

Waterfront property owner perceptions and perspectives on riparian zone aesthetics and shoreline management interventions: Insights for outreach and behaviour change

By

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Abstract

With freshwater biodiversity declining globally, attention is being focused on how human values influence stewardship and restoration efforts. The goal of this thesis is to identify waterfront property owners' relational values, and study how relational values influence property stewardship behaviours. First, I characterized the relational values of waterfront property owners who participated in Love your Lake's shoreline assessment program. Findings reveal differences in relational values of waterfront property owners, and how many waterfronts property owners value personal enjoyment elements that consider shoreline health. Next, I evaluated if the relational values of waterfront property owners align with their stewardship behaviours. I determined that the majority of waterfront property owners' shoreline conditions do align with their reported relational values. The findings also identified gaps in outreach initiatives aimed at understanding the role that values and behaviours play in shoreline degradation and environmental stewardship.

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Co-authorship Statement

Understanding waterfront property owner relational values towards lake shorelines across Ontario

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This manuscript will be submitted to the Socio-Ecological Practice Research journal. This project was conceived by Frempong-Manso, Reid, Lapointe, and Cooke. All statistical analyses were conducted by Frempong-Manso. All authors contributed to the writing of the manuscript.

The relational values of waterfront property owners align with their shoreline stewardship behaviours.

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Chapter 1. General Introduction

Over the last few decades freshwater biodiversity has declined significantly due to the impacts humans have on the planet (Crutzen 2002). Both locally and globally, biodiversity has experienced significant loss arising from unparalleled alteration to natural environments (Vitousek et al, 1997). Notably, since the 1970s freshwater biodiversity has declined at a faster rate than marine and terrestrial biodiversity, with one-third of freshwater species threatened with extinction (Collen et al, 2014; Harrison et al, 2018). These losses have been observed in all regions of the globe and all freshwater ecosystem types. Freshwater habitats encompass less than 1 percent of the Earth's surface but support 10 percent of species (Strayer & Dudgeon 2010; Dijkstra et al, 2014). Moreover, freshwater biodiversity and ecosystems generate many ecosystem services that feed and support humans in diverse ways emphasizing the gravity of these issues.

Human impacts on freshwater ecosystems can be classified into five key stressors: invasive species invasions, habitat degradation, water flow modification, water pollution, and overexploitation (Dudgeon et al, 2006). Yet, after all the “call to arms” by Dudgeon, things have not improved. More recently, Reid et al. (2019) identified twelve different intensified pressures such as harmful algal blooms; changing climates; declining calcium; cumulative stressors; freshwater salinization; e-commerce and invasions; expanding hydropower; microplastic pollution; light and noise pollution; emerging contaminants; infectious diseases; and engineered nanomaterials. Among the stressors described above, habitat degradation has been recognized as one of the main sources of freshwater ecosystem population decreases (WWF 2018). Healthy freshwater habitats are therefore significant in underpinning freshwater biodiversity (Lapointe et al, 2014).

One of the greatest challenges for society is determining how to make human-impacted ecosystems more sustainable. Over the last 50 years, we have failed to protect freshwater ecosystems (Yates & Bailey 2006). Yet, despite all the knowledge of freshwater ecosystems, a large portion of the world continues to live on or near shorelines. With forestry, agricultural fields, and housing developments continuing to be prioritized in these areas. There is a call to action for enhanced governance and planning processes that increase management agencies' knowledge, coordination, and capacity (Cooke et al, 2022). While a significant amount of damage has already occurred, we must find ways to achieve active restoration, by providing incentives to landowners who prioritize conserving, or restoring riparian habitats and protecting the remaining intact systems (Cooke et al, 2022).

Interactions between humans and their physical environments occur in many forms but are exemplified by the construction of dwellings where individuals reside (Bhatti & Church 2001). Such dwellings are placed in various landscapes including immediately adjacent to water bodies which provide essential amenities that also play a role in both the intended and unintended ecological impacts on shoreline habitats (Martin 2008; Larson et al, 2009a). Other socio-economic factors such as wealth, age, and education may also have an influence (Cook et al, 2012). At larger scales such as the neighborhood or community level, often decisions are driven by factors such as unofficial social standards or customs, formal homeowners' associations, or legacy consequences of former decisions (Jenkins 1994; Foster et al, 2003; Lerman et al, 2012). While many people are more aware of and express their opinions on environmental issues, this is not always reflected in their behaviors (Dunlap et al, 2000; Kaplan 2000; Pooley & O'Connor 2000; Kortenkamp & Moore 2001). However, if an individual does not always act in an environmentally conscious manner, this

does not necessarily imply that they have no concerns about environmental issues (Kaplan 2000; Schultz 2000). Much of psychology research focuses on understanding motivation, attitudes, values, and beliefs and searching for an understanding of why some individuals truly engage in environmental behaviors while others say they do when they in fact do not (Dunlap & Mertig 1995; Allen & Ferrand 1999; Kaiser et al, 1999; Pelletier et al, 1999; Nordlund & Garvill 2002). Comprehending the values of waterfront property owners and how they shape and maintain their properties will have significant ecological implications and allow lake organizations and governments to better manage and maintain shoreline habitats.

With research placing more emphasis on creating sustainable social-ecological systems, greater importance is placed on individuals' values, attitudes, and perceptions to inform action and achieve specific outcomes (Raymond et al, 2015; Ormerod 2017). Previous research found that intrinsic (nature, ecosystems, and life have intrinsic value, regardless of their utility to humans) and instrumental (the worth of an entity as a means to an end) values, we're unable to integrate various ecosystem values on a deeper level, as intrinsic and instrumental values are generally expressed in monetary terms and consider the importance of ecosystems as a means to an end. From this, stemmed the development of the concept of relational values (Arias-Arévalo et al, 2017). Relational values stress the variety of diverse ties we have with nature and people in natural surroundings (e.g., social cohesiveness, cultural identity, place attachment) (Chan et al, 2016). Relational values offer a deeper integration into the ecosystem valuation spectrum and are emerging as a unifying framework to express a range of concepts and principles related to human-nature relationships (e.g., human ecology) (Saxena et al, 2018), ethics and moral

foundations (Haidt 2007), and social practice (in contrast to environmental worldviews or held values) (Shove 2010).

In addition to the recent emergence of the term relational values, researchers are looking to comprehend how relational values can promote environmental stewardship. Stewardship is a widely used term for actions taken in the interest of long-term sustainability (Bennett et al, 2018; Mathevet et al, 2018). Stewardship has been redefined in sustainability research to refer to the active structuring of including social-ecological change trajectories in ways that are reflective of the complex and enhance social-ecological resilience and human wellbeing of ecosystems (Worrell & Appleby 2000; Welchman 2012; Chapin et al, 2015; Folke et al, 2016). Stewardship behaviors are frequently thought to be motivated by either intrinsic or instrumental values (Tallis & Lubchenco 2014). However, researchers have recently revealed that stewardship acts may be better understood if they incorporated relational values (Jackson & Palmer 2015; Comberti et al, 2015; Darnhofer et al, 2016). As it will allow for the integration of many disciplines as well as include both qualitative and quantitative approaches used in ecosystem services valuations to better evaluate environmental values (Kenter 2016a; Tadaki et al, 2017; Jacobs et al, 2018). Stewardship is gaining traction as a way of bringing together a range of practices such as natural resource management, biodiversity conservation, ecological restoration, and climate change adaptation (Sayer et al, 2013; Minang et al, 2015; Bieling & Plieninger 2017). In complicated, real-world circumstances, specific types of stewardship action arise (McEwan & Goodman 2010; Raghuram 2016). Therefore, it is valuable to study if relational values influence stewardship behaviours.

Objectives

This research aims to understand waterfront property owners' relational values and shoreline maintenance behaviours across Ontario. To do so I: 1) Characterize waterfront property owners' relational values and how they differ among participants (waterfront property owners), and 2) Identify whether waterfront property owners' relational values are represented in their shoreline stewardship behaviours of their property. To achieve these objectives, in Chapter 2, I used secondary data from the Love Your Lake shoreline evaluation program in Canada, to characterize waterfront property owners' relational values based on their rankings of personal enjoyment elements derived from lake use. In Chapter 3, I used the same set of waterfront property owners to subsequently explore whether relational values align with their shoreline stewardship behaviours.

Significance

This study will be important in not only adding to the existing knowledge of this field but by providing more insight into the relationship between relational values and the extent to which these values translate into shoreline stewardship behaviour. This thesis will also provide governments, lake associations, and waterfront property owners with the much-needed knowledge to help them address the existing gaps in how they currently offer programs, implement policy change, or change the behaviour of waterfront property owners. As we work to develop solutions to environmental issues, more emphasis will need to be placed on not only providing a happy median between waterfront property owners' lifestyles and aesthetic preferences. But also creating initiatives that provide waterfront property owners with resources to participate in stewardship

activities that will make a difference not only in their lake communities but also in preserving freshwater shoreline ecosystems.

Chapter 2: Understanding waterfront property owner relational values towards lake shorelines across Ontario

Abstract:

Freshwater lakes offer numerous ecosystem services including those that draw humans to live, work and play along shorelines. Waterfront property owners and their behaviours play an important role in maintaining healthy shorelines that benefit biodiversity. Conversely, they also have the potential to contribute to shoreline degradation. Using data from a Canadian-based shoreline evaluation program called Love Your Lake, I evaluated the relational values of 668 waterfront property owners from Ontario, Canada, and explored their perceptions about shorelines in 49 lakes to identify which relational values are associated with these Love your Lake participants. A cluster analysis revealed three groupings of stewards: the preservationist (focused on preventing human interference with natural processes and possibly conserving the environment), the conservationist (focuses on sustainably utilizing the earth's resources), and the urbanite (focus on prioritizing individual pleasure) based on how participants ranked the importance of personal enjoyment elements derived from lake use. From those cluster groupings, I observed small differences between relational values suggesting relatively strong conformity in values. Further, I found that lake characteristics (e.g., average property values, lake size, distance to an urban center) did not influence the grouping participants were clustered into based on these values. I conclude that most waterfront property owners who participated in the Love Your Lake program exhibit preservationist relational values. However, it is unclear whether these observations are germane to other individuals who are not participating in the Love Your Lake program. The findings are useful for developing and refining best practices and educational materials that can be shared with waterfront property owners in ways that are targeted to the different groups of water stewards.

Introduction

Biodiversity in freshwater ecosystems is undergoing rapid global decline (Janse et al, 2015; Harrison et al, 2018). Human activities such as modifications of land use, eutrophication, overexploitation, and the introduction of invasive species have extensively altered freshwater ecosystems (Dudgeon et al, 2006; Carpenter et al, 2011). In addition, there are emerging threats and challenges such as climate change that may amplify existing stressors (Reid et al, 2019). Aquatic systems are responsible for the delivery of various ecosystem services (Janse et al, 2015). Yet, according to the Living Planet Index (LPI), freshwater wildlife populations have declined by 83% since the 1970s. This is a substantial decline, especially when compared to marine and terrestrial systems (Harrison et al, 2018). One form of human activity that has been particularly detrimental to freshwater ecosystems is shoreline alteration associated with human development (Toft et al, 2007). Despite the ongoing freshwater biodiversity crisis, waterfront properties remain highly desirable and are applying continued pressure to these systems (Yassin et al, 2009). Pristine lakes are prime real estate, and developed properties provide property owners with valuable space for enjoyment; however, this development is leading to the potential impairment of overall lake health (Amato et al, 2016).

