

LAKE MICHIGAN STAKEHOLDERS' PERCEPTIONS OF COASTAL RISK  
AND MOTIVATIONS FOR COASTAL HABITAT STEWARDSHIP

By

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## **ABSTRACT**

### **LAKE MICHIGAN STAKEHOLDERS' PERCEPTIONS OF COASTAL RISK AND MOTIVATIONS FOR COASTAL HABITAT STEWARDSHIP**

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Lake Michigan communities have already begun to feel the effects of climate change, and research suggests that these areas will experience many phenomena that will negatively impact the ecosystem and human livelihoods (GLISA, 2014). While agencies exist to generally guide coastal management, Michigan lacks institutions that establish regulations or requirements for managing the Great Lakes coastal region (Norton et al., 2018). As a result, Michigan's coastal communities have the responsibility of preparing for an uncertain future under climate change. I compared risk perceptions between different resident groups, as well as between different communities, varying by county, size, and presence of a previous coastal resiliency program. I used a four-wave tailored design for data collection (Dillman, 2009) in six Michigan communities along Lake Michigan from December 2018 to April 2019. I found communities with resiliency programs are less concerned about coastal risk than other communities and lake residents are more concerned about coastal risk than municipal officials. I also found that previous experience with environmental risk and gender are predictors of concern about coastal risk. I suggest that future outreach materials focus on lake residents and that community-engaged work to create more robust coastal resilience plans are beneficial to mitigating risk perceptions. The results from this research can also be used to inform future planning and zoning policies, as well as other coastal resilience policies.

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The statements, findings, conclusions, and recommendation in this thesis are those of the author, Julia Whyte, and do not necessarily reflect the view of the Michigan Department of Environment, Great Lakes, and Energy and the National Oceanic and Atmospheric Administration.

## TABLE OF CONTENTS

|                                                                     |             |
|---------------------------------------------------------------------|-------------|
| <b>LIST OF TABLES.....</b>                                          | <b>viii</b> |
| <b>LIST OF FIGURES.....</b>                                         | <b>x</b>    |
| <b>CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW .....</b>          | <b>1</b>    |
| Physical Dynamics of the Great Lakes .....                          | 2           |
| Challenges to Coastal Resilience .....                              | 3           |
| Mitigation vs. Adaptation .....                                     | 5           |
| Risk Perception .....                                               | 6           |
| Values-Beliefs-Norms Theory .....                                   | 8           |
| Risk Information Seeking and Processing Framework.....              | 9           |
| Research Questions .....                                            | 15          |
| <b>CHAPTER 2: METHODS .....</b>                                     | <b>16</b>   |
| Study Sample .....                                                  | 16          |
| Survey Design .....                                                 | 19          |
| Analysis .....                                                      | 24          |
| <b>CHAPTER 3: PERCEPTIONS OF COASTAL RISK .....</b>                 | <b>29</b>   |
| Results .....                                                       | 29          |
| Discussion .....                                                    | 39          |
| <b>CHAPTER 4: MOTIVATIONS FOR COASTAL HABITAT STEWARDSHIP .....</b> | <b>42</b>   |
| Results .....                                                       | 42          |
| Discussion .....                                                    | 49          |
| <b>CHAPTER 5: CONCLUSIONS .....</b>                                 | <b>52</b>   |
| Limitations .....                                                   | 52          |
| Recommendations.....                                                | 53          |
| <b>APPENDICES.....</b>                                              | <b>54</b>   |
| APPENDIX A: INSTITUTIONAL REVIEW BOARD APPROVAL LETTER.....         | 55          |
| APPENDIX B: SURVEY INVITATION NUMBERS AND RESPONSE RATES .....      | 56          |
| APPENDIX C: QUALTRICS SURVEY .....                                  | 57          |
| APPENDIX D: CODEBOOK .....                                          | 75          |
| APPENDIX E: SOCIO-DEMOGRAPHIC SURVEY AND CENSUS DATA .....          | 91          |
| APPENDIX F: ALLEGAN AND OTTAWA COUNTY RECRUITMENT MATERIALS....     | 96          |
| APPENDIX G: MUSKEGON COUNTY RESIDENT RECRUITMENT MATERIALS .....    | 100         |
| APPENDIX H: MUNICIPAL OFFICIALS EXAMPLE RECRUITMENT MATERIALS ..    | 104         |
| <b>REFERENCES .....</b>                                             | <b>105</b>  |

## LIST OF TABLES

|                                                                                                                                                                                                                                                                   |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Table 1.</b> Community matrix displaying community, county, county size type, total population, previous coastal resilience policy or program, and shoreline type.....                                                                                         | 17 |
| <b>Table 2.</b> Constructs describing different facets of risk perception, the mean response, and standard deviation for the Combined Model. ....                                                                                                                 | 20 |
| <b>Table 3.</b> Number and frequency of respondents who said they were involved in a program or organization whose focus is on Great Lakes habitat preservation, conservation, or management. ....                                                                | 21 |
| <b>Table 4.</b> Socio-demographic variables hypothesized to predict an individual's risk perceptions. Descriptive statistics displaying mean ( $\bar{x}$ ) or frequency of respondents in each category with range or standard deviation (s) in parentheses. .... | 22 |
| <b>Table 5.</b> Summary of goodness-of-fit statistics for baseline models and final structural models of Concern and Knowledge facets of risk perception. ....                                                                                                    | 27 |
| <b>Table 6.</b> Environmental concerns in 10 years. Mean responses from a 1 (not at all concerned) to 5 (extremely concerned) Likert-type-scale are displayed with standard deviations in parentheses. Highest average concerns are noted in bold. ....           | 29 |
| <b>Table 7.</b> Environmental concerns in 50 years. Mean responses from a 1 (not at all concerned) to 5 (extremely concerned) Likert-type-scale are displayed with standard deviations in parentheses. Highest average concerns are noted in bold. ....           | 30 |
| <b>Table 8.</b> Responses to the question "Who do you think owns coastal shoreline in your community?" broken down by Resident Type. ....                                                                                                                         | 31 |
| <b>Table 9.</b> Responses to the question "Who do you think is responsible for managing coastal shoreline in your community?" broken down by Resident Type. ....                                                                                                  | 32 |
| <b>Table 10.</b> What is the best way to manage a receding shoreline? Frequency of response by Resident Type (Lake, Near-lake, Inland, and Municipal officials). ....                                                                                             | 34 |
| <b>Table 11.</b> Regression model of the final structural models for Concern (Model 1 and 2) and Knowledge (Model 3 and 4). Model 1 and 3 look at characteristics of the communities and counties, Model 2 and 4 include socio-demographic factors. ....          | 36 |
| <b>Table 12.</b> Regression models of the final structural models for three counties (Allegan County, Ottawa County, and Muskegon County) of Concern and Knowledge. ....                                                                                          | 38 |
| <b>Table 13.</b> Logistic regression predicting involvement in program for Combined Model. Odds ratios are presented with standard errors in parentheses. ....                                                                                                    | 43 |
| <b>Table 14.</b> Logistic regression predicting involvement in a program or organization by Concern and Knowledge. Odds ratios are presented with standard errors in parentheses. ....                                                                            | 44 |

|                                                                                                                                                                                                                                                                                                                                               |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Table 15.</b> Logistic regression by county predicting involvement in a program or organization. Model 1 includes logistic regression controlling for resident locations. Model 2 includes Model 1 and socio-demographic predictors. Odds ratios are presented with standard errors in parentheses. ....                                   | 46 |
| <b>Table 16.</b> Logistic regression by county predicting involvement in a program or organization for Concern and Knowledge factors. Model 1 includes logistic regression controlling for resident locations. Model 2 includes Model 1 and socio-demographic predictors. Odds ratios are presented with standard errors in parentheses. .... | 47 |
| <b>Table 17.</b> Range of motivations for stewardship concepts determined by emergent coding. ....                                                                                                                                                                                                                                            | 49 |
| <b>Table 18.</b> Survey invitation numbers and response rates for Pooled Counties.....                                                                                                                                                                                                                                                        | 56 |
| <b>Table 19.</b> Survey invitation numbers and response rates for Allegan County. ....                                                                                                                                                                                                                                                        | 56 |
| <b>Table 20.</b> Survey invitation numbers and response rates for Ottawa County.....                                                                                                                                                                                                                                                          | 56 |
| <b>Table 21.</b> Survey invitation numbers and response rates for Muskegon County. ....                                                                                                                                                                                                                                                       | 56 |
| <b>Table 22.</b> Codebook. ....                                                                                                                                                                                                                                                                                                               | 75 |
| <b>Table 23.</b> Socio-demographic survey data compared to census data for gender. ....                                                                                                                                                                                                                                                       | 91 |
| <b>Table 24.</b> Socio-demographic survey data compared to census data for gender by county. ....                                                                                                                                                                                                                                             | 91 |
| <b>Table 25.</b> Socio-demographic survey data compared to census data for age. ....                                                                                                                                                                                                                                                          | 92 |
| <b>Table 26.</b> Socio-demographic survey data compared to census data for age by county. ....                                                                                                                                                                                                                                                | 92 |
| <b>Table 27.</b> Socio-demographic survey data compared to census data for highest level of education.....                                                                                                                                                                                                                                    | 93 |
| <b>Table 28.</b> Socio-demographic survey data compared to census data for highest level of education by county. ....                                                                                                                                                                                                                         | 93 |
| <b>Table 29.</b> Socio-demographic survey data compared to census data for race. ....                                                                                                                                                                                                                                                         | 94 |
| <b>Table 30.</b> Socio-demographic survey data compared to census data for race by county. ....                                                                                                                                                                                                                                               | 94 |
| <b>Table 31.</b> Socio-demographic survey data compared to census data for annual income before taxes.....                                                                                                                                                                                                                                    | 95 |
| <b>Table 32.</b> Socio-demographic survey data compared to census data for annual income before taxes by county. ....                                                                                                                                                                                                                         | 95 |

