digital editions for iPad, iPhone, or Kindle Fire plus online archive). If you wish to be entered in the drawing, your contact information will be collected at the end of the questionnaire. Your contact information will not be connected to your individual responses. The questionnaire will be closed to responses on March 13, 2015.

If you have any questions about this project or your participation in it, you can email me at alebet17@evergreen.edu or call me at 404-819-8192.

Thank you for your participation.

Sincerely,
Bethany Alender

Master of Environmental Studies Candidate
Graduate Program on the Environment
The Evergreen State College
Olympia, WA

Understanding Volunteer Motivations

Consent Form

You are being invited to participate in a research study titled "Understanding Volunteer Motivations to Participate in Citizen Science Projects: A Deeper Look at Water Quality Monitoring." This study is being done by Bethany Alender from The Evergreen State College. You were selected to participate in this study because you are in the volunteer database of an organization that conducts water quality monitoring.

The purpose of this research study is to gather information about volunteers in water quality monitoring projects and produce a thesis research paper about the findings. If you agree to take part in this study, you will be asked to complete an online questionnaire. This questionnaire will ask about your volunteering habits, reasons for volunteering, and opinions. It will take you approximately 10 minutes to complete.

You may not directly benefit from this research; however, I hope that your participation in the study may provide insight into volunteers' reasons for long-term participation. This information will help project coordinators tailor their programs to better serve their volunteers, while reducing costs associated with the recruitment and retention of volunteers allowing the program to better meet its goals.

Risks to you are minimal and are likely to be no more than mild discomfort with sharing your opinion. To the best of my ability your answers in this study will remain confidential and anonymous. Your email and IP addresses will not be collected. With any online related activity, however, the risk of a breach of confidentiality is always possible. I will minimize any risks by storing the questionnaires in a password protected electronic format. Only I will be able to access your individual responses to the questionnaire. Aggregates and summaries of the responses, however, will be shared with participating project coordinators and may appear in publications and presentations of the research findings.

Your participation in this study is completely voluntary and you can withdraw at any time. You are free to skip any question that you choose. However, I encourage you to answer all questions to the best of your ability. The final data set will be most useful if all questions are answered.

If you have questions about this project or if you have a research-related problem, you may contact the researcher, Bethany Alender, at 404-819-8192 or alebet17@evergreen.edu. If you have any questions concerning your rights as a research subject, or you experience problems as a result of participating in this research project, you may contact John McLain, IRB Administrator at The Evergreen State College at 360.867.6045 or irb@evergreen.edu.

***1. By clicking "I agree" below you are indicating that you are at least 18 years old, have read and understood this consent form and agree to participate in this research study. Please print a copy of this page for your records.**

- ○ I agree
- ○ I do not agree

Understanding Volunteer Motivations

Demographics

Please tell me a little about yourself.

2. What is your age?

- 17 or younger
- 18-20
- 21-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70-79
- 80 or older

3. What gender do you identify as?

- Male
- Female
- Prefer not to answer
- Please specify

4. Do you have any children under 18?

- Yes
- No

5. What is the highest level of school you have completed or the highest degree you have received?

- Less than high school degree
- High school degree or equivalent (e.g., GED)
- Some college but no degree
- Associate degree
- Bachelor degree
- Graduate degree

Understanding Volunteer Motivations

6. Are you currently enrolled as a student?

- ○ No, I am not currently enrolled as a student
- ○ Yes, at a high school or equivalent
- ○ Yes, part time at an undergraduate college/university
- ○ Yes, full time at an undergraduate college/university
- ○ Yes, part time in graduate school
- ○ Yes, full time in graduate school

7. Which of the following categories best describes your employment status?

- ○ Employed, working full-time
- ○ Employed, working part-time
- ○ Not employed, looking for work
- ○ Not employed, NOT looking for work
- ○ Retired
- ○ Disabled, not able to work

8. How much money did YOU personally earn in 2014? Do not include income earned by members of your family or household.

- ○ $0 to $9,999
- ○ $10,000 to $24,999
- ○ $25,000 to $49,999
- ○ $50,000 to $74,999
- ○ $75,000 to $99,999
- ○ $100,000 to $124,999
- ○ $125,000 to $149,999
- ○ $150,000 to $174,999
- ○ $175,000 to $199,999
- ○ $200,000 and up
- ○ Prefer not to answer

Understanding Volunteer Motivations

9. How much total combined money did all members of your HOUSEHOLD earn last year?

- ○ $0 to $9,999
- ○ $10,000 to $24,999
- ○ $25,000 to $49,999
- ○ $50,000 to $74,999
- ○ $75,000 to $99,999
- ○ $100,000 to $124,999
- ○ $125,000 to $149,999
- ○ $150,000 to $174,999
- ○ $175,000 to $199,999
- ○ $200,000 and up
- ○ Prefer not to answer