Waterfront property owners have major impacts on freshwater biodiversity dynamics through the decisions they make regarding their properties (Gilbank 2016). Despite this knowledge, there has been little action to address these issues (Harrison et al, 2018). Previous research has shown that shoreline development has negative impacts on invertebrates and fish communities (Toft et al, 2007). Overexploitation, water pollution, flow modification, habitat damage or degradation, and exotic species invasion are the five interrelated threats to global freshwater biodiversity (e.g., Allan & Flecker 1993, Naiman et al, 1995; Naiman & Turner 2000;

Jackson et al, 2001; Malmqvist & Rundle 2002; Rahel 2002; Postel & Richter 2003; Revenga et al, 2005). Overfishing predominantly impacts vertebrates, largely fishes, reptiles, and certain amphibians, whereas the other four hazard categories have implications for all freshwater biodiversity, ranging from bacteria to megafauna (Dudgeon et al, 2006). Freshwater lakes are necessary for both ecological and social-economic functions, and properties along the shoreline can have a significant impact on these freshwater aquatic systems and the ecosystem services they generate.

Values stem from cultural ideas and are therefore essential for transmitting culture's criteria for determining what is fair and just in society (Adler 1956). Values are frequently discussed with vague references to societal norms, aims, motivations, and intent (Horcea-Milcu et al, 2019). Values are complicated constructions that require distinct consideration (Raymond et al, 2019). Values have various dimensions, each of which is important to different people in different ways (Norton 2005). Individuals may have the same values, but they are likely to prioritize them differently, leading to differences in preferences, beliefs, attitudes, conventions, and decisions (Steg & De Groot 2014). Some people care deeply about the mere presence of certain species, while others value utilitarian qualities such as food, clean water, or fresh air, or personal enjoyment elements such as experiencing peace and quiet while walking in the woods (Bieling et al, 2020).

Value theories suggest that values are broad, stable ideas that structure and steer specific beliefs, conventions, and attitudes that are more prone to change through time (Feather 1995; Barker & Rokeach 1975). We also know that values are not static, but rather positioned on a temporal stability gradient, with some changing more easily than others, allowing for the different potential for intentionally initiating value shifts (Bieling et al, 2020). Behaviour is influenced by these beliefs, conventions, and attitudes. As a result, it is argued that particular beliefs, attitudes,

and norms mediate the effect of values on behaviour. Indeed, several studies have shown that values indirectly influence beliefs, attitudes, and conventions that are specific to behaviour (Steg & De Groot 2014).

As we continue to battle with environmental change and sustainability, there is a growing focus on the role that values play in stewardship and restoration efforts (Abson et al, 2017; Diaz et al, 2015). Relational values, which are assumed to fit alongside more established axiological categories such as instrumental and intrinsic values, have lately been suggested as a third class of values for understanding natural values (Stålhammar & Thorén 2019). The notion of relational values has swiftly gained traction to better capture how individuals and groups perceive their well-being and make decisions concerning the natural world. Relational values refer to a conventional human sense of affiliation or kinship with other living organisms, which is then reflective of their identity, belonging, and duty and is coherent with ideas about what it means to live a "good life" (Klain et al, 2007). These values are ultimately linked with preferences, ideals, and virtues related to personal relationships, as well as policies and societal standards that contribute to an individual's awareness of nature's contributions to people (Diaz et al, 2015; Chan et al, 2016). Understanding waterfront property owners' relational values can provide insights on how to improve current environmental protection (Haidt 2007). Waterfront property owners are vital caretakers of freshwater ecosystems, and the actions of these property owners will be a major deciding factor in aquatic ecosystem health (Davis & Whitman 2018). Understanding the relational values of waterfront property owners is thus important in finding a balance between societal needs and ecosystem health.

Canada's peoples are proud of the nation's natural and scenic beauty. Canadians, in particular, enjoy the recreational and economic benefits that their lakes provide to both tourists

and native Canadians (Clapper & Caudill 2014). Shorelines are attractive regions that provide the space for many recreational activities, offer ample distance from the city, provide areas with a sense of community through their social norms, and are becoming popular destinations for new home construction (Gartner 1987). With more individuals seeking tranquility away from the city and pursuing life near shorelines, property owners understand the decision of renting or buying involves several trade-offs. While price is frequently the most important consideration, other factors that individuals consider include house size and condition, interior and exterior appearance, location, school district quality, investment potential, perceived safety, neighborhood image, proximity to recreational amenities, shopping facilities, and the workplace (Larsen & Harlan 2006).

Understanding how an individual's environmental awareness and inclination to actively contribute to communal and ecological well-being allows decision-makers to create strategies for complementing cultural lifestyles and inspire individuals to participate in positive environmental actions (Punzo et al, 2019). To better understand the relational values of individuals within Ontario, I examined survey responses of waterfront property owners who participated in the Love Your Lake program and how lake characteristics may influence these values. The overall objective of this study is to characterize the relational values of waterfront property owners and understand how they may vary among participants (waterfront property owners). Specifically, I aim to (1) identify distinct groups of participants based on their reported personal enjoyment elements of lakes and how they can be translated into relational values, and (2) explore how lake characteristics (e.g., lake size, property value, and location) may influence the characterization of relational values. I hypothesize that waterfront property owners will have differing relational values and prioritize personal enjoyment elements based on how these elements contribute to their relational

values. This potentially is the result of the differing needs and values each person has and how they decide to use and maintain their property's shoreline. I also hypothesize that distance to an urban center, lake size, and property value will have some influence on the cluster group that an individual is placed in, as these factors will have an impact on the type of recreational activities, social standards, and shoreline maintenance behaviours these individuals can participate in. Exploring these hypotheses will allow for an enhanced understanding of the values of waterfront property owners and how these values impact shoreline management.

Methods:

Love Your Lake (LYL), founded in 2013, is a shoreline evaluation program established by Watersheds Canada and the Canadian Wildlife Federation (CWF). They are federally incorporated non-profit organizations working to conserve and inspire the conservation of Canada's wildlife and habitats through the development and delivery of adaptive solutions and programs in Canada. The Love Your Lake program is carried out in shoreline communities across Canada by local organizations. It is then these lake associations that recruit participants to participate in the Love Your Lake program. If participants from these lake associations and organizations choose to participate, every property on the lake undergoes a water survey evaluation using a standardized assessment protocol, and waterfront property owners receive a personalized property report describing the state of their shoreline and recommended actions for improving lake health for people and wildlife. To enhance their understanding of how participants use and value their lake, Love your Lake ask participants to fill out a survey, which provides a better understanding of how residents use their lake properties and how they feel about the current health of the lake surrounding their properties. With this information, they are better able to facilitate interactions

between waterfront property owners' and their surrounding environments. The program has successfully assessed 173 lakes which include 41,354 waterfront shoreline properties within Canada.

Participant recruitment:

As part of the Love Your Lake program, introductory letters, and surveys were distributed by regional partners to first help Love your Lake gather more information on what waterfront property owners value most about their lake and what is most important to waterfront property owners when it comes to their shoreline. Introductory letters either mentioned an enclosed values survey or asked waterfront property owners to visit LoveYourLake.ca to fill out the survey online.

Survey Instrument:

The survey intended to capture waterfront property owners' reflections on what they value most about their lakes, and what action they are taking to ensure these values are reflected. The survey consisted of 12 questions including a mix of closed and open-ended questions, and 5-point Likert-scale questions. A Likert scale is a five (or seven) point scale that allows individuals to indicate how strongly they agree or disagree with a given proposition (Batterton & Hale 2017). Questions asked in the survey included: what types of recreational activities waterfront property owners participate in on the lake; how would they rank (on a scale of 1-5) fifteen personal enjoyment elements (water quality, natural shorelines, scenery/view, wildlife viewing, dark skies, tranquility/quiet, fishing, ice fishing, preserving vacant land, hunting, swimming, power boating, non-power boating, and lake social activities) in terms of their contributions to their enjoyment of the lake; what are the top issues and possible solutions currently facing their lake? And finally, would they be interested in stewardship participation (See Appendix A for full questionnaire). To

understand the relational values of participants, I used responses from the question asking participants to rank (on a scale of 1-5) personal enjoyment elements and how they contribute to their enjoyment of the lake, as these elements can provide insight into the relational values participants hold. All fifteen personal enjoyment elements from the survey were considered variables in the analysis. If respondents did not rank one or more personal enjoyment elements, they were excluded from the analysis. It should be noted that questions on relational values were not explicitly asked in the survey but rather are an interpretation of how personal enjoyment can be translated into an individual's relational values. All components of the usage of this survey and secondary data were approved in adherence to the Carleton University Research Ethics Board (Ethics Clearance ID: 116172).

Data Processing:

All data was stripped of any personal information such as names, addresses, and phone numbers to protect the identity of property owners. A data-sharing agreement was signed with Love Your Lake for the use of secondary data for research. While Love your Lake has successfully assessed waterfront shorelines of 41,354 properties, only a total of 972 property owners within Canada completed the value survey that is distributed and asked to be completed before the water assessment. Invalid or incomplete surveys were removed from the analysis. In addition to this survey participants who resided in Alberta, British Columbia, and Saskatchewan were removed due to the small sample size. The study focuses solely on the Ontario region (see Figure 1).

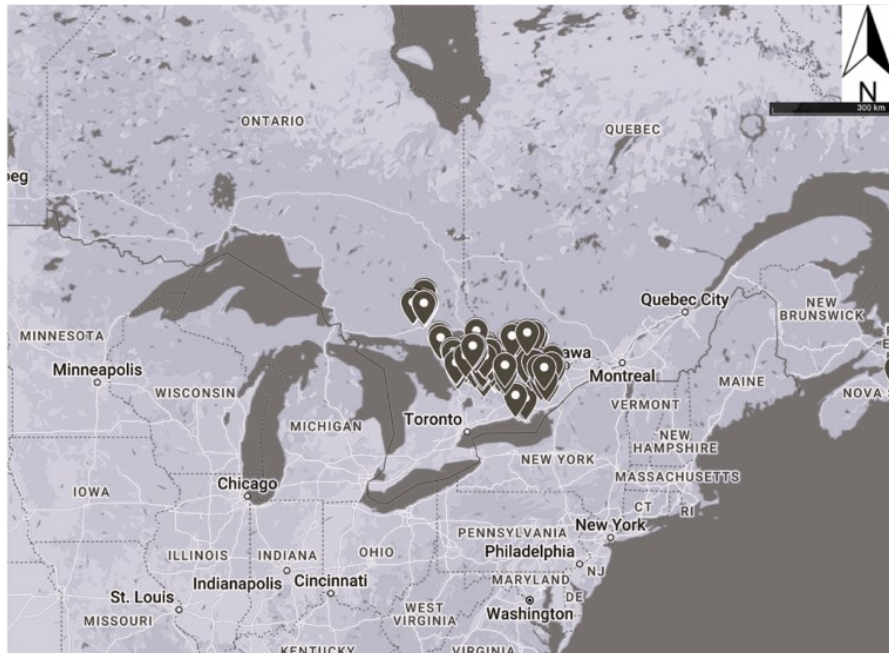


Figure 1: Map of all the Lakes assessed in Canada by Love Your Lake used in this study

Data Analysis – Relational Values Segmentation:

I grouped respondents based on their responses to the fifteen personal enjoyment elements using a K-means Clustering method to characterize relational values. K-means is a centroid-based clustering algorithm in which the distance between each data point and a centroid is calculated and then assigned to a cluster, the purpose is to figure out how many groups exist within the dataset (Bansal et al, 2017). The K-means clustering algorithm attempts to arrange variables in a dataset that is similar into clusters (k groups). It compares the objects and divides them into clusters based on their similarity (Bansal et al, 2017). Cluster analysis has been frequently used throughout similar studies to understand the differences and similarities of a sample population by dividing respondents into identical groups using a distance measure (I used Euclidean distance) between data points (Kreft & Jetz 2010). One of the essential steps in the K-means clustering algorithm is to establish the number of clusters to use for your model. The best number of clusters is rather subjective and depends on the method used to measure similarities as well as the partitioning

settings. In most cases two to five clusters are sufficient; however, this will vary depending on your data characteristics (Wu 2012).