## LIST OF FIGURES

|                                                                                                                                                                                                                                                                                                 |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| <b>Figure 1.</b> Map of shoreline recession risk in Michigan (from Section 309 Assessment and Five-Year Strategy for Coastal Zone management Enhancement Fiscal Years 2016-2020). ....                                                                                                          | 4  |
| <b>Figure 2.</b> Risk Information Seeking and Processing model, adapted from Yang et al. 2014 and Griffin et al. 1999. Dotted arrows represent theorized causal relationship that were not supported by Yang et al. (2014) who applied the RISP model to climate change mitigation policy. .... | 10 |
| <b>Figure 3.</b> The Risk Seeking Information and Processing model as a precursor to the Theory of Planned Behavior, adapted from Griffin et al. 1999. Variables in the blue box are part of the Theory of Planned Behavior, variables in the grey box are part of the RISP framework. ....     | 12 |
| <b>Figure 4.</b> Conceptual mode of "Concern" as a facet of risk perception. ....                                                                                                                                                                                                               | 13 |
| <b>Figure 5.</b> Conceptual model of self-reported "Knowledge" as a facet of risk perception. ....                                                                                                                                                                                              | 14 |
| <b>Figure 6.</b> Conceptual model of "Concern" as a facet of risk perception with factor loadings. ....                                                                                                                                                                                         | 25 |
| <b>Figure 7.</b> Conceptual model of self-reported "Knowledge" as a facet of risk perception with factor loadings. ....                                                                                                                                                                         | 26 |
| <b>Figure 8.</b> Response of the participants to the question of who owns coastal shoreline in their community (n=907). ....                                                                                                                                                                    | 31 |
| <b>Figure 9.</b> Response of the participants to the question of who is responsible for coastal shoreline in their community (n=919). ....                                                                                                                                                      | 32 |
| <b>Figure 10.</b> Response of the participants to the question of what is the best way to manage a receding shoreline (n=844). ....                                                                                                                                                             | 33 |

## **CHAPTER 1:**

### **INTRODUCTION AND LITERATURE REVIEW**

The Great Lakes coastal region offers a rich and diverse habitat for millions of people in North America. From 2000 to 2010 there was a 5.94% increase in migration to Michigan's coastal floodplain (Crossett, Ache, Pacheco, & Haber, 2013). The picturesque views and capacity to support a variety of livelihoods makes these areas highly sought-after real estate. However, Great Lakes coastal habitat is a very dynamic and constantly changing system, making management strategies and regulation more complicated. Furthermore, climate models project that these fluctuations will continue in the future and may increase in intensity (GLISA, 2014; 2017). It is estimated that the Great Lakes region will also experience increases in extreme storms, increases in precipitation, more precipitation as rain than snow, reduced ice cover on the Great Lakes, more flooding events with the risk of erosion, and increases in extreme temperatures.

Although agencies and programs exist to generally guide coastal management in Michigan, these institutions are not officially considered active regulatory bodies (Norton, David, Buckman, & Koman, 2018a). As a result, Michigan's coastal communities have the responsibility of preparing for an uncertain future, especially under a climate-change scenario. Michigan's local government structure also makes planning more challenging because its townships, which are within county bounds, are regulated by the adjacent cities or villages. In Michigan, 41 of its 83 counties are coastal and 1241 civil townships (67 called "townships"). Therefore, there is certainly a need to understand community members' perceptions of coastal risk because they are ultimately the actors who make coastal management decisions (Norton et al., 2018). If we can understand community members' perceptions of risk and motivations for stewardship, we can create a foundation of evidence-based best practices to assist community

decision-making, particularly in communities lacking coastal resilience policies or educational or other capacity training deficits. This research seeks to help fill the existing knowledge gap surrounding stakeholders' perceptions of risk and the implications for coastal resilience policy.

### **Physical Dynamics of the Great Lakes**

The Great Lakes cover a region of almost 95,000 mi<sup>2</sup> and hold about 21% of the world's freshwater (EPA, 2018). They are also relatively young, formed about 10,000 years ago at the end of the most recent ice age. The Great Lakes have a highly variable shoreline, consisting of flat coast, dunes, bluffs, and coastal wetlands, all which offer a diverse ecosystem. Compared to most other Michigan landscapes, coastal sand dunes are especially dynamic systems that constantly change over the long and short term (Lovis, Arbogast, & Monaghan, 2012). The dunes, which in many places are greater than 30-m high, began to form during the Nipissing high stand (~5500 cal. years BP) and have grown episodically since that time (Arbogast, Hansen, & Van Oort, 2002). The eastern shore of Lake Michigan likely holds the largest number of freshwater dunes in the world (Peterson & Dersch, 1981). This geographical feature of Michigan makes living on the coastal zones of Lake Michigan very attractive. However, for these sand dunes to continue to form and grow, natural sand movement by wind must be maintained.

In general, the average lake levels also fluctuate over the years depending on the amount of water entering the lake basin, compared to the amount of water leaving through natural processes and human intervention (Gronewold et al., 2013). Increased temperatures due to climate change are projected to cause higher rates of evaporation and less ice cover on the lakes during the winter (Bai, Wang, Sellinger, Clites, & Assel, 2012; Mason et al., 2016). Fluctuating lake levels greatly impact the shoreline, causing erosion of the coastline.

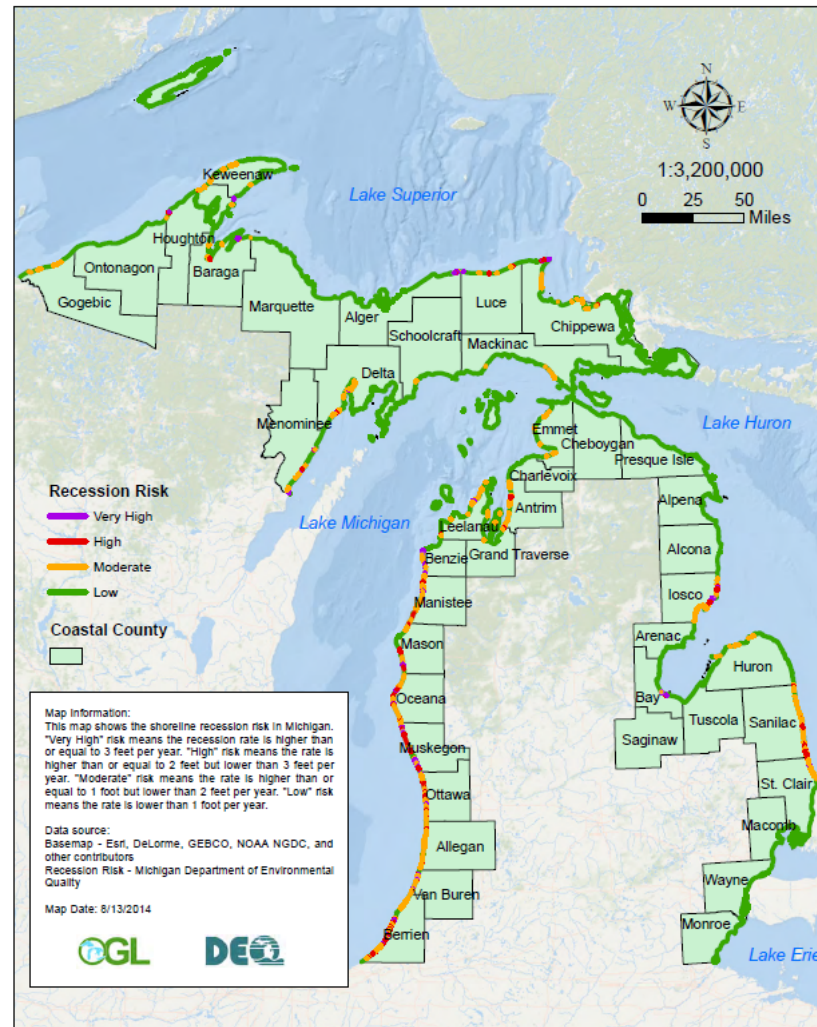
Lake levels partially control the Great Lakes coastal dynamics, which can negatively impact communities primarily through soil erosion and flooding. Although the lake levels are

currently relatively high (2018), there are also long periods of time when lake levels are lower, allowing for the formation of more dunes and beaches. Lake Michigan residents often seem to forget about higher water levels and develop in areas that are at a higher risk for flooding and coastal erosion because of the beautiful sandy beaches (Norton, David, Buckman, & Koman, 2018b). These natural fluctuations in lake level alone are reason to encourage communities to engage in coastal resiliency management practices. However, climate models project that these fluctuations will continue in the future and are likely to increase in intensity (Byun & Hamlet, 2018; Hayhoe, VanDorn, Croley, Schlegal, & Wuebbles, 2010; Pyror et al., 2014). Rising average temperatures cause less ice coverage on the Great Lakes, which leads to higher rates of evaporation. Climate change is also predicted to cause more extreme weather events which pose a risk for coastal communities. Leveraging social science insight to aid coastal communities in adapting to the diverse, dynamic systems in which they live can help better prepare them for a future of resilience under extreme climate change scenarios.