Understanding Volunteer Motivations

Your Volunteer Organization

***10. Which organization do you volunteer for? Please complete the remainder of the survey according to this selection.**

- California: South Yuba River Citizens League (SYRCL)
- Florida: Museum Volunteers for the Environment (MUVE)
- Maine: Maine Volunteer Lake Monitoring Program (VLMP)
- Maine: North Pond Association of Maine
- New York: Boquet River Association (BRASS)
- Rhode Island: University of Rhode Island Watershed Watch Program (URIWW)
- Washington: Nisqually River Education Project (NREP)
- Washington: South Sound GREEN (Global Rivers Environmental Education Network)
- Washington: Stream Team
- Other (please specify)

Understanding Volunteer Motivations

Volunteer Habits

11. When you volunteer for this project, which of the following tasks do you perform? Select all that apply.

- ☐ Collect data or record observations
- ☐ Analyze data
- ☐ Validate data
- ☐ Develop research questions or hypotheses
- ☐ Develop study designs
- ☐ Conduct research to support the study
- ☐ Train new volunteers
- ☐ Perform administrative tasks
- ☐ Serve on board of directors
- ☐ Teach student groups that participate
- ☐ None of the above

12. In what year did you first volunteer for this project?

13. On average, how frequently do you volunteer or attend volunteer events?

- ○ One or more times per week
- ○ 2 times per month
- ○ One time per month
- ○ Once every 2 to 4 months
- ○ One or two times per year

14. On average, how much time do you spend *each time* you volunteer or attend a volunteer event?

- ○ Less than 30 minutes
- ○ Between 30 minutes and 1 hour
- ○ Between 1 hour and 2 hours
- ○ Between 2 hours and 4 hours
- ○ More than 4 hours

Understanding Volunteer Motivations

15. Do you prefer to perform tasks in a group or alone? Choose the option that best fits your most frequent choice.

- ○ Alone
- ○ With a partner
- ○ Small group (3-5)
- ○ Medium group (6-10)
- ○ Large group (10 or more)

16. In the future, how likely are you to...

	Not at all likely	Slightly likely	Moderately likely	Quite likely	Extremely likely
Continue volunteering with this project?	○	○	○	○	○
Increase the amount of time you spend volunteering?	○	○	○	○	○
Decrease the amount of time you spend volunteering?	○	○	○	○	○
Recommend this project to others?	○	○	○	○	○

Understanding Volunteer Motivations

I volunteer because...

17. Please indicate your level of agreement with the following phrases that complete the statement: "I volunteer for this organization because..."

	Strongly Disagree	Disagree	Neutral or Undecided	Agree	Strongly Agree	N/A
I want to help or enhance the environment.	○	○	○	○	○	○
I want to help the community.	○	○	○	○	○	○
I want to help this organization do more for less money.	○	○	○	○	○	○
I want to contribute to scientific knowledge.	○	○	○	○	○	○
I want to learn skills or new knowledge.	○	○	○	○	○	○
I want to learn more about water quality.	○	○	○	○	○	○
I want to engage with other people.	○	○	○	○	○	○
I want to get outside or connect with nature.	○	○	○	○	○	○
I want to do something physically active.	○	○	○	○	○	○
I want to have fun.	○	○	○	○	○	○
I want to advance my career through gained experience or networking.	○	○	○	○	○	○
I want to enhance my reputation in my community.	○	○	○	○	○	○

Understanding Volunteer Motivations

Outdoor Activities

18. When volunteering, how often do you perform tasks outdoors?

Never	Seldom	About half the time	Usually	Always
○	○	○	○	○

19. How likely are you to perform an outdoor task if the weather is unfavorable?

Not at all likely	Slightly likely	Moderately likely	Quite likely	Extremely likely
○	○	○	○	○

20. When a task must be completed outdoors, which of the following best describes your attitude?

- ○ I'm a fair weather participant - Bring on the sun!
- ○ I will go out if the weather is somewhat unfavorable.
- ○ There's no such thing as bad weather, just bad gear!
- ○ It would take a severe storm or unsafe conditions to stop me from going out.

21. When the weather requires protective clothing or boots, would you rather use your own gear or borrow gear from the organization?

- ○ I would prefer to use my own gear.
- ○ I usually use my own gear, but I might need to borrow certain items in some conditions.
- ○ I would prefer to borrow gear so that mine doesn't get messed up.
- ○ I usually need to borrow gear.

Understanding Volunteer Motivations

Use of Data

22. Please indicate your level of agreement with the following statements about how this organization uses data collected by volunteers.