Data Analysis – Lake Characteristics Differences among Waterfront Property Owner Typology

To assess whether waterfront property owners' cluster groupings were associated with different lake characteristics (i.e., lake size, average property value, and distance to nearest urban center) I used multinomial logistic regression (often referred to simply as “polynomial regression”) (Kwak & Clayton-Matthews 2002). Based on the model fitting information, the AIC (Akaike Information Criterion) and BIC (Bayesian Information Criterion) evaluated the model based on how similar its fitted values are to true the expected values, as measured by a certain expected distance between the two. The best model is the one with fitted values that are nearest to true outcome probabilities. These analyses were conducted in IBM SPSS Statistics Software version 27, and all statistical significance was established with $\alpha = 0.05$.

Lake size was quantified by searching the internet using Google to get an estimation of lake size, lake size was then measured in Km². HouseSigma was used to estimate the average property value for each lake. HouseSigma is a technological platform that uses artificial intelligence to accurately predict real-time property prices in Canada. This app provides house buyers with an estimated home value for every listing. In addition, the HouseSigma algorithm correctly finds similar neighbouring sold properties, which might assist buyers in determining their final offer price. Finally, to measure the distance to an urban area, I defined an urban area as a city or town with a population of 1 million or more (See Table 2).

Table 1: Descriptive Lake characteristics (Lake Size, Average property values, and Distance to an urban area)

Lake Name	Region	Sample Size (n)	Lake Size (Km ²)	Average Property Value	Distance to an urban area (Km)
Ada Lake	Central ON	1	0.283	1,007,500	215
Lake Ardoch	Eastern ON	2	0.903	549,450	129
Bass Lake	Central ON	2	2.901	700,000	95
Big Hawk Lake	Eastern ON	1	22.090	1,394,500	221
Blackstone Lake	Northern ON	7	5.337	997,450	231
Brandy Lake	Central ON	6	1.052	1,534,950	219
Bruce Lake	Central ON	13	0.991	1,699,950	234
Lake of Bays	Central ON	88	671.5	1,441,950	213
Carson Lake	Eastern ON	3	6141.790	572,500	193
Clearwater Lake	Central ON	6	33.260	555,000	215
Crane Lake	Northern ON	5	5.192	997,450	237
Dalhousie Lake	Eastern ON	16	6.035	1,419,000	103
Desert Lake	Eastern ON	16	3.818	474,450	164
Fairbank Lake	Northern ON	1	7.050	564,500	439
Frenchman Lake	Northern ON	7	0.438	309,104	427
Georgian Bay	Northern ON	7	15000	1,778,000	165
Green Lake	Eastern ON	1	0.340	639,250	143
Hanmer Lake	Northern ON	5	0.544	524,949.50	427
Healey Lake	Central ON	3	7.620	1,564,000	212
Joe Lake	Northern ON	6	2.162	187,000	430
Kahshe Lake	Central ON	50	8.300	825,000	187
Kapikog Lake	Central ON	2	3.209	1,426,950	222
Kawagama Lake	Central ON	2	3.200	300,000	262
Kennebec Lake	Eastern ON	1	5.459	842,000	146
Lake Kasshabog	Central ON	61	8.094	1,699,500	260
Leonard Lake	Southern ON	5	195	370,000	214
Little Boshkung Lake	Central ON	1	1.286	1,249,950	207
Long Lake	Eastern ON	26	8.613	1,394,500	146
Looncall Lake	Eastern ON	4	23.040	700,000	229
Malcolm Lake	Eastern ON	11	2.115	347,450	156
Mazinaw Lake	Eastern ON	22	2401	474,000	192
McKay Lake	Northern ON	11	1.319	1,041,500	208
Minnow Lake	Northern ON	2	0.209	419,900	407

Mississippi Lake	Eastern ON	35	150.230	449,000	69
Muskrat Lake	Eastern ON	22	12.190	694,950	123
Olmstead Jeffrey Lake	Eastern ON	18	0.396	524,900	108
Paugh Lake	Eastern ON	2	7.07	572,500	189
Ramsey Lake	Northern ON	22	7.922	2,143,250	409
Richard Lake	Northern ON	1	0.836	890,000	388
Round Lake	Northern ON	29	30.740	649,000	240
Salmon Lake	Eastern ON	20	1.720	574,900	207
Stewart Lake	Central ON	8	1.520	694,950	207
Sturgeon Bay	Central ON	4	44.920	1,999,950	182
Three Mile Lake	Northern ON	31	150.230	1,287,449	188
Trout Lake	Eastern ON	1	348.100	749,950	147
Upper Rideau	Eastern ON	6	61.000	609,947	128
Vernon Lake	Central ON	36	15.843	750,000	233
Whitewater Lake	Northern ON	14	9.491	689,950	414
Wood Lake	Central ON	23	4350	1,072,500	212

Results

Survey Demographics:

A total of 972 surveys were sent out to waterfront property owners and were completed and returned to Love Your Lake. Of those surveys, 668 surveys had usable data to include in the analysis. Participants who were included in the analysis reside seasonally (58% of 668), reside permanently (28.5%), owns a vacant property (7.1%), rent a property (1.4%), own a farm (1.1%), and owns a business (4.2%). These sum to greater than 100% because survey respondents were able to select more than one residential status. Respondents, on average, owned their lake property for 37.6 years.

Individual Personal Enjoyment Preferences

Respondents were asked to rate the level of importance on a scale of 1-5 (1= not important, 2= not as important, 3= neutral, 4= somewhat important, and 5= extremely important) for fifteen

Likert-scale questions capturing relational values. The majority of respondents in this study ranked “Swimming” (over 91.0% of N=668), and “Water Quality” (over 76.8% of N=668) to be extremely important (received a 5 score on the Likert scale), whereas “Hunting” (over 72.6% of N=668), and “Ice Fishing” (over 54% of N=668) were deemed not important, respectively (received a 1 score on the Likert scale) (see Figure 2).

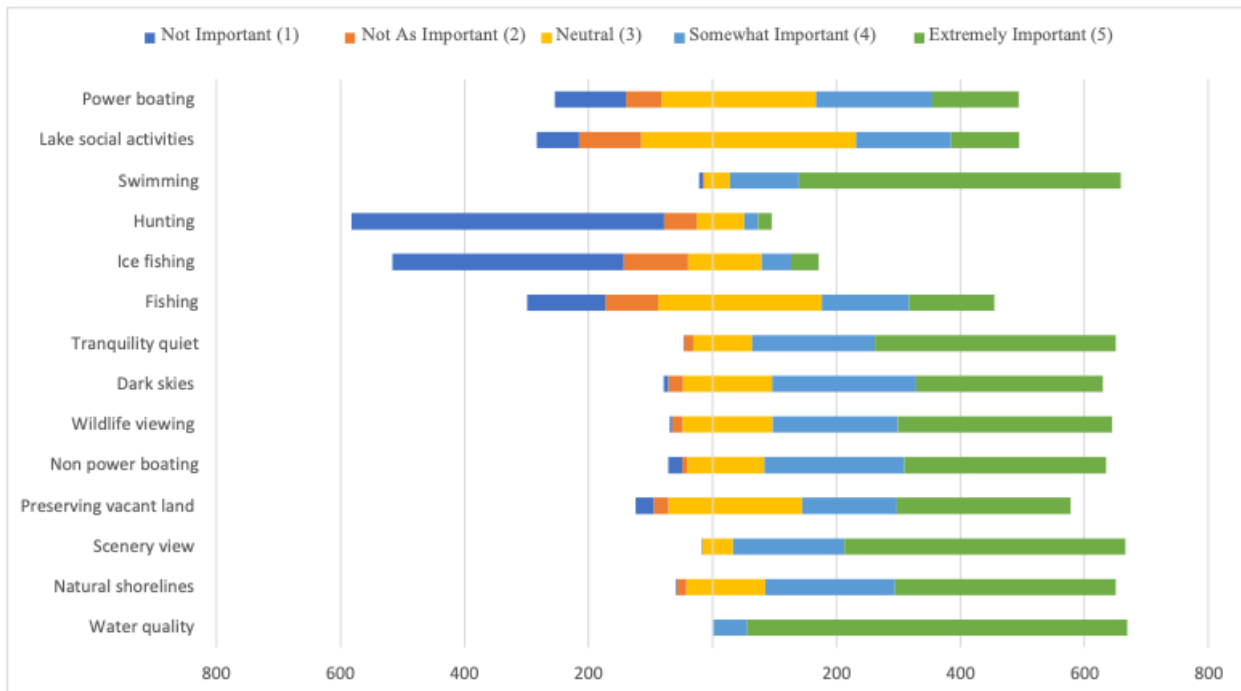


Figure 2: Distribution and response summary of the fifteen Likert variables used in the K-Means clustering analysis on waterfront property owners across the three property owner types

Relational Values Typology of Waterfront Property Owners

Three cluster groupings were generated based on participant rankings of the personal enjoyment elements of lakes. I labeled the first cluster as “the preservationist” consisting of 367 respondents (55.0% of N=668; figure 3). I used the word “preservationist” in the label to reflect the trend that the individuals in this group prioritized personal enjoyment elements, which concentrated on preventing human interference with natural processes and possibly preserving

nature (natural shorelines, preserving vacant land, and water quality). In this cluster (preservationist), it appears that some importance is being placed on how nature is important based on the enjoyment elements that were prioritized.

I labeled the second cluster as “the conservationist” consisting of 120 respondents (18.0% of N=668, figure 3). I used the term “conservationist” to specify that this cluster group selected personal enjoyment elements that focused on sustainably utilizing the earth’s resources (i.e., many ranked fishing and hunting highly and it is often shown that these individuals have pro-conservation behaviours (Mahoney 1995). Importance is being placed on the use of available resources in a way that prevents them from being depleted with an emphasis being placed on not using these resources indiscriminately or wastefully (i.e., fisheries resources).

Finally, I labeled the third cluster as “the urbanite” consisting of 180 respondents (27.0% of N=668, figure 3). Waterfront property owners in this group emphasized personal enjoyment elements that focus on prioritizing individual pleasure and enjoyment such as powerboating, swimming, and scenery viewing. Importance is being placed on utilizing available resources, although not in an extractive way, as these resources are contributing to an individual’s enjoyment.