### **Challenges to Coastal Resilience**

Although federal and state agencies and programs, such as the Coastal Zone Management Program established by Coastal Zone Management Act of 1972, exist to generally guide coastal management in Michigan, these institutions do not act as active regulatory bodies (Norton et al., 2018b). As a result, Michigan's coastal communities have the jurisdictional responsibility of preparing for an uncertain future under climate change. The few legal regulations that exist include the High Risk Erosion Area program (HREA), the Ordinary High Water Mark (OHWM), and the Public Trust Doctrine (Norton, Meadows, & Meadows, 2011a). The HREA designates coastal areas as "high risk" that are receding more than a foot per year, over a minimum of 15 years. These areas have an additional permitting process and regulatory standards enforced by the Michigan Department of Environment, Great Lakes, and Energy (EGLE, formally (MDEQ).

Currently 6.1% of Michigan's coastline falls under the "high risk" designation. In Michigan, the coast of Lake Michigan has the highest risk of coastal recession compared to any other Great Lakes shorelines (Figure 1).



**Figure 1.** Map of shoreline recession risk in Michigan (from Section 309 Assessment and Five-Year Strategy for Coastal Zone management Enhancement Fiscal Years 2016-2020).

The OHWM, updated in 1985 to 581.5' elevation on Lake Michigan by the U.S. Army Corps of Engineers, dictates the elevation at which a permit is required for construction, such as dredging, seawalls, revetments, and other structures. Lastly, the Public Trust Doctrine, upheld by the Michigan Supreme Court in *Glass vs. Goeckel*, ensures that the state of Michigan is a trustee

for the public and protects the land from the water's edge to the OHWM for public use.

Regulating the public trust area under the OHWM and Public Trust Doctrine is complicated because of the natural fluctuations in lake levels and continuous shoreline erosion (Norton, Meadows, & Meadows, 2011b).

### **Mitigation vs. Adaptation**

There are currently two options decision-makers can choose from when determining the best course of action to reduce impact from environmental issues, such as coastal risk: mitigation or adaptation. Mitigation refers to creating actions of plans, often involving technological changes, that actively decrease harmful activities or processes (Portman, 2016). However, these coastal dynamic trends are arguably inevitable, regardless of climate change, which negates the benefits of mitigation policy (Arbogast et al., 2002). Furthermore, while people may agree it is necessary to change one's lifestyle, few are actually willing to engage in actions required by mitigation strategies (Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006).

On the other hand, adaptation is focused on "actions taken to prepare for and adjust to new conditions to reduce harm and take advantage of new opportunities" (Portman 2016). In general, adaptation strategies contribute to a community's overall resilience to environmental issues. Because it is difficult to predict future coastal dynamic trends, building up a community's resilience to better deal with unexpected events is critical (Tompkins, Adger, & Adger, 2004).

While agencies, such as the Coastal Zone Management Program (CZMP), or the Michigan Hazard Mitigation Plan (MHMP), or programs, such as the high-risk erosion program with CZMP, exist to generally guide management, neither of these institutions establish regulations or requirements for managing the Great Lakes coastal region (Norton et al., 2018b). Therefore, the responsibility for preparing for an uncertain future falls onto 318 townships, cities, and villages along Lake Michigan (Norton et al., 2018a). Community leaders are only beginning

to use adaptive approaches deal with the projected impacts climate change (Stults & Larsen, 2018). Communities need robust information and effective resiliency techniques if they hope to achieve sustainability goals. There is certainly a need to understand community members' perceptions of coastal risk because they are ultimately the actors who make resilient policy decisions (Norton et al., 2018b). If we can understand community members' perceptions of risks and motivations for stewardship, we can determine the best approaches to assist communities with educational or capacity and training needs that are lacking in coastal resiliency policy (Feltman, Norris, & Batanian, 2017). Therefore, it is important to understand stakeholders' perceptions of risk and motivations for stewardship of these coastal habitats, and the implications for coastal resiliency policy.

This research is part of a community-engaged scholarship effort conducted in partnership with the Michigan Coastal Resiliency Team (CRT). Together with the Michigan Department of Natural Resources (MDNR), Office of the Great Lakes (OGL), Coastal Zone Management Program (CZMP), Michigan Association of Planning (MAP), University of Michigan (UM), Michigan Technological University, Michigan Environmental Council, Michigan Sea Grant (MSG), and Michigan State University Extension, the CRT aims at providing coastal communities with information and methods to improve resiliency.

## **Risk Perception**

There are two leading theories used to explain risk perception, the Cultural Theory of risk and the psychometric model (Sjoberg, 2000). The Cultural Theory, originally proposed by (Douglas & Wildavsky, 1983), suggests that risk perception is heavily influenced by the social context in which individuals find themselves. The theory describes four types of people (egalitarian, individualistic, hierarchic, and fatalistic) who differ based on their concern for types of hazards (Dake, 1991). Egalitarians are concerned with technology and the environment,

individualists focus on war and the economy, hierarchists care most about law and order, while fatalists care about none of the previously mentioned topics (Sjoberg, 2000). While extremely influential, Sjoberg (2000) notes that this theory is generally lacking in empirical evidence and the scales and concern measurements only explained about 5-10% of the variance.

On the other hand, the psychometric model argues that risk perceptions are based on the individual factors of the risks themselves. This model focuses on three exploratory factors to study risk: dread, “new-old”, and number of exposed individuals (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1978). Fischhoff et al. (1978) studied women voters and their spouses, and found that activities associated with the higher levels of dread and negative consequences were in most need of risk reduction. “New-old” refers to the finding that higher levels of risk are more tolerated for “old, voluntary activities with well-known and immediate consequences.” Fischhoff et al. (1978) also suggest that higher level of risk perception is positively related to the number of people who are potentially at risk. Sjoberg & Drottz-Sjoberg (1993) also argue that there is a fourth factor, morality, that is missing from risk perception research. However, morality can be thought of as a factor that influences and individual’s risk perception instead of a characteristic of the risk itself (Slimak & Dietz, 2006). The psychometric model also includes factors such as perceived behavioral control and knowledge about a risk, as well as attitudes towards risk management. The quantitative nature of this model allows for comparisons between different risks as well as different participant groups.

Although the psychometric model was originally used in markets and cost-benefit analysis, many studies have used it to explain risk perceptions of natural hazards. Applications in flood risk research suggest that exposure to the risk and cultural differences influence flood risk perception (Kellens, Terpstra, & De Maeyer, 2013). Specifically, individuals who have been previously exposed to flooding seem to be less willing to adopt mitigation policies than the

general public (Ho, Shaw, Lin, & Chiu, 2008; Lin, Shaw, & Ho, 2008). In their study comparing different types of risk, Ho et al. (2008) found that while perceived control over landslides mitigated the risk perception, the opposite was true for flood victims. The authors suggest this is due to the financial cost that is more difficult to mitigate, while landslides usually result in human death which is easier to avoid.

Although the psychometric model has its limitations (Sjoberg, 2000), I use it to explore the characteristics of the risks themselves, rather than the social contexts that may form risk perceptions. My research is also focused on perceived risk rather than assessed risk, as it is an individual's risk perception that actually influences their behavior (Slovic, 1987). (Kettle & Dow, 2014) point out that the "nature and magnitude of the perceived risk" influences individual's actions to reduce risk. Understanding community members' perceptions of risk is important to mitigate environmental hazards because people act on their perceptions, rather than the objective, quantifiable risk itself.