	Strongly Disagree	Disagree	Neutral or Undecided	Agree	Strongly Agree	N/A
The data collected for this project is used appropriately.	○	○	○	○	○	○
More should be done with the data collected.	○	○	○	○	○	○
It is important to me that our data is used for scientific publications.	○	○	○	○	○	○
I feel good when data and/or results are shared with me.	○	○	○	○	○	○
I feel good when our data is used to determine if there are environmental problems.	○	○	○	○	○	○
I feel good when environmental problems are addressed because of our data.	○	○	○	○	○	○

Understanding Volunteer Motivations

Knowledge and Training

23. Please indicate your level of agreement with the following statements.

	Strongly Disagree	Disagree	Neutral or Undecided	Agree	Strongly Agree	N/A
I like "one-time" training events in order to participate.	○	○	○	○	○	○
I like to complete sequential training activities to increase my level of expertise.	○	○	○	○	○	○
I like to earn recognition or reward for completing training activities, such as a rank for my expertise level or a special event.	○	○	○	○	○	○
Opportunities for my role to grow or advance within this project are important to me.	○	○	○	○	○	○
I feel that the staff would support me if I wanted to deepen my level of participation.	○	○	○	○	○	○

Understanding Volunteer Motivations

Social Interactions

24. Please indicate your level of agreement with the following phrases that complete the statement: "I volunteer for this organization because..."

	Strongly Disagree	Disagree	Neutral or Undecided	Agree	Strongly Agree	N/A
I want to meet new people.	○	○	○	○	○	○
I want to interact with like-minded people.	○	○	○	○	○	○
I want to spend time with family or friends.	○	○	○	○	○	○
I like learning from others with more experience than me.	○	○	○	○	○	○
I like sharing my experience, knowledge, or expertise with other volunteers.	○	○	○	○	○	○

Understanding Volunteer Motivations

Recognition

25. I have received some form of recognition or appreciation for my work

- ○ Yes
- ○ No
- ○ Unsure

26. Please indicate your level of agreement with the following statements.

	Strongly Disagree	Disagree	Neutral or Undecided	Agree	Strongly Agree	N/A
It is important to me to receive some form of recognition or appreciation for my work	○	○	○	○	○	○
I would prefer not to receive any recognition or appreciation for my work	○	○	○	○	○	○

Understanding Volunteer Motivations

27. How important or meaningful are the following forms of recognition to you?

	Not meaningful at all	Not very meaningful	Neutral or Undecided	Moderately meaningful	Very meaningful	N/A
Hand-written card	○	○	○	○	○	○
Personalized email	○	○	○	○	○	○
Volunteer appreciation event	○	○	○	○	○	○
Certificate or token of appreciation	○	○	○	○	○	○
Paraphernalia - such as stickers, hats, or t-shirts from this organization	○	○	○	○	○	○
Name recognition in this organization's newsletter	○	○	○	○	○	○
Name recognition in social media - such as Facebook or Twitter	○	○	○	○	○	○
Name recognition in a scientific publication	○	○	○	○	○	○

Understanding Volunteer Motivations

End of Questionnaire

You have reached the end of the questionnaire. Thank you for participating in my thesis research! Your responses will be kept completely confidential and anonymous.

If you would like to be entered into the drawing to win one of ten subscriptions to National Geographic, please click "submit" below, and then follow the link on the next page to enter the drawing.

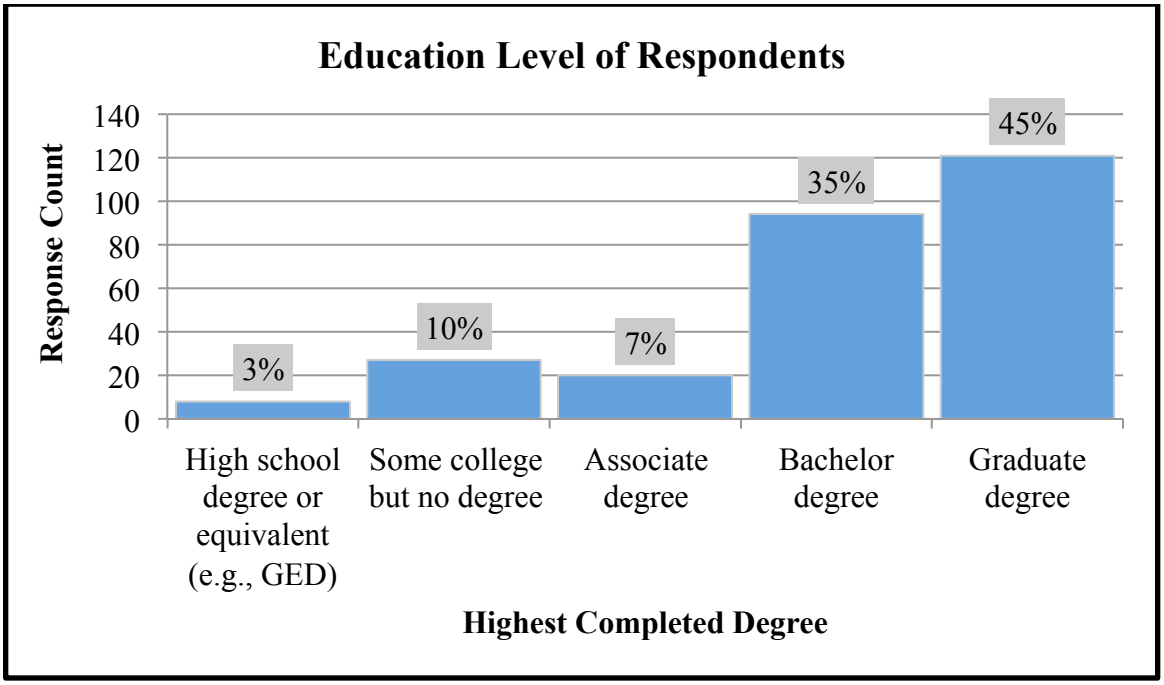
If you win the drawing, you will receive a one-year subscription to National Geographic (12 issues). You have your choice of a print or digital edition. The digital edition includes online archive and is available on iPad, iPhone, or Kindle Fire.