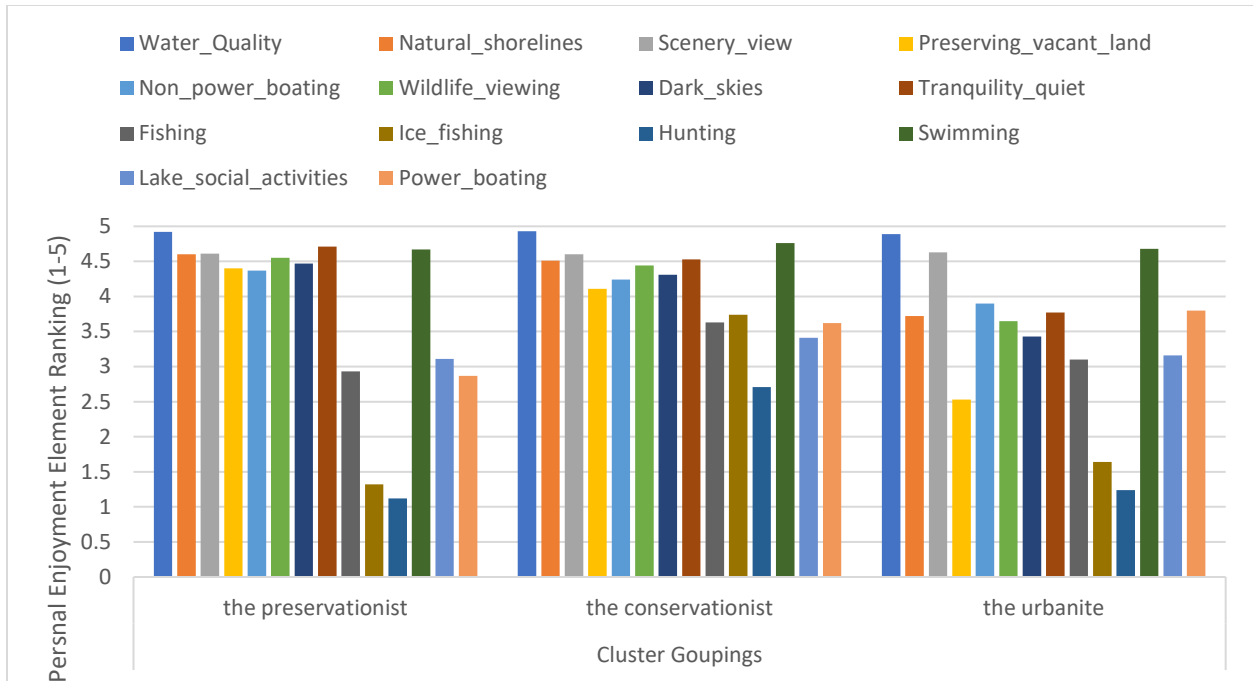


Figure 3: K-means clustering (k=3) final cluster centers of responses from participants in the Love Your Lake shoreline assessment program

Demographic Distribution Across Waterfront Property Owner Types

Lake characteristics (lake size, average property value, and distance to nearest urban center) were not able to significantly predict which cluster group an individual would be assigned to base on their relational values ($p= 0.994$) (see Table 2). AIC, BIC, and $-2\log$ likelihood are all extremely similar in this model (El-Habil 2012). With a p-value of 0.994, the full model does not statistically predict the dependent variable better than the intercept-only model alone.

Table 2: Multinomial logistic regression likelihood ratio and model fitting criteria.

Likelihood Ratio Tests

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log-Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	331.363	10.012	2	.007
Lake Size	321.530	.180	2	.914
Average Property Value	321.732	.382	2	.826
Distance to urban area	321.411	.061	2	.970

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

Discussion

Using secondary data from Love Your Lake, this study attempted to understand what distinct groups exist among waterfront property owners' reported personal enjoyment elements used as indicators of relational values, and the potential influence lake characteristics have on influencing these values. Three cluster groups were identified which represent the relational values of waterfront property owners in Ontario who participated in the Love your Lake program. Noticeably, preservationist relational values were the most dominant group among all participants.

Within this study, three groups were identified based on reported relational values: the preservationist, the conservationist, and the urbanite. While all three identified groups generally reported to value personal enjoyment elements that can in some way promote shoreline health, the majority of waterfront property owners expressed concern for preserving resources and preventing human impact on natural resources (preservationist). There was also a large overlap between cluster groupings making it difficult to identify distinct groups. Overall, I observed more preservationist relational values from survey participants. One potential reason for this could be that more individuals are aware of the gravity of the freshwater biodiversity crisis. While it is clear that motivations and relational values vary widely from individual to individual (Scyphers et al, 2015), this seems to have little impact on the relational values an individual is willing to report. More individuals are recognizing that there needs to be a better resolution in place to deal with the conflict about disputes over resource allocation and to ensure resource allocation is consistent with societal objectives (Cocklin 1988).

Furthermore, Love your Lake may have had some sort of influence on the relational values of waterfront property owners such as social desirability bias where participants may respond in a manner that appears favourable to others (Van de Mortel 2008). Love your Lake's goal is to promote behaviors and values that reflect positive impacts on shoreline and ecosystem health. Therefore, they may have imposed environmental values that focus on prioritizing the conservation of shoreline habitats. Typically, Lake associations often provide guidance on what residents can and cannot do to their homes and yards (McKenzie 1994), and as a private governing body they can impose pre-existing land-use regulations, guidance for how individuals should maintain common areas, and decide what community standards need to be upheld (Cheshire et al, 2009).

While legally these associations cannot enforce these standards and values, an individual may feel pressure to behave within generally recognised or perceived expectations out of fear of the possibility of social exclusion (or other informal punishments) (Robbins 2007). These societal norms and overall influence may have an impact on the relational values property owners are willing to report.

Average property value, distance to an urban center, and lake size were not significant lake characteristics to predict which of the three identified groups waterfront property owners would be assigned to base on their relational values. This was quite interesting, as I thought that these three characteristics would provide more information on how relational values can be influenced by external factors. For instance, living near water promotes a more physically active way of life compared to living in the city (Finlay et al, 2015), therefore, each lake provides a variety of different land (hiking, gardening, wildlife viewing, etc.) and water-based (power boating, fishing, swimming, etc.) activities (Davenport & Davenport 2006). Gartner (1987) found that seasonal homeowners are more likely to make purchases based on recreational opportunities the lake community provides. This is quite interesting as seasonal waterfront property owners only occupy their residence for a limited time of the year therefore external factors have the potential to influence their relational values. As this may influence where individuals decide to purchase waterfront properties, some may prefer a property that suits their outdoor lifestyle.

In addition to recreational activities, the growth of waterfront properties as both short- and long-term vacation rentals may influence where individuals choose to vacation. With higher densities and little access to waterfronts in the cities, more individuals are searching for vacation

getaways to enjoy the water and outdoor activities (Paracchini et al, 2014). Previous studies indicate that in delicate natural environments such as shorelines, tourists and short-term vacationers are often responsible for the further degeneration of shoreline habitats (Clare 1971; Hiranyakit 1984). Tourism activities are supported by healthy freshwater and marine ecosystems (Arkema et al, 2017). If shorelines continue to degrade as a result of human activities, humans may no longer be able to rely heavily on ecosystem benefits. Therefore, lakes that are perceived as vacation spots to tourists may potentially be unappealing to potential permanent residents, as tourists may not care to uphold the preservationist relational values of the lake during their stay.

Limitations

I acknowledge that this study has certain limitations because the data was gathered from a small sample of people who took part in the Love Your Lake initiative. Which does not fully reflect all waterfront property owners in Ontario. Furthermore, those who completed the value survey are a small percentage of those who had their properties assessed through the Love Your Lakes program. Due to self-selection bias, those who willingly engage in environmental surveys are more likely to have pro-environmental views. Environmental interest group members are more likely than the general population to prioritise environmental issues and respond to environmental postal surveys more regularly (Whitehead 1991). Self-reporting was also used in the survey instrument (Moore and Rutherford 2020). This can introduce more bias, as there is the possibility of a social desirability bias (Van de Mortel 2008), which may cause individuals to want to be perceived in a certain way. Some inaccuracies could have occurred in the form of over-reported socially positive behaviours regarding attitudes toward shoreline conservation. One potential solution to mitigate these limitations would be for future studies to directly ask waterfront property owners to report

their relational values and how it impacts their stewardship behaviour, as this study was only able to make inferences on how relational values can be interpreted by examining personal enjoyment elements. In addition to this, having a third party administer the value survey may reduce any external pressures an individual may feel to over-report relational values. Lastly, finding creative ways to encourage more participation in the Love your Lake program will allow for a better understanding of all waterfront property owners in Ontario.

Management And Conservation Implications:

Human uses of natural resources affect freshwater ecosystems and their surrounding terrestrial environments (Alho et al, 2015). If the degradation continues at its current rate, natural shoreline habitats will likely face a significant reduction in ecosystem resilience and services (Smith et al, 2017). Therefore, it will be crucial for lake and reservoir managers to identify which communication tools will be effective at persuading property owners to adopt and maintain behavioural measures that preserve ecosystems. Communication efforts could be focused on relational values that resonate with different users (Shaw et al, 2011). For example, when attempting to create materials for “the urbanite” group, efforts could focus on personal enjoyment elements that individuals in that cluster ranked as extremely important (i.e., water quality, scenery viewing, and swimming) and how preserving and conserving shoreline habitats can only increase their enjoyment of these personal enjoyment elements. Given the emphasis on powerboating in the urbanite cluster, there may be opportunities to emphasize how boat wakes can contribute to erosion that may impact other activities they value such as water quality. Finally, efforts that provide property owners with tailored action plans that recommend personalized strategies based on the property owner’s specific situation and characteristics (e.g., awareness, knowledge, attitudes,

social norms, skills, financial resources, recreational goals) seems to be a productive activity (like Love Your Lakes does).

Conclusions

This study characterized 668 waterfront property owners who participate in the Love Your Lake shoreline assessment program. This study illustrates that there are noticeable differences in the relational values among waterfront property owners within the Canada Ontario region, with preservationist relational values representing the majority of waterfront property owners. However, lake characteristics are unable to predict which cluster group and an individual will belong. Relational values have the opportunity to provide valuable data that, if continued to be collected over time, can help identify trends of the differing relational values and their impacts on the environment (Schultz et al, 2005; Biggs et al, 2011; Bottrill & Pressey 2012). Lake associations and water stewardship groups will be able to use this information to not only characterize individuals but also act as a tool to tailor educational materials and the kinds of messaging used to address different groups. Human dimensions research of social-ecological systems will be vital for the management of shorelines, particularly to inform management strategies that address present and potential future issues. Relational values have the potential to provide information on ways in which individuals consider how their well-being impacts the environmental decisions they make, including preferences, and values defined by societal norms (Chan et al, 2016). Future research should focus on understanding what factors influence relational values and how this impacts the environmental decisions of waterfront property owners.

Chapter 3: Relational values of waterfront property owners align with their shoreline stewardship behaviours.

Abstract:

Many ecosystem services are generated by freshwater lakes, including those that attract people to live, work, and play along shorelines. The loss of habitat due to shoreline development poses a threat to biodiversity. Individual differences in relational values are most likely to blame for individual disparities in shoreline stewardship behaviours. This study analysed the relational values of 658 waterfront property owners from Ontario, Canada, using data from a Canadian-based shoreline evaluation program called Love Your Lake, and investigated if their relational values and principles were represented in their shoreline stewardship behaviours based on property-level shoreline assessments conducted by the Love Your Lake team. Variables (such as natural, degraded, regenerative, ornamental, and developed) were used to assess the status of an individual's shoreline and ultimately determine if an individual's shoreline site activities correspond to their relational values. Strong alignment and misalignment between individual-level relational values and property assessments was observed. Specifically, natural and developed shorelines were strong predictors in determining if individuals' relational values were true to the current condition of their shoreline. However, it is uncertain whether these observations apply to those beyond the Love Your Lake initiative. This study's findings can help identify gaps in outreach initiatives aimed at enlisting property owners' participation in reducing habitat degradation caused by shoreline development.

Introduction:

The alteration of shoreline habitats is an important example of a global issue brought about by the combined actions of individuals, small groups, and governments (Lotze et al, 2006; Janse et al, 2015). Globally, freshwater biodiversity is declining and will likely continue to decline (MEA 2005; Revenga et al, 2005), potentially at a greater rate than in terrestrial and marine environments (Loh & Wackernagel 2012). Despite the ongoing freshwater biodiversity crisis, waterfront properties continue to be in great demand (Yassin et al, 2009). Shoreline alteration connected with human development is one type of human activity that has been particularly damaging to freshwater ecosystems (Toft et al, 2007). Pristine lakes are valuable real estate, and developed properties offer a variety of services provided by residential outdoor areas, yet these activities may jeopardise overall lake health (Amato et al, 2016).