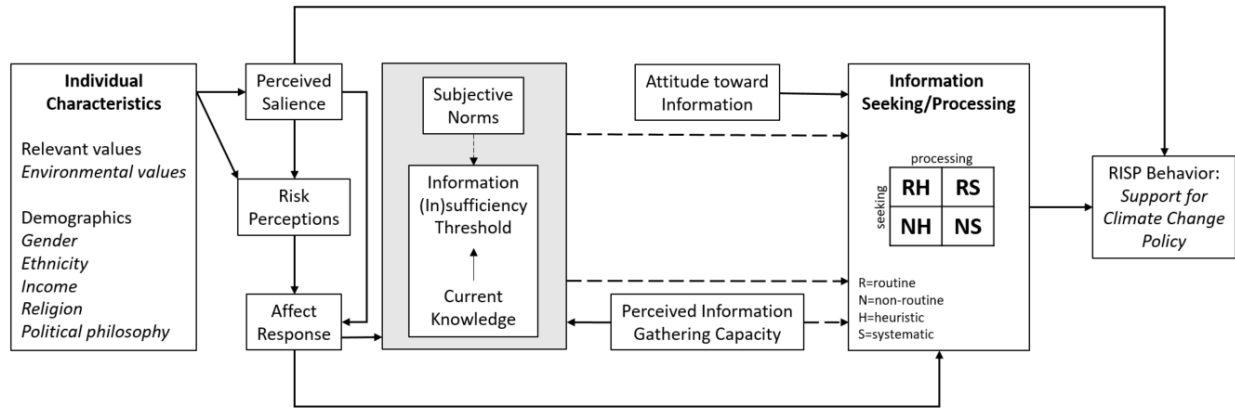
### **Values-Beliefs-Norms Theory**

Resilience is often thought of in the context of social-ecological systems. Social-ecological systems are based on the assumption that human behavior and social structures are directly related to natural systems and the two should not be thought of separate entities (Folke, 2006; Folke, Biggs, Norstrom, Reyers, & Rockstrom, 2016). In hazard research, resilience refers to the ability of a community to respond to and deal with environmental hazards, including "the capacity to reduce or avoid losses, contain effects of disasters, and recover with minimum social disruptions" (Cutter et al., 2008). Cutter et al. (2008) suggest six indicators to measure community resilience: ecological, social, economic, institutional, infrastructure, and community competence.

Enhancing a coastal community's resilience capacity will help ensure the community will be sustained in the future, especially with the uncertainty of environmental change on the Great Lakes. Relating community members' perceptions of coastal risk to resilience policy (as a proxy for behavior) will provide us with more insight for this area of study. The value-belief-norm theory (VBN) suggests that individual's values and beliefs can help explain individual's actions and behaviors (P. C. Stern, 2000; P. Stern et al., 1999; Stern, Paul C., Dietz, 1994). For example, those whose values align with pro-environmental values, form beliefs about the environment, and those beliefs lead to norms about taking action to reduce threats to the environment. For the purposes of this research, risk is measured by community member's perceptions of risk characteristics. Risk perception can be thought of as the belief, while participating in resilience programs or policies can be thought of as the action or behavior. The VBN theory connects coastal risk perceptions to behaviors, such as creating policy that increases community resilience.

### **Risk Information Seeking and Processing Framework**

The questionnaire was developed based on risk and resilience concepts, as well as the Risk Information Seeking and Processing (RISP) framework (Appendix B). The RISP framework, developed by Griffin et al. (1999), combines the Heuristic Systematic Model (HSM) and the Theory of Planned Behavior (TPB) to attempt to explain how people come to seek and attend information, and resulting risk-related behaviors. HSM focuses on three factors, information sufficiency, perceived information gathering capacity, and relevant channel beliefs that are driven by individual characteristics to explain information seeking and processing (Figure 2).



**Figure 2.** Risk Information Seeking and Processing model, adapted from Yang et al. 2014 and Griffin et al. 1999. Dotted arrows represent theorized causal relationship that were not supported by Yang et al. (2014) who applied the RISP model to climate change mitigation policy.

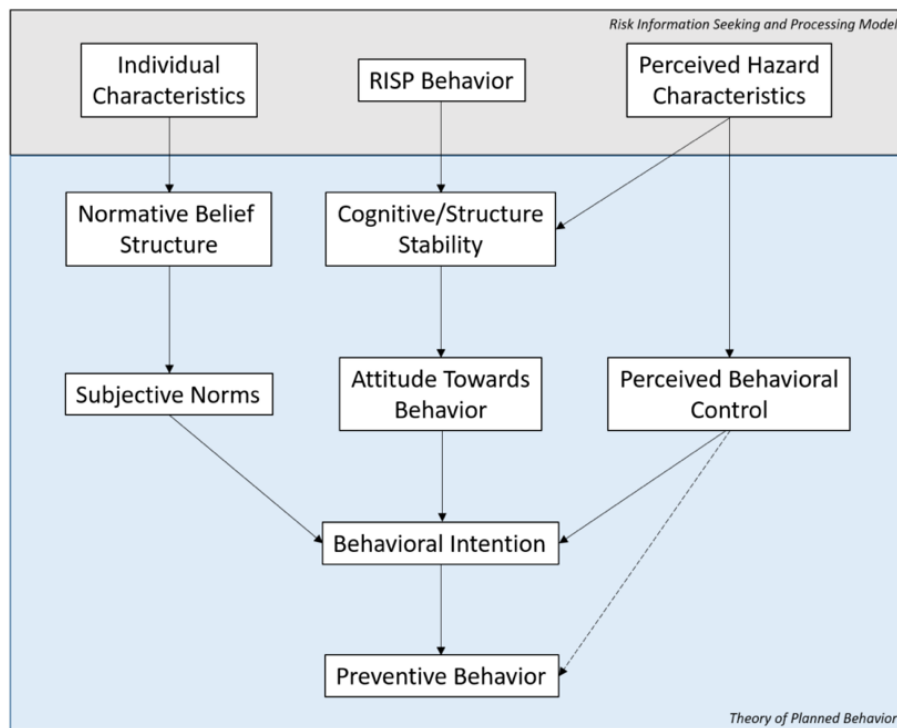
Information gathering capacity is a measurement of how much an individual can seek and process information about risk. Research suggests that individuals with higher information gathering capacity are better able to understand and seek out information about risk, and therefore process risk systematically rather than heuristically (ter Huurne, Griffin, & Gutteling, 2009; Yang & Kahlor, 2013). Informational subjective norms are the perceived social normative influences that dictate how much an individual should know about an issue. In other words, those who perceive more social pressure to be knowledgeable about issues, such as coastal risk, will believe they need to know more about the issue, and are therefore more likely to process information systematically rather than heuristically. (Griffin, Dunwoody, & Neuwirth, 1999) suggest that one's demographic characteristics and political party affiliation dictate one's subjective norms about environmental issues. However, (Yang et al., 2014) found no causal relationship between perceived information gathering capacity and systematic processing. Individual characteristics are described as environmental values (Yang et al. 2014), relevant hazard experience, and demographics. In their reappraisal of the RISP model, Griffin et al.

(2012) suggest that gender, ethnicity, income, political party affiliation, and religion are the most important demographic factors.

These individual characteristics impact “perceived hazard characteristics,” which then lead to an “affective response.” Griffin et al. (1999) list seven different perceived hazard characteristics that address estimates and assessments of risk, level of personal control, and trust in management. However, in their paper relating the RISP model to climate change policy, Yang et al. (2014) suggest that “perceived salience,” or the likelihood of an individual to attend to relevant or important issues, is more applicable to climate change policy. The authors find that perceived salience and individual characteristics influence risk perceptions, which in turn impact an individual’s affect response. The model predicts that positive moods and emotions about an issue lead one to process information heuristically, while negative moods and emotions lead to systematic processing. However, studies suggest that extreme negative moods and emotions lead to heuristic processing.

The RISP model attempts to provide an explanation for why some information is processed heuristically, which requires less cognitive effort and resources, and why other information is processed systematically, requiring more comprehensive effort to analyze and understand an issue. One’s subjective norms, which are the perceived social normative influences that dictate how much an individual should know about an issue, influence both the information sufficiency threshold and information processing. In other words, those who perceive more social pressure to be knowledgeable about issues, such as climate change, will believe they need to know more about the issue, and are therefore more likely to process information systematically rather than heuristically. Griffin et al. (1999) suggest that one’s demographic characteristics and political party affiliation dictate one’s subjective norms.

However, Yang et al. (2014) found no causal relationship between perceived information gathering capacity and systematic.