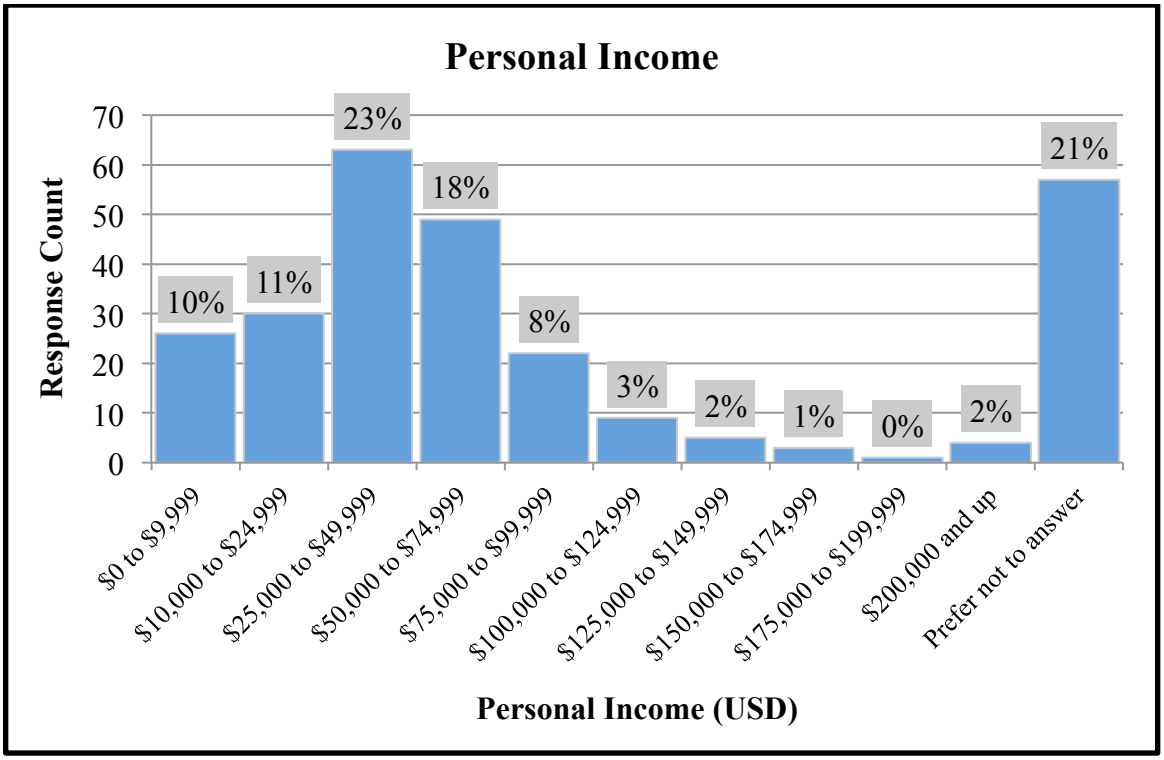
This questionnaire and the opportunity to be entered in the drawing will be closed March 13, 2015. Winners will be notified within 2 to 4 weeks of the closing date.