Residential landscapes serve as a primary setting for human-environment interactions on a daily basis (Bhatti & Church 2001). The outdoor space of waterfront properties is frequently thought of as a functional extension of the home, which is often created and managed to satisfy the aesthetic and recreational needs of the property owners (Jenkins 1994; Martin et al, 2003; Larson et al, 2009a). These outdoor spaces provide residents with a "sense of place," reminding them of the native ecosystems, their geographic origins, or specific settings such as "home" or "nature" (Bhatti & Church 2001; Fuller et al, 2007; Tzoulas et al, 2007). These outdoor areas also provide many services that promote human mental and physical well-being, which allows for more recreational activities and social gatherings with family and friends (Beard & Green 1994; Matsuoka & Kaplan 2008; Abraham et al, 2010).

Ecosystem management requires a new method of assessing natural resources (Manzo 2003), one that considers the values people connect with locations and landscapes (Williams & Patterson 1996), as well as the bonds people create with these areas (Williams & Vaske 2003). Environmental issues will continue to have an impact on environmental meanings, including intrinsic (aesthetic), functional (goal-directed), societal (symbolic), and individual (expressive) meanings (Williams & Patterson 1996). An individual's perceptions of ecological conditions and reactions to environmental issues are therefore influenced by these meanings (Kaltenborn 1998).

As we continue to address environmental and stability issues, there will need to be more emphasis on the role that values play in facilitating stewardship efforts (Diaz et al, 2015; Abson et al, 2017). Relational values are currently being pushed as essential in creating sustainable development through global efforts toward stewardship approaches (Sayer et al, 2013). Relational values are manifestations of the interplay of natural processes and human behaviours across time, located at the interface between people and nature (Plieninger et al, 2015). Given that stewardship behaviours are fundamental aspects of landscapes, personal views, and experiences of nature (Gundersen & Makinen 2009). It is also an ethical idea that emphasises accountability, collaboration, participation, plurality, and communication (Cockburn et al, 2019). Relational values are a traditional human feeling of affiliation with other living organisms that is reflective of identity, belonging, and duty, and are consistent with views about what it means to live a "good life" (Klain et al, 2007). These values are linked with an awareness of nature's contributions to people and culturally specific understandings of what it means to live a "good life," as described by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) framework (Diaz et al. 2015; Chan et al, 2016). Waterfront property owners are critical stewards of freshwater ecosystems, and with our climate continually changing, their actions will

be a major influencer of aquatic ecosystem health (Davis & Whitman 2018). Thus, it is important to further examine how and if relational values influence stewardship behaviours to facilitate finding a balance between both societal needs and the health of the environment.

Residential shoreline development is a significant threat to lake health and biodiversity (USEPA 2010). Shoreline development frequently degrades habitats for native species while promoting habitats for invasive species that have evolved to thrive in human-altered habitats (Rahel 2002). Therefore, it is necessary to investigate how relational values influence property maintenance behaviours and how it may inform effective education or communication strategies. Currently, there is little research done on the impact of relational values on shoreline maintenance behaviours, and such understanding is absent for waterfront property owners. To better understand how relational values are reflected in the maintenance behaviours of individuals within Ontario, this study examined waterfront property owners who participated in the Love Your Lake program. The overall objective of this study is to identify if waterfront property owner's relational values are reflected in their decisions on shoreline stewardship of their property. Specifically, this study aims to identify if participants reported relational values align with their shoreline stewardship behaviours.

Methods:

The Love Your Lake program is a combined venture between the Canadian Wildlife Federation (A federally regulated non-profit) and Watersheds Canada (a non-governmental organisation) with the overall objective of understanding how properties along shorelines are valued and maintained and providing property owners with the resources they need to make their

shorelines healthier. The program's initiative is delivered regionally across Canada in collaboration with local entities (lake associations, conservation agencies, etc.). These lake associations are responsible to recruit participants for the Love Your Lake program. If a lake association chooses to participate, every property on the lake will be assessed using a comprehensive assessment protocol, and waterfront property owners will receive a custom-tailored property report with specific details about the state of their shoreline as well as suggested actions on how to improve their shoreline (herein called water assessment). Since being founded in 2013, the Love Your Lake program has been implemented in Ontario, Alberta, British Columbia, and Saskatchewan and has successfully evaluated 173 lakes across Canada, totaling 41,354 shoreline properties. This study uses secondary data from the Love Your Lake program, which gathered useful information on the riparian zone, shoreline, and aquatic zone of waterfront property owners' shorelines across various locations and provinces in Canada. This method supplied the study with information and the opportunity to comprehend how Canadian property owners utilise and maintain the health of Canada's lakes.

Participant recruitment:

Conservation groups and lake organisations were responsible for the success of recruiting waterfront property owners to participate in the Love your Lake program. If participants agreed to partake in the program regional partners would then issue a survey and introductory letter to the participants. Once their surveys have been completed, a trained surveyor is sent to assess the property's shoreline condition and health.

Survey instrument:

This study analyzed both survey and water assessment data collected by the Love Your Lake program. A survey was sent to participants via a link online or hardcopy paper survey that was mailed to the individual. Once completed, a trained volunteer conducted a water assessment of the property. The goal of the value survey was to collect perspectives from waterfront property owners on what they love most about their lakes and what steps they are taking to ensure these values are reflected. The survey comprised 12 questions, including a combination of closed and open-ended questions, as well as 5-point Likert-scale questions (see Appendix A). This study focuses mainly on the question of personal enjoyment elements and how they contribute to an individual's enjoyment of their lake. It should be emphasised that questions on relational values themselves were not directly asked in the survey, but rather an interpretation of the personal enjoyment elements question from the survey and how these activities and actions can be translated into relational values.

Upon completion of the survey, trained shoreline surveyors (who undergo a three-day course on how to accurately assess shoreline properties) evaluate the shorelines of the individuals participating in the program. To guarantee consistency along the entire shoreline, all data collected for a lake is collected by the same surveyor or survey team (i.e., trained staff or students). The data collected constitutes the best judgement of the surveyor or survey team. Private reports are subsequently generated for each waterfront property owner on a specific lake, as well as lake-wide data for each lake association. The evaluation assesses numerous aspects of the shoreline's physical condition from 30 metres away on a boat in the water (which will be moved as near to the shore as safely as possible), so as not to disturb shoreline property owners. Volunteer surveyors steer the

boat with guidance from computerised maps and GPS software. The evaluation included general information about the property, signs of erosion or degradation, shoreline and riparian zone characteristics, and recommendations and opportunities for restoration. Overall, the surveyor assigned a percentage (which must be rounded to the nearest 10%) to each of the following five scoring categories: natural, regenerative, ornamental, degraded, and developed, with the total for all five categories equaling 100%. Among the five categories, *natural* properties contain little to no human disturbance to the natural vegetation or land cover (with the goal of the property being 100% natural); *regenerative* properties are those that are beginning to re-naturalize; *ornamental* properties are where natural vegetation has been removed and a manicured lawn and/or artificial grass has been installed; *degraded* properties have erosion, pollution, clear-cutting, or other apparent harmful practices; and *developed* refers to any building, structure, or impermeable surface (e.g., paving stones, driveways, or paths) placed in the riparian zone. Reports are then created with prefabricated paragraphs that correlate to the data collected for each property. The shoreline surveyors can make changes to these paragraphs as needed. For example, if an individual has a hardened vertical retaining wall on their property, the report may recommend that it be replaced with riprap at a moderate slant in the future. Through focused education, the goal is to encourage shoreline care and re-naturalization. Individual codes can be used to download reports for free, or property owners can pay \$20 for a print copy to be mailed to them.

Data Processing:

To protect the identity of property owners, all data was stripped of any personal information such as names, addresses, and phone numbers. For the use of secondary data for the study, a data-sharing agreement was made with Love Your Lake. From the years 2013 to 2020 Love your Lake

has successfully assessed the waterfront shorelines of 41,354 homes, however only 972 property owners across Canada completed the value survey that was issued before the water assessment. Due to the small sample size, survey participants from Alberta (n= 154), British Columbia (n= 86), and Saskatchewan (n=232) were eliminated from the analysis. Additionally invalid, or incomplete surveys were also removed. With the study focusing primarily on lakes in Ontario. All components of the usage of this survey and secondary data were approved in adherence to the Carleton University Research Ethics Board (Ethics Clearance ID: 116172). This study acts as a continuation of chapter 2 (Understanding waterfront property owner relational values towards lake shorelines across Ontario), and I will now be using the cluster groupings from chapter 2 to now test whether participants relational values align with shoreline property assessment/shoreline management behavior.

Data Analysis

This study utilised a K-mean cluster analysis to identify and characterise the fifteen personal enjoyment elements of waterfront property owners and how these elements translated into relational values (see Chapter 2 and Table 3). Cluster analysis has been used extensively in research studies to divide respondents into identical groups by applying a distance measure (I used Euclidean distance) between data points, allowing for the grouping of waterfront property owners with similar or distinct responses patterns together (Kreft & Jetz 2010).

Table 3: List of the fifteen personal enjoyment elements from the survey that were used to interpret relational values.

Personal Enjoyment elements
Water quality
Natural shorelines
Scenery view
Preserving vacant land
Non-power boating
Wildlife viewing
Dark skies
Tranquility quiet
Fishing
Ice fishing
Hunting
Swimming
Lake social activities
Powerboating

This study also used multivariate and univariate statistics to assess whether waterfront property owners' riparian zone classifications (natural, regenerative, ornamental, degraded, and developed) align with their reported relational values within this study. A tree-based classification model was built using the Chi-squared Automatic Interaction Detection (CHAID) growing method to see which factors were most predictive of a waterfront property owner's shoreline condition and cluster group assignment (which represents their reported relational values). At each step of the process, the CHAID technique determines the independent variable with the strongest interaction and merges categories that are not statistically different in relation to the dependent factor (Milanović & Stamenković 2016). Before analysis, the scale of independent variables is automatically banded into distinct groups using the CHAID tree growth approach (Rashidi et al,

2014). All tests were computed using the Statistical Package for the Social Sciences (SPSS), Version 28, and $P = 0.05$ was considered statistically significant for all tests.

Results:

Waterfront property owner's sample description and property characteristics

Love your lake distributed a total of 972 surveys, this study included 658 surveys in the analysis after eliminating invalid or incomplete surveys (of the 972 surveys completed 314 surveys were missing information from either the water assessment data sheets or the values surveys, hence why they were removed from the analysis). Additionally, respondents from Alberta, British Columbia, and Saskatchewan were filtered out due to small sample sizes. The survey sample of waterfront residents was composed of seasonal residents (58.0%), permanent residents (28.5%), vacant property owners (7.1%), rental properties (1.4%), and farm owners (1.1%), and business owners (4.2%). On average, respondents had lived at their current residence for 37.6 years.

Waterfront property owner typology groupings

Using the same cluster classifications from chapter 2, I was able to characterise three distinct groupings: “the preservationist”, “the conservationist”, and “the urbanite”. For full descriptions of the cluster, and groupings refer to chapter 2 results.