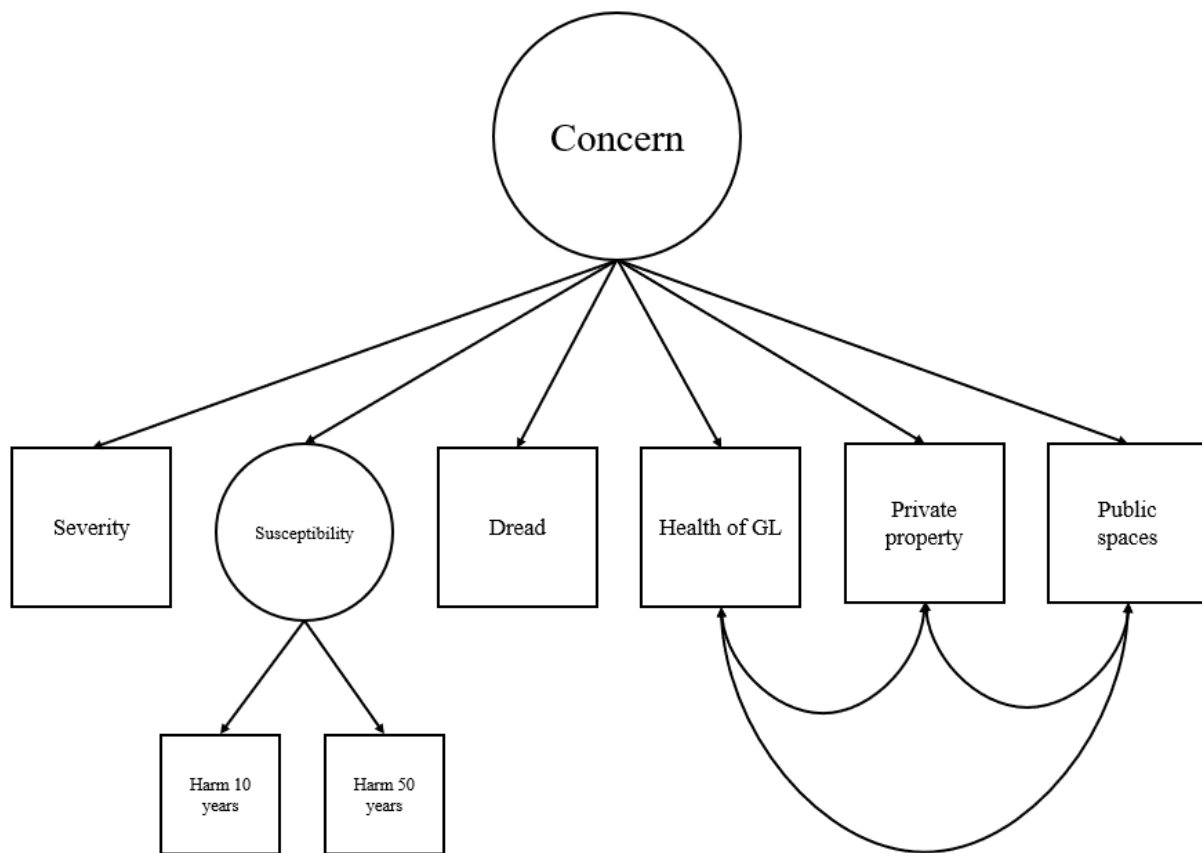


**Figure 3.** The Risk Seeking Information and Processing model as a precursor to the Theory of Planned Behavior, adapted from Griffin et al. 1999. Variables in the blue box are part of the Theory of Planned Behavior, variables in the grey box are part of the RISP framework.

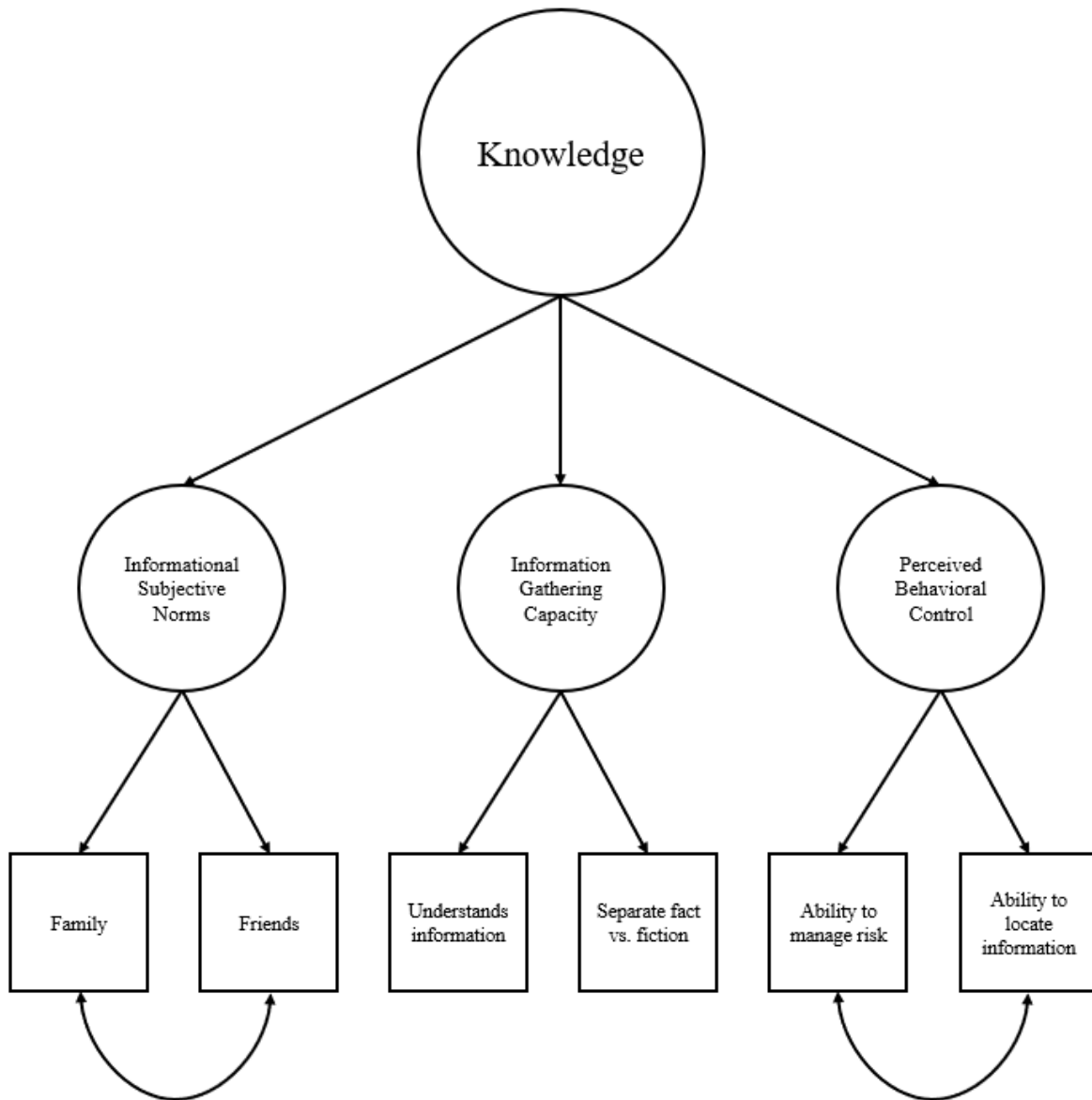
The Theory of Planned Behavior, or the idea that all behaviors are completely voluntary, is also incorporated into the RISP model (Figure 3). One's attitude toward performing a behavior is influenced by salient behavioral beliefs that are weighed against each other. For example, if an individual's attitude towards climate change information is positive, then one would expect that individual to process policy information systematically, rather than heuristically.

The RISP model is a useful tool to investigate the connection between coastal communities' perceptions of risk and climate change policy. Using constructs from the RISP model and the Values-Beliefs-Norms theory will allow for comparison within and between coastal communities on Lake Michigan. In this research I explore constructs of risk, namely

“Concern” and self-reported “Knowledge.” Constructs of severity, susceptibility, dread, and concern for the health of the Great Lakes, private property, and public spaces were closely related and therefore grouped into the general category of “Concern” (Figure 4). The constructs of informational subjective norms, information gathering capacity, and perceived behavioral control were grouped into the category self-reported “Knowledge” as a facet of risk perception (Figure 5).



**Figure 4.** Conceptual mode of "Concern" as a facet of risk perception.



**Figure 5.** Conceptual model of self-reported "Knowledge" as a facet of risk perception.

## Research Questions

The research questions are:

1. What are the differences in perceptions of coastal risks and hazards in Lake Michigan communities?
  - a. What factors influence concern for coastal risks and hazards in Lake Michigan communities?
  - b. What factors influence self-reported knowledge of coastal risks and hazards in Lake Michigan communities?
2. What are Lake Michigan stakeholders' motivations for coastal habitat stewardship?
  - a. What community characteristics and socio-demographic factors predict motivation for coastal habitat stewardship?
  - b. What factors of coastal risk perception (e.g., concern, self-reported knowledge) predict motivation for coastal habitat stewardship?

## **CHAPTER 2:**

### **METHODS**

#### **Study Sample**

Coastal communities were identified based on their county, population size, shoreline type, and level of active coastal resilience policies or practices. I determined the level of coastal resilience policies or practices based on prior interventions since 2016 by Resilient Michigan or by presence of policies or programs that reflected obvious prioritization of coastal resilience. Resilient Michigan is an organization funded by the Coastal Zone Management Program that has taken a community-engaged approach to helping Michigan communities update their master plans with a focus on coastal resilience. Three Michigan counties met these criteria and were selected to represent the diversity of communities on Lake Michigan. A total of 8 communities were chosen (Table 1). The counties were Allegan County, Ottawa County, and Muskegon County. In Allegan County, I surveyed City of Douglas, Saugatuck City, and Saugatuck Township. In Ottawa County I surveyed Ferrysburg City, Grand Haven City, and Grand Haven Charter Township. In Muskegon County I surveyed City of Muskegon and City of Norton Shores. Allegan County was considered a county with small population sizes, communities in Ottawa County had mixed population sizes, and communities in Muskegon County had large population sizes. Grand Haven City, Grand Haven Charter Township, and City of Muskegon all had coastal resiliency policies or programs at the time of the study.