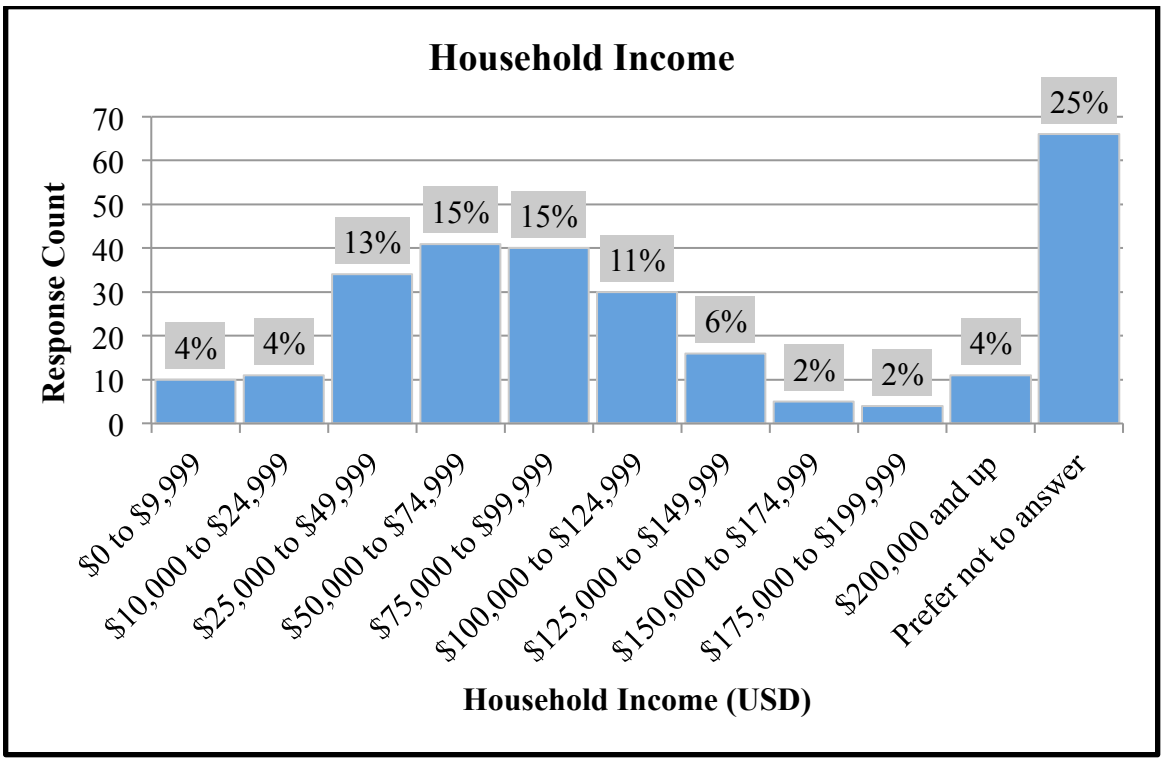
Make sure you click "SUBMIT" on this page before you close the window!

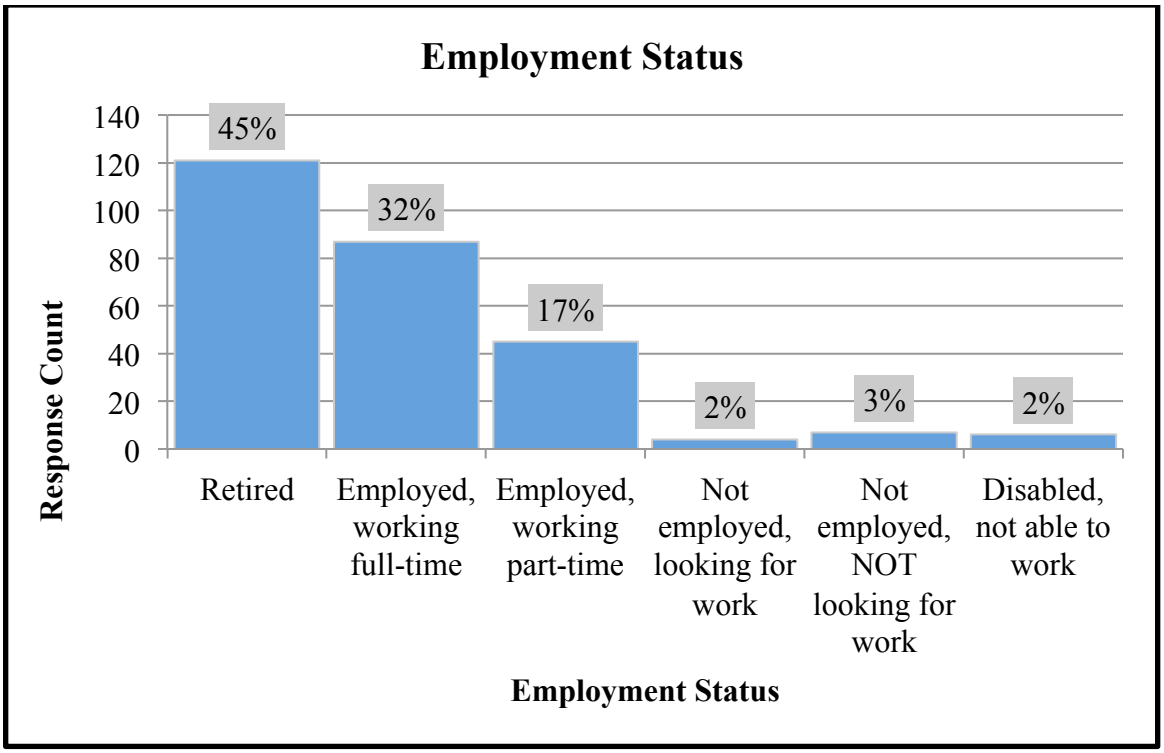
Thank you!