Riparian Zone Classifications

The five prominent shoreline zone classifications (natural, regenerative, ornamental, degraded, and developed) were examined to determine if survey participants reported relational values that reflect the shoreline condition of their waterfront property. The majority of shorelines were classified as ornamental (38.19%), regenerative (31.45%), natural (26.95%), or developed

(31.26%). Degraded classifications were relatively uncommon (0.12% of respondents' shorelines). I employed a classification tree analysis to identify if waterfront property owner's relational values align with their shoreline condition. The final tree model for predicting an individual's existing shoreline state and whether or not this is reflected in their reported relational values indicated that the classifications *natural* ($X^2 = 24.291$ $df = 11$, $n = 438$, $p = 0.035$) and *developed* ($X^2 = 31.149$ $df = 12$, $n = 639$, $p = 0.0006$) were the most powerful predictors in determining if reported relational values align with riparian zone classifications (Figure 4a; Figure 4b). Among the three waterfront property groups, all three had a 99.4% probability of having a shoreline without any *degradation*. Conversely, among the waterfront property groups, the urbanite group had a probability of (15.5%) of having a shoreline where only 10% was classified as 10% *ornamental*, whereas both the preservationist and conservationist groups had a probability of (20.4%) of having a shoreline that contained zero *ornamental* properties. The urbanite group had a 16.0% probability of having a shoreline that was classified as 10-70% *regenerative*, whereas the preservationist and conservationist groups had a probability of (21.2%) of having a shoreline that had zero *regenerative* properties. The urbanite group had a probability of (26.3%) of having a shoreline where only 10% of the shoreline was classified as *natural*, whereas the preservationist and conservationists had a (33.2%) probability of having a shoreline that was classified as having zero *natural* properties. The classified group had a 25.9% probability of having a shoreline that was classified as only 10% *developed*, whereas the preservationist and conservationist group had a 22% probability of having a shoreline that was not developed.

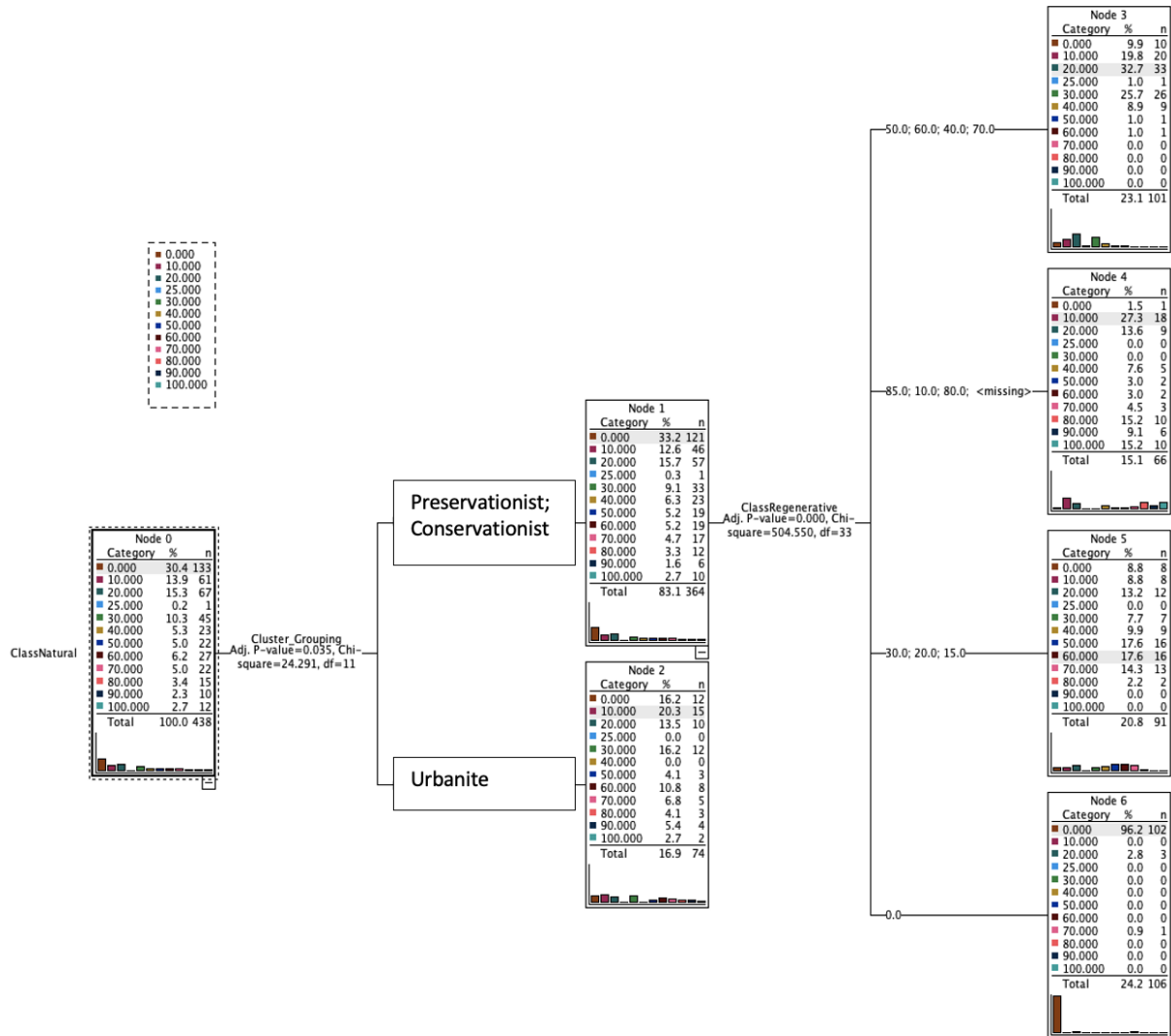


Figure 4a: Classification tree analysis showing shoreline condition (natural) and stated relational values. Separate branches indicate statistically significant differences at $P < 0.05$. Each colour represents a specific percentage for the riparian zone classification that the shoreline surveyor assigned to the property, with 100% being the maximum percentage a classification can receive.

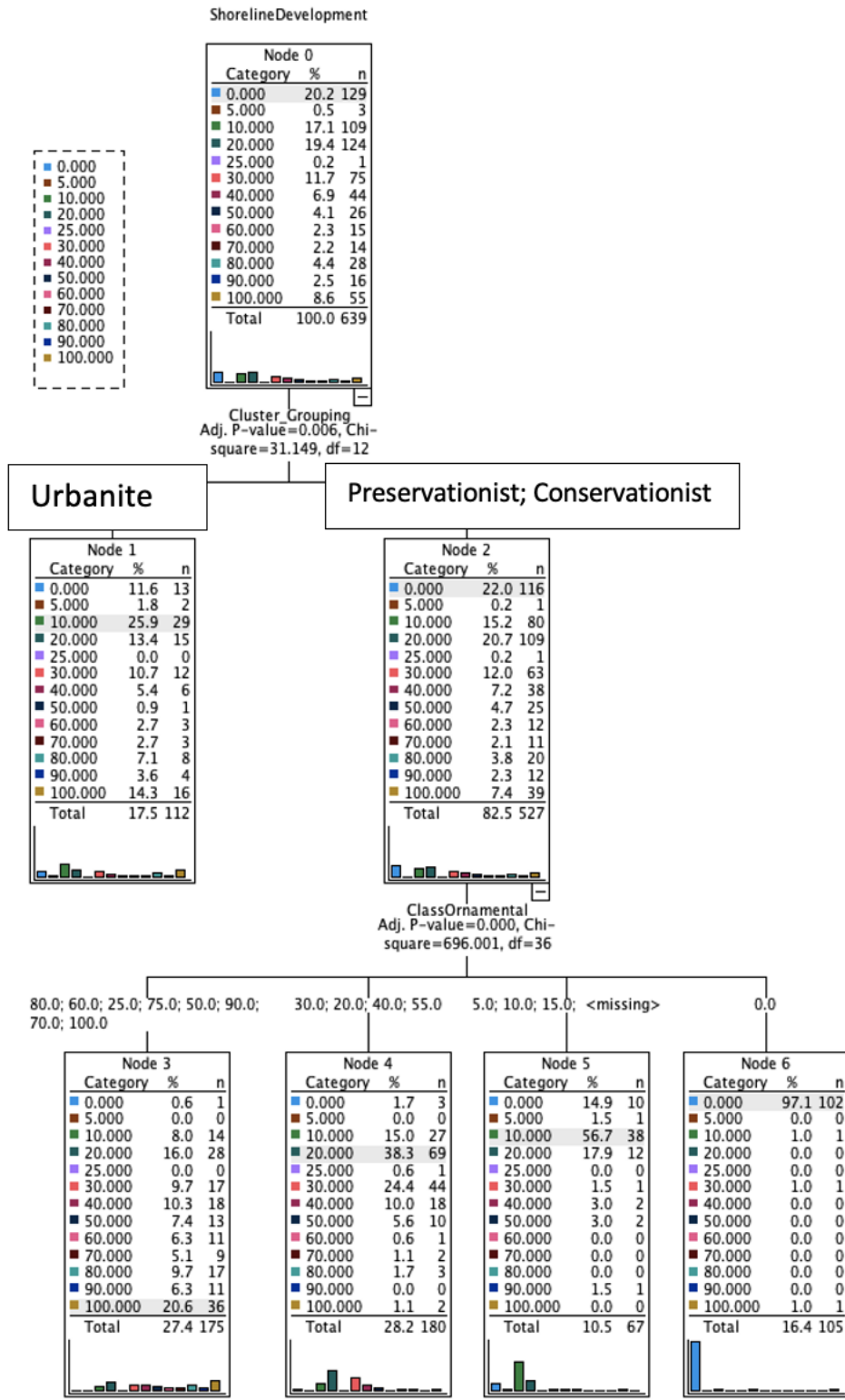


Figure 4b: Classification tree analysis showing shoreline condition (development) and stated relational values. Separate branches indicate statistically significant differences at $P < 0.05$. Each

colour represents a specific percentage for the riparian zone classification that the shoreline surveyor assigned to the property, with 100% being the maximum percentage a classification can receive.

Discussion:

Using secondary data from Love your Lake this study was able to understand how relational values may impact shoreline stewardship. Notably, I observed remarkable alignment and misalignment between natural and developed shorelines being significant predictors in determining the likelihood of whether an individual's shoreline is reflective of their relational values. With the approach taken, this study was able to collect valuable information on how lake associations such as Love your Lake can adjust their current outreach programs to be more successful in their messaging or educational/outreach programs for the protection of shoreline habitats.

Within this study, I identified three distinct groups: “the preservationist”, “the conservationist”, and “the urbanite” based on waterfront property owners reported relational values. In this study, the three relational values groups of waterfront property owners demonstrate a preference for personal enjoyment elements that exemplify relational values which have minimum impacts on shoreline habitats. For example, across the board participants agreed that water quality, swimming, and scenery viewing were among the most important personal enjoyment elements of a lake. In addition to relational values, I also assessed whether an individual's relational values align with the current condition of their shoreline. I was able to determine that of the five riparian zone classifications I studied, only two (*natural* and *developed*) were able to accurately predict if an individual's relational values were reflective of their shoreline conditions. I also discovered that *ornamental* shoreline conditions were amongst the most

dominant shoreline conditions of waterfront property owners, despite the majority of waterfront property owners reporting to have preservationist relational values.

Among the three identified waterfront property groups, all three groups had a very high probability (99.4%) of having a shoreline with no degradation. The preservationist and conservationist groups had higher probabilities in the *regenerative, ornamental, natural, and developed* riparian zone classifications compared to the urbanite group. These findings were quite interesting as despite having preservationist relational values, they had a 33.2% probability of having a shoreline that was not natural at all. This may have occurred for many different reasons, one being that individuals today are more aware of environmental issues that impact our planet (Vermeir & Verbeke 2006; Bonini & Oppenheim 2008; Dunlap 2008; Bleda & Valente 2009). However, there is still a significant knowledge gap that exists between an individual's environmental values and their stewardship behaviours (Tarkiainen & Sundqvist 2009; Diaz-Rainey & Tzavara 2012, Englis & Phillips 2013). Many behaviours strategies are centered around values. Values are excellent predictors of change; however, they are also malleable (Gatersleben et al, 2014). The malleability of values may explain the observed disconnect in the preservationist group and their 32.2% probability of having a shoreline not being natural, potentially indicating that values cannot predict behaviour with 100% certainty.