**Table 1.** Community matrix displaying community, county, county size type, total population, previous coastal resilience policy or program, and shoreline type.

| Community                    | County   | County Size Type | Total Population <sup>a</sup> | Resiliency Policy? | Shoreline Type <sup>b</sup> |
|------------------------------|----------|------------------|-------------------------------|--------------------|-----------------------------|
| City of Ferrysburg           | Ottawa   | Mixed            | 2,992                         | No                 | HD                          |
| Grand Haven City             | Ottawa   | Mixed            | 10,929                        | Yes                | HD/HB                       |
| Grand Haven Charter Township | Ottawa   | Mixed            | 16,266                        | Yes                | HD/HB                       |
| City of Douglas              | Allegan  | Small            | 993                           | No                 | HB                          |
| Saugatuck City               | Allegan  | Small            | 915                           | No                 | HB                          |
| Saugatuck Township           | Allegan  | Small            | 3,113                         | No                 | HB                          |
| City of Muskegon             | Muskegon | Large            | 38,131                        | Yes                | HD                          |
| City of Norton Shores        | Muskegon | Large            | 23,994                        | No                 | HD                          |

<sup>a</sup>data from American Community Survey (5-year estimates, 2013-2017) conducted by the U.S. Census Bureau

<sup>b</sup>HD = high dunes; HB = high bluffs; HD/HB = high dunes and high bluffs

I identified four strata for my sampling frame. The four categories are: (1) “Lake Residents” who are people who own land parcels immediately adjacent to Lake Michigan, (2) “Near-lake Residents” who were people who own land parcels within a quarter-mile from Lake Michigan, not including Lake Residents, (3) “Inland Residents” who were people who own land parcels more than a quarter-mile from Lake Michigan, and (4) “Municipal Officials” who were both elected and appointed municipal officials and staff people. Although people who were only part-time residents or simply owned property on the coast were included in the survey, for the purposes of this thesis they are all termed “residents.” Municipal officials were identified based on their position in the community and how directly they worked with issues related to coastal resilience. Municipal officials include, but are not limited to, members of the Planning Commission, Zoning Board, and Parks and Recreation Board. The first three categories were established based on interest from agency partners, who hypothesized that there would be

differences in risk perception between Lake, Near-lake, and Inland Residents. I was also interested in looking at potential differences between the first three categories compared to municipal officials who ultimately have decision-making power.

The contact information for Lake, Near-lake, and Inland Residents was obtained through the relevant county Geographic Information System (GIS) service's department. ArcGIS was then utilized to determine residents who owned land parcels on the lake, a quarter-mile from the lake, and more than a quarter-mile from the lake. Necessary survey sample sizes were based on the total number of residents in each community. A total of 8420 survey invitations were mailed to the three counties (Appendix A). A four-wave tailored design methodology was used for data collection (Dillman, 2009). Lake, Near-lake, and Inland Residents were mailed four invitations (letter, postcard, letter, postcard) to participate in the online Qualtrics survey. The invitation included an explanation of the study, a link to the survey, an individual code to ensure participants only completed the survey once and to make sure I could identify responses by resident type, and relevant contact information (Appendix F). The survey invitation materials were altered slightly for Muskegon County due to explicitly mention participants could take the survey over the phone and to clarify who to contact with questions (Appendix G). I expected a response rate of about 40% for the email-based invitation (Greenlaw & Brown-welty, 2009) and a response rate of about 10-12% for the mailed invitations (Dykema, Stevenson, Klein, Kim, & Day, 2013; Kaplowitz, Lupi, Couper, & Thorp, 2012). I received 924 total responses for a response rate of 11.0%

To reach the appropriate municipal officials, invitations to participate in the online survey were emailed (Appendix H). In Ottawa County, a community contact voluntarily emailed county listservs to the appropriate officials and staff people. In Allegan County and Muskegon County,

officials were emailed individually, and administrative assistants were also asked to further distribute the invitation to relevant officials and staff people.

This study was approved and determined as exempt by The Michigan State University Institutional Review Board on October 22, 2018 (STUDY00001557) (Appendix E). Allegan and Ottawa County residents were contacted from December 6, 2018 to December 28, 2018. Allegan and Ottawa County municipal officials were contacted from December 12, 2018 to December 20, 2018. Muskegon County residents were contacted from April 2, 2019 to April 30, 2019. Muskegon County municipal officials were contacted from April 26, 2019 to June 2, 2019. The delay in contacting Muskegon County was due to logistical issues.

### **Survey Design**

I asked participants questions related to environmental coastal risk to better understand how and why community residents form their risk perceptions (Sjoberg, 2000) (Table 2). For the purposes of this predominantly exploratory study, environmental coastal risk was not explicitly defined in order to keep participant responses as unbiased as possible. First, I asked participants to indicate perceived levels of severity, susceptibility, and dread about coastal risk (Yang, Rickard, Harrison, & Seo, 2014). To measure severity, I asked participants to indicate how serious they think coastal risks are to their community. Severity was measured on a 5-point Likert-type scale from 1 (not at all serious) to 5 (very serious). To measure susceptibility, I asked participants to indicate how much they think coastal risks will harm their local community in the next ten and 50 years. Susceptibility was measured on a 5-point Likert-type scale from 1 (not at all susceptible) to 5 (extremely susceptible). To measure dread, I asked participants to indicate how much information about coastal risks makes them feel worried. Dread was measured on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree).

**Table 2.** Constructs describing different facets of risk perception, the mean response, and standard deviation for the Combined Model.

| Model     | Construct                      | Description                                                                           | Mean | SD   |
|-----------|--------------------------------|---------------------------------------------------------------------------------------|------|------|
| Concern   | Severity                       | How serious of a threat are coastal risks to your community?                          | 3.43 | 1.13 |
|           | Susceptibility                 | How much do you think coastal risks will harm your community in the next TEN years?   | 3.13 | 1.11 |
|           |                                | How much do you think coastal risks will harm your community in the next FIFTY years? | 3.77 | 1.19 |
|           | Dread                          | How worried do you feel about coastal risks?                                          | 3.44 | 1.26 |
|           | Stewardship                    | How concerned are you about the health of your community's shoreline?                 | 3.80 | 1.07 |
|           |                                | How concerned are you that coastal risks could affect private property?               | 3.19 | 1.35 |
|           |                                | How concerned are you that coastal risks could affect public spaces?                  | 3.64 | 1.17 |
| Knowledge | Information gathering capacity | I understand information about coastal risk.                                          | 3.99 | 0.96 |
|           |                                | When it comes to information about coastal risk, I can separate facts from fiction.   | 4.05 | 0.97 |
|           | Informational subjective norms | My family expects that I know something about coastal risk.                           | 3.68 | 1.07 |
|           |                                | My friends expect that I know something about coastal risk.                           | 3.60 | 1.02 |
|           | Perceived behavioral control   | I can easily locate information about coastal risk.                                   | 3.36 | 1.15 |
|           |                                | I am personally able to take action to manage coastal risk.                           | 2.63 | 1.17 |

I also asked participants about characteristics that influence risk perceptions, such as information gathering capacity, informational subjective norms, and perceived behavioral control (Table 2). Information gathering capacity was measured using two items on 5-point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree), in which participants were asked to indicate how much they understand information about coastal risk and how much they feel

they can separate facts from fiction. Informational subjective norms were also measured using two items on 5-point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree), in which participants were asked to indicate how much their family and how much their friends expect them to know something about coastal risks. Perceived behavioral control was measured using two items on 5-point Likert-type scales ranging from 1 (strongly disagree) to 5 (strongly agree), in which participants were asked to indicate how easily they can locate information about coastal risk and how able there are to take action to manage coastal risk.

To understand motivations for coastal habitat stewardship, I asked participants several questions that measured their levels of concern about the health of the Great Lakes coastal region (Table 2). I also asked participants if they have even been involved in a program or organization whose primary goal was Great Lakes coastal zone management (Table 3). Participants were given several involvement options and were asked to mark all that applied. I also asked participants to list any programs or organizations and briefly explain why they become involved.