Appendix D: Demographics

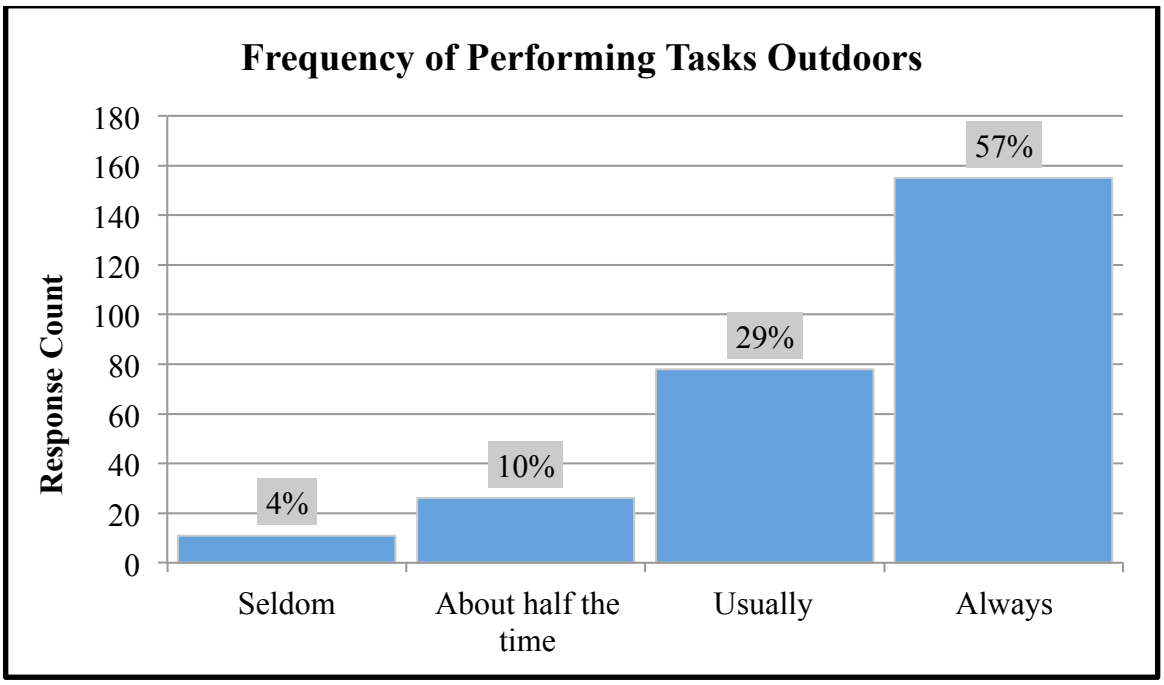


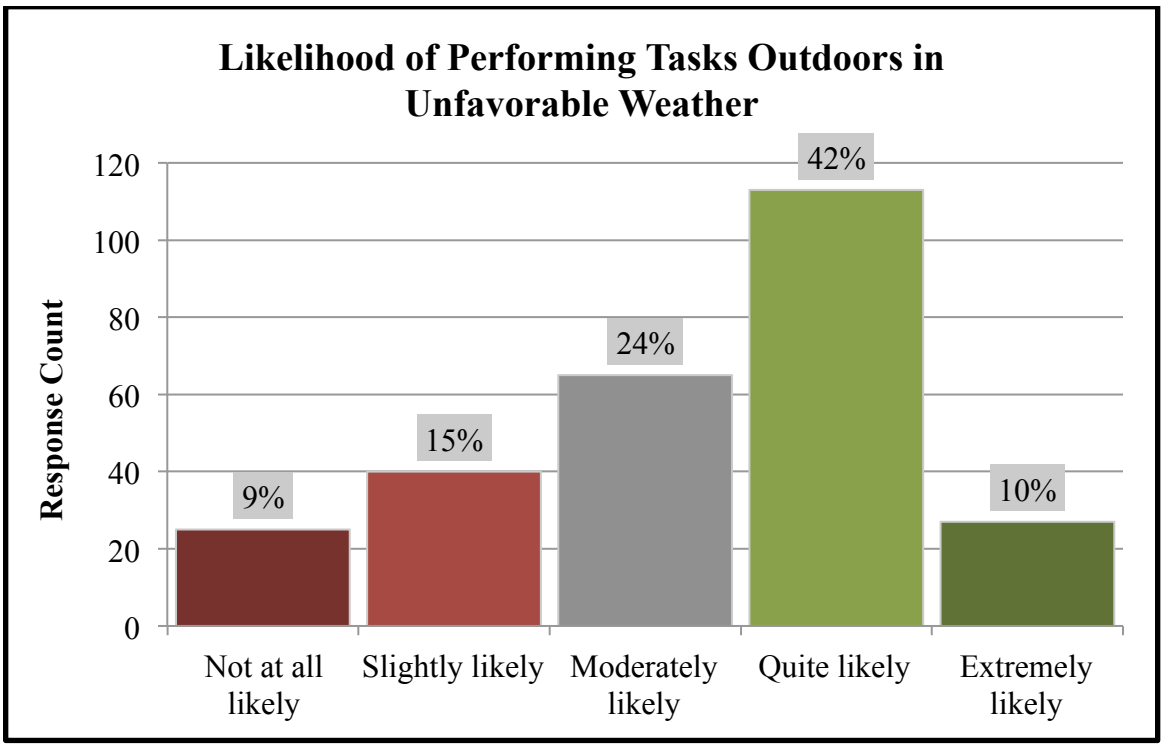


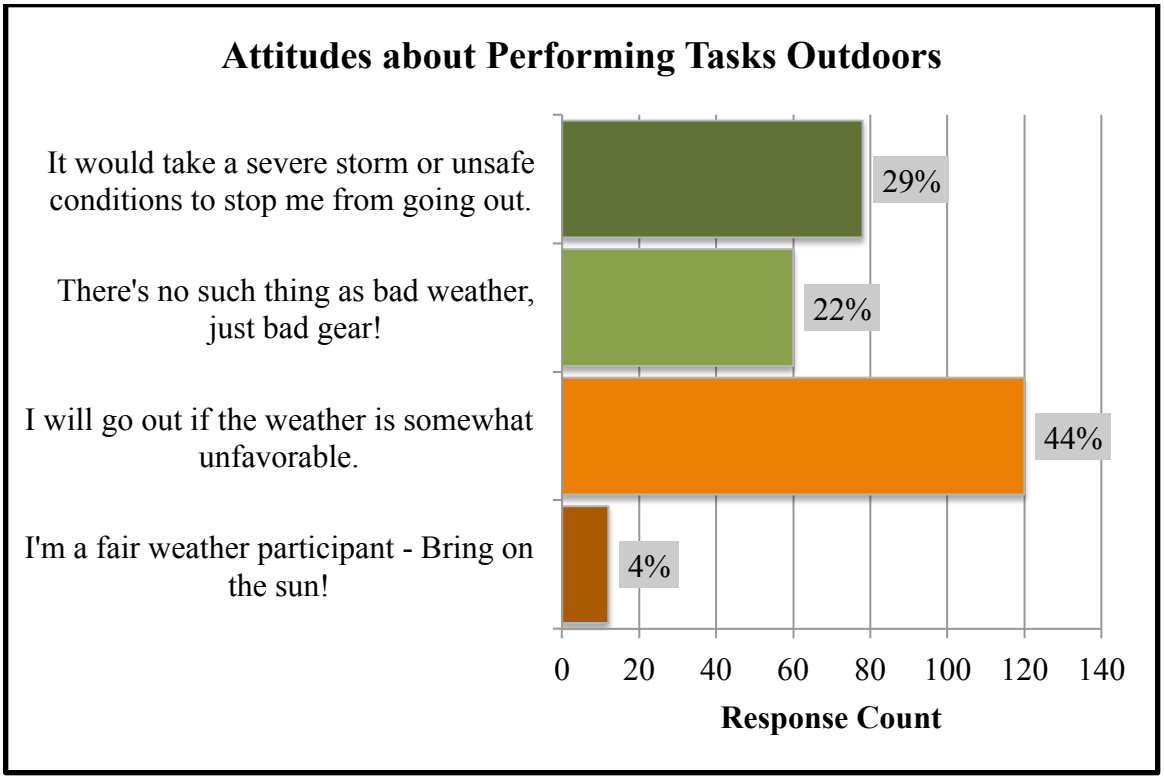

Household Income
Response Count
70
60
50
40
30
20
10
0
4%
4%
13%
15%
15%
11%
6%
2%
2%
4%
25%
$0 to $9,999
$10,000 to $24,999
$25,000 to $49,999
$50,000 to $74,999
$75,000 to $99,999
$100,000 to $124,999
$125,000 to $149,999
$150,000 to $174,999
$175,000 to $199,999
$200,000 and up
Prefer not to answer
Household Income (USD)