Values and attitudes are generally easy to change, and they may shift in response to new knowledge or situations (Ajzen 2005). A value towards a certain behaviour may or may not be correlated to another. Individuals who have strong values or attitudes about recycling are more likely to recycle, however, this does not necessarily mean they partake in other activities such as

cycling to work or using eco-friendly cars. Similarly having strong relational values in a certain context does not always directly correlate with other relational values in another context (e.g., Karp 1996; Corraliza & Berenguer 2000; Milfont et al, 2006; Oreg & Katz-Gerro 2006; Dolnicar & Grun 2009).

The concept of relational values is a fairly new social-ecological topic for comprehending how individuals relate to and derive value from their interactions with their environment. Incorporating the influence of relational values provides the opportunity to make stewardship efforts more effective (Fischer et al, 2021). Because environmental issues promote working with varied values held by multiple actors, a relational values lens could aid in explaining how people's preferences influence the stewardship projects they are willing to participate and aid with the lake association program's success (Cundill et al, 2017; Jax et al, 2018). On the one hand, a feeling of place and local identity can stimulate an individual to want to participate more in restoration initiatives (Kibler et al, 2018), but if an individual has strong opinions on the management efforts of specific landscapes (for economic or other reasons) this may impact their involvement in any ecological restoration efforts (Chapman et al, 2019). Accounting for these various representations of relational values for specific places can provide valuable information on informing stakeholders on how to create and support restoration projects, as well as aid in potential conflict resolution (Fischer et al, 2021).

Additionally, I recognised that external expectations from others and their behaviours may influence the actions of environmentally relevant intentions (Heath & Gifford 2002; Nolan et al, 2008; Schultz et al, 2016). Despite its utility in theoretical models, measuring the impact of social

norms is not simple, values are constantly changing and adapting when an individual has a new experience or gains new information. Therefore, improving the framework for which we collect, analyse, and interpret these values will provide meaningful gains in understanding in the normative processes in the environmental domain, which are both achievable (Schultz et al, 2007; Thgersen, 2006) and required (Bamberg & Möser 2007; Göckeritz et al, 2010). Understanding how various actors from government, NGOs, and lake associations collect, interpret, and implement policy on the interactions between waterfront property owners and their shorelines will be critical in assessing and improving how to find a balance between riparian zone aesthetics and shoreline management interventions.

Management And Conservation Implications:

To fully address the alignment and misalignment of relational values and stewardship behaviours examined in this study. Lake and reservoir managers need to develop specific marketing tools that target different aspects of personal enjoyment elements to allow for better education for property owners to adopt and maintain behavioural measures that conserve ecosystems. For example, when attempting to create materials for the preservationist and conservationist relational values group focusing on how riparian zone characteristics such as natural and regenerative shorelines can contribute to the personal enjoyment elements (water quality, natural shorelines, and preserving vacant land) they indicated are extremely important to them. And lead to the preservation and conservation of natural shorelines but also their enjoyment of their lakes will be beneficial in changing stewardship behaviours. For the urbanite relational values group, they should focus on educational messaging that explains how natural shorelines can improve their enjoyment of personal enjoyment elements (fishing, hunting, and preserving vacant

land), and place more importance on these riparian zone characteristics will improve their enjoyment of their lake. Also understanding that relational values may differ in certain contexts and the messaging will have to be adjusted accordingly. Additionally, continuing to give property owners customised action plans that include customized solutions that are tailored to their specific circumstances and attributes (e.g., awareness, knowledge, attitudes, social norms, skills, financial resources, and recreational goals), will be important in addressing.

Limitations

Due to the nature of the survey, some biases may exist within this study. This study only examined a fraction of waterfront property owners who participated in the Love your Lake program and is not a full representation of all waterfront property owners in Ontario. Additionally, the survey relied on honest reporting from participants, therefore there is the potential for a self-reporting bias. Lastly, due to the nature of the secondary data questions regarding relational values were not directly asked in the survey. Therefore, all of these assumptions are based on interpretations of personal enjoyment elements. One potential solution to mitigate these limitations would be for future studies to directly ask waterfront property owners to report their relational values and how it impacts their stewardship behaviour. In addition to this, having a third party administer the value survey may reduce any external pressures an individual may feel to over-report relational values. Finding creative ways to encourage more participation in the Love your Lake program will allow for a better understanding of all waterfront property owners in Ontario.

Conclusion

This study analysed data of 658 waterfront property owners who engaged in the Love Your Lake shoreline assessment program. This study provided more information on the relational values

and shoreline stewardship efforts of waterfront property owners in the Ontario region of Canada. Understanding the role that relational values play in influencing shoreline stewardship will be critical for management, especially in informing management techniques that attempt to address current and perhaps future shoreline issues. Relational values in combination with stewardship behaviours data can provide valuable information on how individuals assess how their actions influence the environmental decisions they make (Chan et al. 2016). Future research should concentrate on determining the long-term impacts of what additional factors influence the relational values and stewardship behaviours of waterfront property owners.

Chapter 4: General conclusion

The goal of this thesis was to discover what relational values exist among waterfront property owners within Ontario Canada and also determine if these relational values are upheld in the ways waterfront property owners engage in shoreline stewardship.

The first empirical chapter (Chapter 2) set out to understand and characterize the relational values of waterfront property owners that participated in the Love your Lake shoreline evaluation program, and also determine if lake characteristics such as lake size, average property value, and distance to, the urban area had an influence on an individual's relational values and the cluster group they were assigned to. Using secondary data from Love your Lake, I analyzed value survey data of fifteen personal enjoyment elements with the intent of gaining an understanding of what waterfront property owners in Ontario specifically value most in regard to their lake properties. Moreover, I assessed which actions and behaviours participants were engaging in to reflect their values. The survey consisted of 12 questions, which included a combination of open and closed-ended questions, as well as 5-point Likert-scale questions. This study focused on the question which had participants rank fifteen personal enjoyment elements on a scale of 1-5. Questions about relational values were not explicitly asked in the survey, so therefore all of the conclusions are interpretations of the personal enjoyment elements participants ranked and how they can be translated into relational values.

From this study, I was able to identify three waterfront property groups: “the preservationist”, “the conservationist”, and “the urbanite”, which represented the different relational values of waterfront property owners. From this, I was able to determine that majority

of participants prioritize personal enjoyment elements that can have positive impacts on shoreline health. I was unable to conclude that lake characteristics such as lake size, average property value, and distance to an urban area were able to determine which cluster group an individual would be placed in based on their relational values.

The goal of the second empirical study (i.e., chapter 3) was to use the same set of waterfront property owners and now determine if their relational values are reflected in their shoreline stewardship behaviours. By using the same secondary data from Love your Lake, I then analysed water assessment data which assessed the state of each waterfront property owners' shoreline. The water assessment data consisted of a shoreline survey sheet which was comprised of six sections (general property information, erosion, degradation, shoreline, and riparian zone features, and recommendations and opportunities for restoration) on various aspects of their shoreline. This study concluded that riparian zone characteristics such as *natural* and *developed* shorelines were the strongest predictors in determining if an individual's relational values were reflected in their shoreline stewardship behaviours.

I also concluded that all three waterfront property groups had a 99.4 percent chance of having a shoreline with no degradation. In addition, compared to "the urbanite" group, "the preservationist" and "the conservationist" groups showed higher probability in four of the five riparian zone classifications used to assess shorelines (*ornamental, regenerative, natural, and developed*). Although indicating they have preservationist relational values, preservationist the relationship values group had a 33.2 percent probability of having a non-natural shoreline. This finding potentially indicates that having a relational value in one context does not always translate

into another context. Therefore, lake and reservoir managers should look carefully at how specific relational values influence stewardship behaviours.

Future Research Directions

Stewardship has now become a widely used term when attempting to address socio-ecological issues, and there is growing interest in how relational values drive stewardship behaviour (Cornell et al, 2013). The concept of relational values provides one possible avenue for the effective implementation of varied social scientific viewpoints in ecosystem sustainability and environmental decision-making (Chan et al, 2018). In this thesis, I have argued that it will be critical to continue to gain more understanding of how relational values impact the way we measure, analyze, and interpret stewardship behaviours. Relational values may offer one step toward a more even playing field within which economics, other social sciences, and humanities contribute complementary perceptions toward a sustainable world (Chan et al, 2018). With the continued collection of the concept of relational values can ultimately serve as a tool for interdisciplinary integration and meaningful inclusion of the social sciences and diverse approaches to values in conservation, environmental management, and sustainability science by providing a common framework for ideas in a variety of disciplines and fields (Chan et al, 2016)

Developing a good understating of relational values will also be important when designing interventions, as participants' involvement, identity, and societal norms may impact these values (Göckeritz et al, 2010; Fellner et al, 2013). As this will help generate more knowledge on how lake associations and governments can improve existing programs and create new programs that incorporate how relational values impact stewardship and management of riparian habitats in

freshwater lakes. Future studies will need to focus more closely on the changing elements of relational values to address narrow intervention attempts to alter behaviour. Addressing questions such as do relational values affect individuals' conceptions of global social norms, their own within community social norms, will be essential for future study (Vesely & Klöckener 2018). Relational values have been mostly operationalized as static variables in environmental psychology, with little attention paid to their formation, transmission, and evolution (Grnhj & Thgersen 2012; Matthies, et al, 2012). This could be overcome by combining both qualitative and quantitative methodologies, as the results will allow researchers to find more complete findings compared to only using one methodological perspective. Though it may be difficult in terms of conceptualization and cost, the benefit of integrating methodologies in research is becoming increasingly desirable (Lieber 2009). The collective effort on this research topic will provide scholars and decision-makers with different ways to determine how to best design, carry out, and analyse the data generated by mixed methods projects.

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Appendix A

Love your Lake Value Survey Questions

1. Which of the following apply to you? (Select ALL that apply)
 - Permanent resident
 - Seasonal resident
 - Own vacant property
 - Operate a farm
 - Operate a business
 - Other
2. Do you have a two or three season cottage that you plan on winterizing?
 - Yes
 - No
 - I don't know
3. How long have you or your family been on your lake?