**Table 3.** Number and frequency of respondents who said they were involved in a program or organization whose focus is on Great Lakes habitat preservation, conservation, or management.

|     | Pooled      | Allegan County | Ottawa County | Muskegon County |
|-----|-------------|----------------|---------------|-----------------|
| Yes | 307 (35.2%) | 100 (38.7%)    | 142 (33.7%)   | 57 (34.7%)      |
| No  | 565 (64.8%) | 140 (61.3%)    | 278 (66.3%)   | 132 (65.3%)     |

Finally, participants were asked to self-report socio-demographic information, including: race and ethnicity, highest level of education, annual income before taxes, birth year, gender, and zip code (Table 4). Participants were also asked about their resident status (full-time, part-time, visitor, or other), what best describes their resident location (lake-front property, private beach access but not lake-front property, or neither), and how long they or their family has owned property in their coastal community. Previous experiences have been shown to impact risk perception, so I asked participants if they had experienced the following events in the last five

years: coastal flooding, inland flooding, coastal erosion, severe storm events (Melillo, Richmond, & Yohe, 2014; Owens & Driffill, 2008; Weber, 2011). Participants were also asked to estimate how many times they have experienced any of the previously mentioned events in the last five years.

**Table 4.** Socio-demographic variables hypothesized to predict an individual's risk perceptions. Descriptive statistics displaying mean ( $\bar{x}$ ) or frequency of respondents in each category with range or standard deviation (s) in parentheses.

| Variable name              | Measurement                                                                             | Descriptive statistics       |
|----------------------------|-----------------------------------------------------------------------------------------|------------------------------|
| Age                        | Continuous (centered)                                                                   | $\bar{x}$ =60.87 (19-91)     |
| Previous experiences       | Continuous                                                                              | $\bar{x}$ =3.11 (0-111)      |
| Property ownership time    | Ordinal                                                                                 | $\bar{x}$ =3.33 ( $s$ =1.38) |
|                            | 1 (< 5 years)                                                                           |                              |
|                            | 2 (6-10 years)                                                                          |                              |
|                            | 3 (11-20 years)                                                                         |                              |
|                            | 4 (21-49 years)                                                                         |                              |
|                            | 5 (> 50 years)                                                                          |                              |
| Income                     | Ordinal                                                                                 | $\bar{x}$ =5.04 ( $s$ =1.27) |
|                            | 1 (< \$20,000)                                                                          |                              |
|                            | 2 (\$20,000 ≤ income ≤ \$34,999)                                                        |                              |
|                            | 3 (\$35,000 ≤ income ≤ \$49,999)                                                        |                              |
|                            | 4 (\$50,000 ≤ income ≤ \$74,999)                                                        |                              |
|                            | 5 (\$75,000 ≤ income ≤ \$99,999)                                                        |                              |
|                            | 6 (> \$100,000)                                                                         |                              |
| Year-round resident        | 1 if year-round; 0 if not year-round                                                    | 73.29%                       |
| Resiliency policy          | 1 if community has a resiliency policy or program; 0 if no resiliency policy or program | 57.63%                       |
| Gender                     | 1 if male; 0 if non-male                                                                | 59.62%                       |
| <i>Education</i>           |                                                                                         |                              |
| Associate's degree or less | 1 if high school degree, Associate's degree, or some college                            | 18.34%                       |
| Bachelor's degree          | 1 if Bachelor's degree                                                                  | 37.13%                       |
| Graduate degree (ref.)     | 1 if Master's degree or higher                                                          | 44.53%                       |
| <i>County size</i>         |                                                                                         |                              |
| Small (ref.)               | 1 if resident of Allegan County (small)                                                 | 26.60%                       |
| Mixed                      | 1 if resident of Ottawa County (mixed)                                                  | 50.86%                       |
| Large                      | 1 if resident of Muskegon County (large)                                                | 22.54 %                      |
| <i>Resident location</i>   |                                                                                         |                              |
| Lake (ref.)                | 1 if lake-front property                                                                | 17.13%                       |
| Near-lake                  | 1 if 0.25 miles from Lake Michigan                                                      | 25.99%                       |
| Inland                     | 1 if more than 0.25 miles from Lake Michigan                                            | 51.07%                       |
| Municipal officials        | 1 if municipal official or staff                                                        | 5.81%                        |

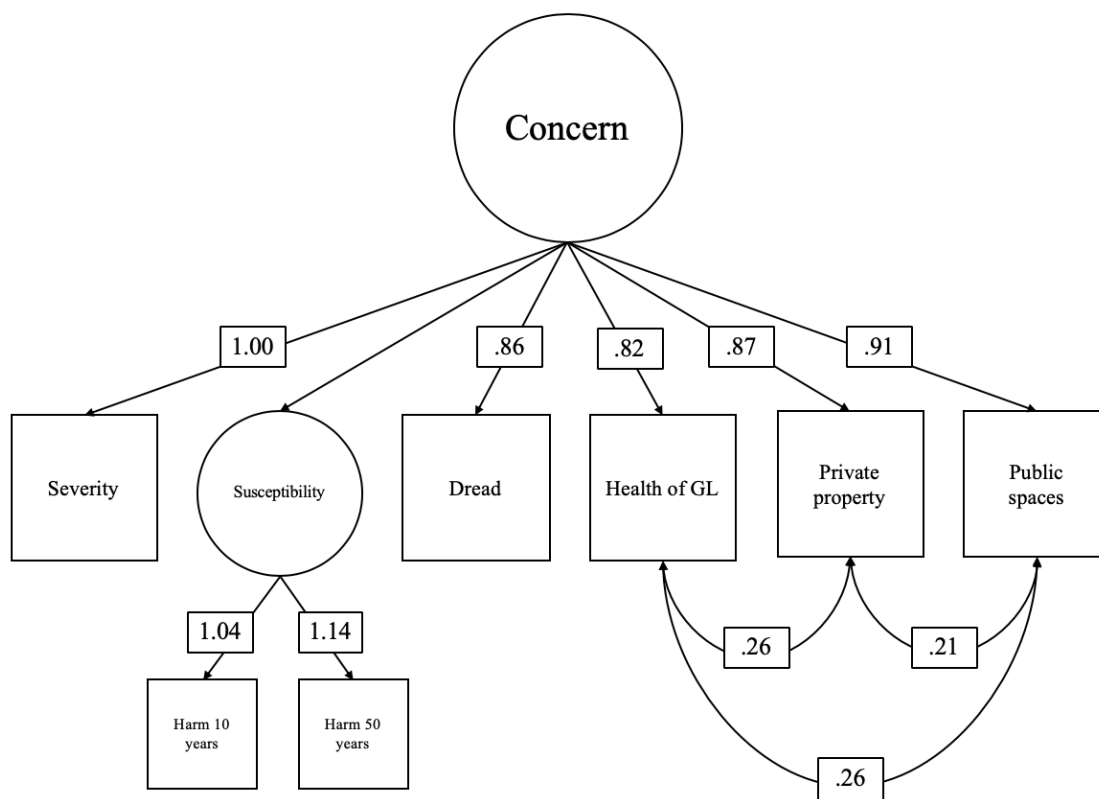


## Analysis

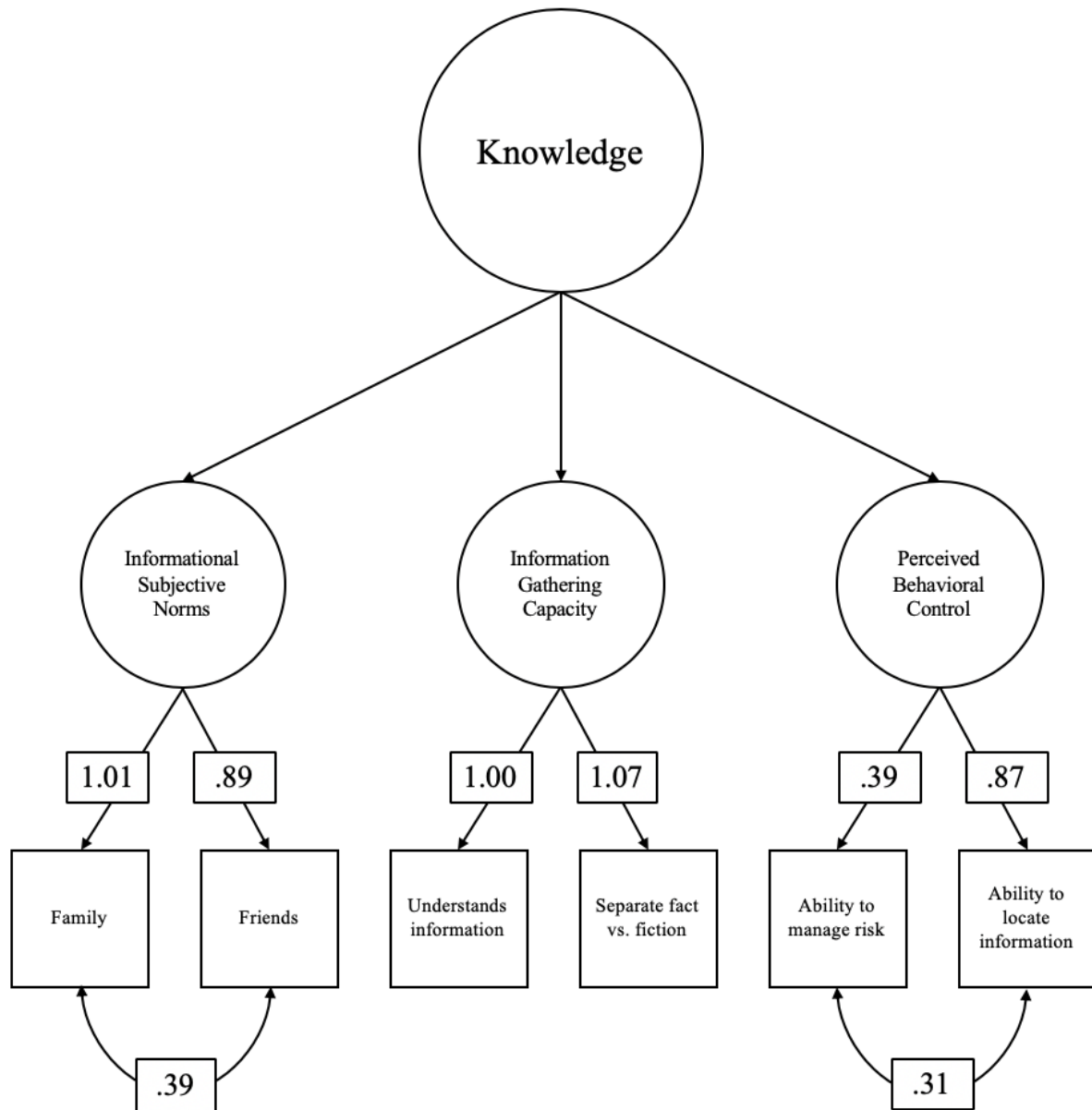
*Research Question #1: What are the differences in perceptions of coastal risks and hazards in Lake Michigan communities?*