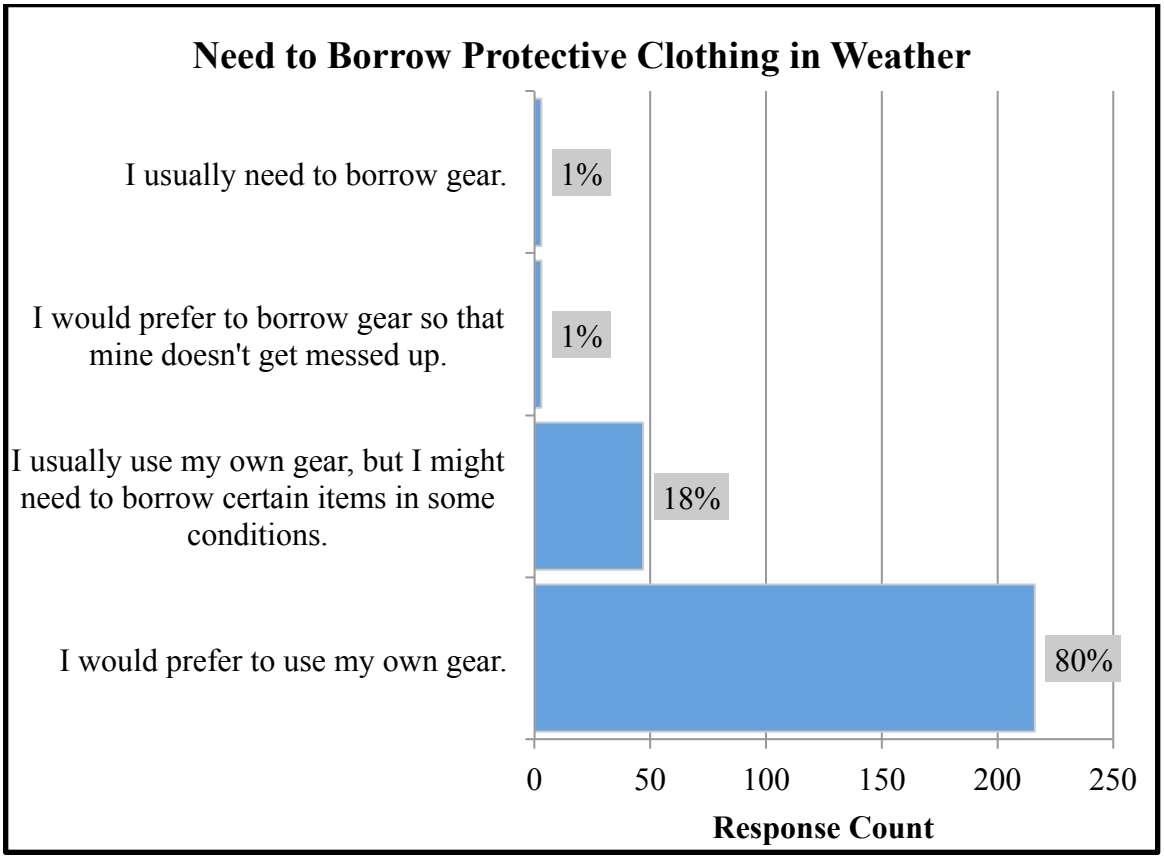

Employment Status
Response Count
140
120
100
80
60
40
20
0
45%
32%
17%
2%
3%
2%
Retired
Employed, working full-time
Employed, working part-time
Not employed, looking for work
Not employed, NOT looking for work
Disabled, not able to work
Employment Status

Appendix E: Outdoor Activity






Attitudes about Performing Tasks Outdoors
It would take a severe storm or unsafe conditions to stop me from going out.
There's no such thing as bad weather, just bad gear!
I will go out if the weather is somewhat unfavorable.
I'm a fair weather participant - Bring on the sun!
29%
22%
44%
4%
0
20
40
60
80
100
120
140
Response Count


Need to Borrow Protective Clothing in Weather
I usually need to borrow gear.
I would prefer to borrow gear so that mine doesn't get messed up.
I usually use my own gear, but I might need to borrow certain items in some conditions.
I would prefer to use my own gear.
1%
1%
18%
80%
0
50
100
150
200
250
Response Count

Appendix F: Recognition