Recreation

4. What types of recreational activities do you participate in at the lake? (Select as many as apply)
 - Camping
 - Canoeing Or Kayaking
 - Cross-country Skiing
 - Fishing
 - Hunting
 - Hiking
 - Ice Fishing
 - Ice Skating
 - Jet Skiing
 - Mountain Biking
 - Nature Appreciation
 - Power Boating
 - Sailing
 - Snowmobiling
 - Snow Shoeing
 - Socializing
 - Swimming
 - Wind Surfing
 - Water Skiing/wake Boarding
 - Other

Values

5. Please rate how the following 15 elements add to your personal enjoyment of your lake. Please select only one number for each value. (Options were not important, somewhat important, important, very important, extremely important and I don't know)

- Water Quality
- Natural Shorelines
- Scenery/View
- Wildlife Viewing
- Dark Skies (no light pollution)
- Tranquility/Quiet
- Fishing
- Ice Fishing
- Preserving Vacant Land
- Hunting
- Swimming
- Power Boating
- Non-Power Boating
- Lake Social Activities

6. What do you see as the top three issues facing your lake and your lake use?

- Water Quality
- Water Levels
- Fish Populations
- Boating
- Cottage Conversions to Permanent Homes
- Shoreline Development
- Faulty Or Poorly Maintained Septic's
- Noise Pollution
- Light Pollution
- Wildlife

7. Please identify the top three actions you believe should be undertaken to benefit your lake and lake community.

- Stop Mowing Grass by The Shoreline
- Plant Trees and Shrubs Along Shore
- Limit Boat Wakes Near Shore
- Engage In a Septic Re-inspection Program
- Provide Education Materials to Property Owners on A Variety of Subjects
- Undertake More Water Quality Testing
- Create Or Enforce Stricter Rules for New Development
- Create Or Enforce Stricter Rules for Re-development (cottage Conversions)
- Improve Communication Between Property Owners and Lake Association
- Engage More Property Owners in Lake Activities
- Undertake A Lake Management Plan
- Nothing

Water quality

8. Describe your lake's water quality:
 - Excellent
 - Good
 - Poor
 - Don't know

9. What are your particular concerns with respect to your lake water quality?
 - Bacteria
 - Smell
 - Algae/aquatic Vegetation
 - Clarity
 - Chemical Contamination
 - No Concerns

Stewardship

10. Are you interested in learning more about how your activities as a shoreline property owner can affect water quality, wildlife habitat, and the overall health of your lake?
 - Yes
 - No
11. Would you be interested in participating in stewardship projects/activities related to your lake?
 - Yes
 - No
12. What barriers have you encountered when trying to participate in stewardship projects?
(Select all that apply)
 - Cost
 - Lack Of Time
 - Lack Of Information
 - Not A Priority

Appendix B

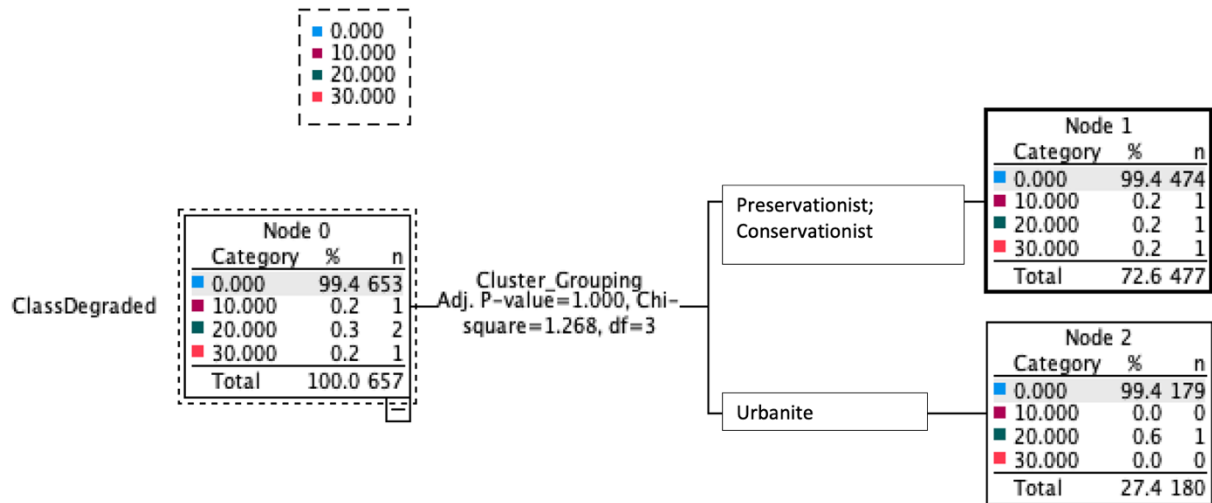


Figure 4c: Classification tree analysis showing shoreline condition (degraded) and stated relational values. Separate branches indicate statistically significant differences at $P < 0.05$. Each colour represents a specific percentage for the riparian zone classification that the shoreline surveyor assigned to the property, with 100% being the maximum percentage a classification can receive.

Appendix C

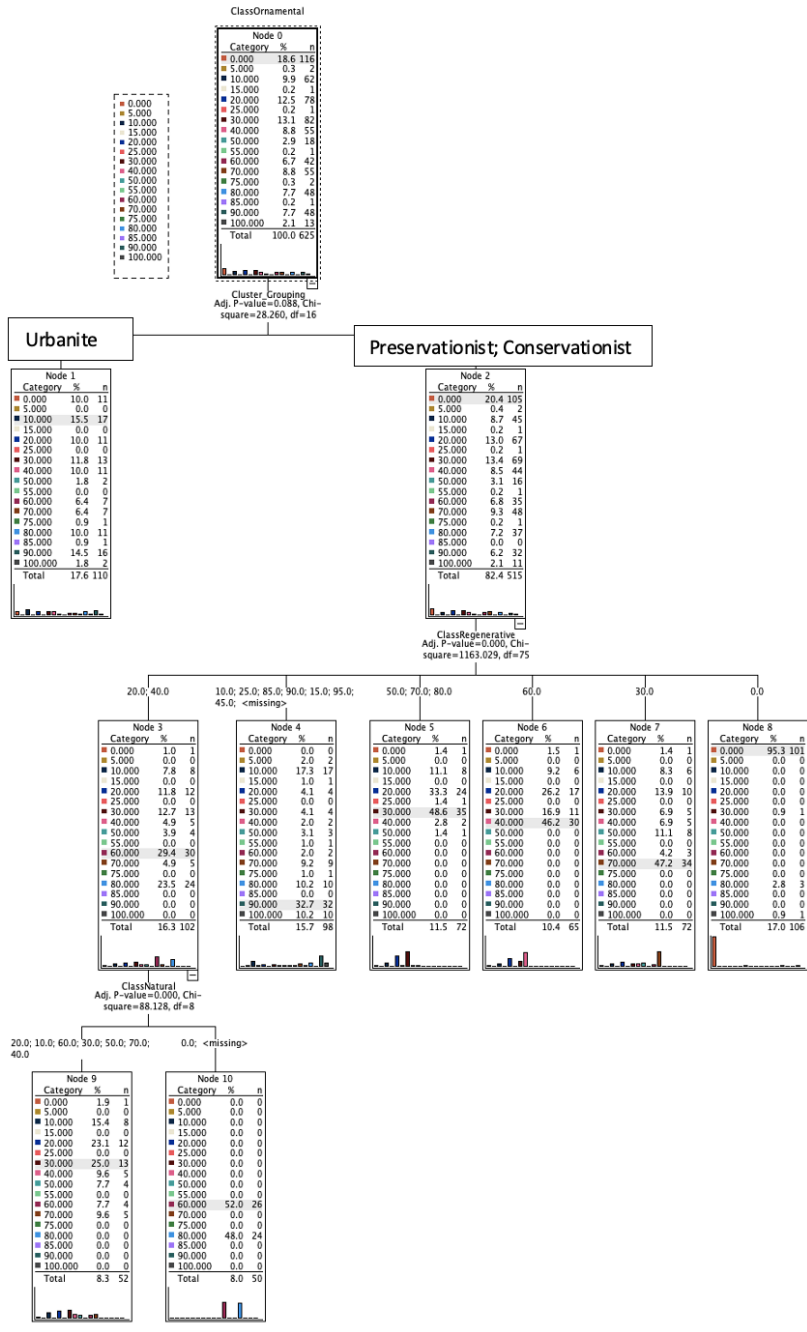


Figure 4d: Classification tree analysis showing shoreline condition (ornamental) and stated relational values. Separate branches indicate statistically significant differences at $P < 0.05$. Each colour represents a specific percentage for the riparian zone classification that the shoreline surveyor assigned to the property, with 100% being the maximum percentage a classification can receive.

Appendix D

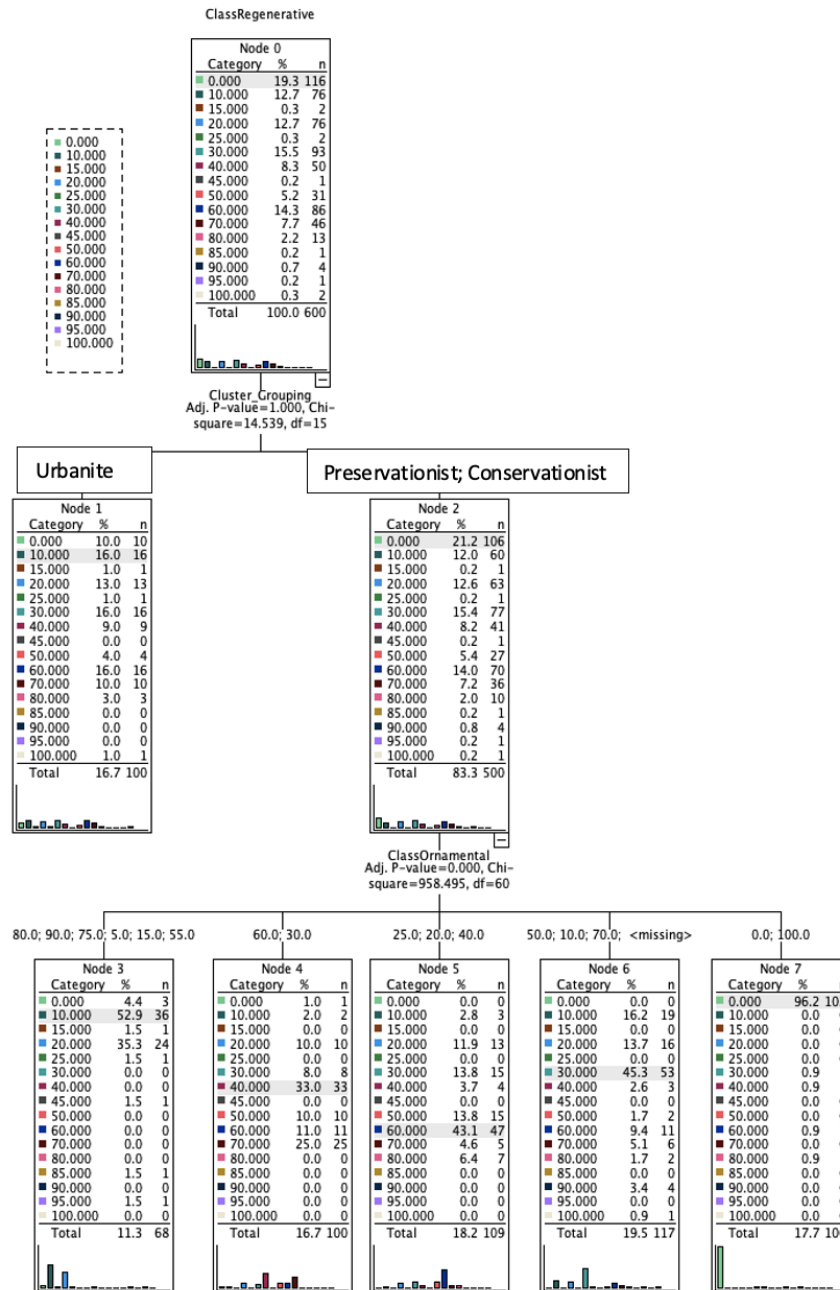


Figure 4e: Classification tree analysis showing shoreline condition (regenerative) and stated relational values. Separate branches indicate statistically significant differences at $P < 0.05$. Each colour represents a specific percentage for the riparian zone classification that the shoreline surveyor assigned to the property, with 100% being the maximum percentage a classification can receive.

Appendix E

Table 4: K-Means Clustering iteration history, convergence achieved due to no or small change in cluster centers. The maximum absolute coordinate change for any center is .000. The current iteration is 13. The minimum distance between initial centers is 10.536.

Iteration	Change in Cluster Centers		
	1	2	3
1	4.87	5.578	0
2	0.47	2.026	2.728
3	0.056	0.082	4.834
4	0.314	0.704	3.139
5	0.4	0.16	1.256
6	0.017	0.051	0.043
7	4.30E-05	0	0
8	1.12E-07	3.65E-06	1.50E-06
9	2.92E-10	3.09E-08	8.89E-09
10	7.60E-13	2.62E-10	5.26E-11
11	6.02E-15	2.22E-12	3.11E-13
12	0	2.44E-14	2.28E-15
13	0	0	0