Descriptive statistics were measured for the seven different environmental coastal issues under climate change and for questions related to governance. One-way analyses of variance (ANOVA) were first used to determine appropriate reference categories and for data reduction. A Tukey post-hoc test was conducted to determine the individual differences between counties (proxy for county size categories), resident types (lake, near-lake, inland, and municipal officials), and education levels. A two-way analysis of variance was also conducted to determine if there was an interaction between county and resident type, however there were no significant findings so the results are not included in this chapter.

Confirmatory factor analysis first using structural equation modeling and then a structural regression was conducted to understand differences in risk perception within and between Lake Michigan coastal communities. This method is appropriate because the observed variables are all facets of risk perception and reducing the data is much preferred for analysis and interpretation. A general model for one score of risk perception was attempted, but the model fit was not adequate. Therefore, one model was created based on variables related to concern about coastal risk (“Concern Model”) (Figure 6), while the other model was based on variables related to self-reported knowledge and behaviors about coastal risk (“Knowledge Model”) (Figure 7). A baseline model was created based on risk perception theory and was adjusted based on the goodness-of-fit statistics and modification indices (Table 5). All variables had factor loadings greater than .30 (Hair, Black, Babin, Anderson, & Tatham, 2006).



**Figure 6.** Conceptual model of "Concern" as a facet of risk perception with factor loadings.



**Figure 7.** Conceptual model of self-reported "Knowledge" as a facet of risk perception with factor loadings.

**Table 5.** Summary of goodness-of-fit statistics for baseline models and final structural models of Concern and Knowledge facets of risk perception.

| Model                              | $\chi^2$ | <i>df</i> | <i>p</i> | RMSEA (90%<br>CI, lower<br>bound) | CFI  | TLI  | SRMR |
|------------------------------------|----------|-----------|----------|-----------------------------------|------|------|------|
| Baseline CFA model (Concern)       | 238.32   | 14        | < .05    | .138 (.123)                       | .948 | .921 | .041 |
| Final structural model (Concern)   | 24.89    | 11        | < .05    | .039 (.018)                       | .997 | .994 | .013 |
| Baseline CFA model (Knowledge)     | 299.64   | 9         | < .05    | .187 (.169)                       | .857 | .761 | .083 |
| Final structural model (Knowledge) | 20.54    | 7         | < .05    | .046 (.024)                       | .993 | .986 | .019 |

CFA = confirmatory factor analysis; *df* = degrees of freedom; RMSEA = Steiger-Lind Root Mean Square Error of Approximation; CFI = Bentler Comparative Fit Index; TLI = Tucker Lewis Index; SRMR = standardized root mean square residual.

*Research Question #2: What are Lake Michigan stakeholders' motivations for coastal habitat stewardship?*

To better understand what factors predict whether or not individuals are involved in a program or organization focused on Great Lakes habitat stewardship, I used logistic regressions. Let *Y* represent whether or not participants are involved in a program or organization and let *X<sub>i</sub>* represent independent variables described in Table 4.

$$\text{logit}(Y_i) = \beta_0 + X_i\beta_i + \varepsilon_i$$

Analysis is broken into two parts: (1) Combined Model that combines all three counties and (2) county models that look at counties individually. For the Combined Model, logistic regressions were run to determine the effect of county characteristics (i.e. size and presence of resiliency policy), resident type (lake, near-lake, inland, municipal officials), and various socio-demographic factors. Four models were run to determine the effect of resident type, county characteristics, and various socio-demographic factors on Great Lakes habitat stewardship. Model 1 compared Lake Residents to the remaining three resident types (Near-lake, Inland, and Municipal Officials). Model 2 included a comparison between resident types, as well as the

existence of resiliency policy. Model 3 included county size. Model 4 included various socio-demographic factors. For the individual county models, logistic regressions were run to determine the effect of resident type and various socio-demographic factors. Model 1 is a comparison between Lake Residents and the remaining three residents, and Model 2 includes the various socio-demographic factors. For all models, factors predicting concern for coastal risk and self-reported knowledge of coastal risk were also used to determine the effect on program involvement. The Combined Model includes an additional model that investigates all potential factors influencing involvement in one logistic regression. Effect of shoreline type was also investigated but resulted in no significant findings, and is therefore removed from results. All analysis and descriptive statistics were conducted using statistical package Stata 14.2 and R 3.5.1.

To determine participants motivations for coastal habitat stewardship, I used emergent coding to look for common themes in responses to “What motivated you to become involved with the program(s) or organization(s) [whose main goal is Great Lakes coastal region management, conservation, or preservation]?” Through this method, codes are inductively determined, meaning they come from the response data rather than the literature or the researcher’s previous experiences (Miles & Huberman, 1994). This method is preferred for this type of research, as the motivations for stewardship of this specific area and system have not been previously studied. Participants’ responses could be coded into multiple categories, depending on their response and the range of topics they mentioned.

## CHAPTER 3:

### PERCEPTIONS OF COASTAL RISK

#### Results

##### *Environmental concerns*

In general, residents were more concerned about seven environmental concerns related to climate change in the next 50 years than in the next 10 years (Table 6, 7). Residents are most concerned about coastal erosion (3.84 (1.17)) and least concerned about increases in precipitation (2.72 (1.23)). Residents in all three counties also reported they are most concerned about coastal erosion and least concerned about increases in precipitation. In general, residents of Allegan County were more concerned about all seven risks than Ottawa or Muskegon County. For all risks and for all counties, the average concern for climate change risks was higher when asked about the next 50 years when compared to the next 10 years.

**Table 6.** Environmental concerns in 10 years. Mean responses from a 1 (not at all concerned) to 5 (extremely concerned) Likert-type-scale are displayed with standard deviations in parentheses. Highest average concerns are noted in bold.

|                                            | Combined<br>Model  | Allegan<br>County  | Ottawa<br>County   | Muskegon<br>County |
|--------------------------------------------|--------------------|--------------------|--------------------|--------------------|
| More frequent and severe storms            | 2.93 (1.28)        | 3.17 (1.25)        | 2.86 (1.26)        | 2.85 (1.34)        |
| Increases in precipitation                 | 2.72 (1.23)        | 3.05 (1.25)        | 2.58 (1.19)        | 2.68 (1.25)        |
| More precipitation as rain than<br>snow    | 2.82 (1.27)        | 3.15 (1.24)        | 2.76 (1.22)        | 2.65 (1.35)        |
| Reduced ice coverage on the Great<br>Lakes | 3.12 (1.32)        | 3.43 (1.27)        | 3.08 (1.27)        | 2.94 (1.39)        |
| More flooding events                       | 3.13 (1.30)        | 3.38 (1.25)        | 3.04 (1.28)        | 3.10 (1.34)        |
| Coastal erosion                            | <b>3.84 (1.17)</b> | <b>4.11 (1.07)</b> | <b>3.71 (1.22)</b> | <b>3.82 (1.11)</b> |
| Increases in extreme temperatures          | 3.29 (1.36)        | 3.50 (1.31)        | 3.21 (1.34)        | 3.27 (1.41)        |

**Table 7.** Environmental concerns in 50 years. Mean responses from a 1 (not at all concerned) to 5 (extremely concerned) Likert-type-scale are displayed with standard deviations in parentheses. Highest average concerns are noted in bold.

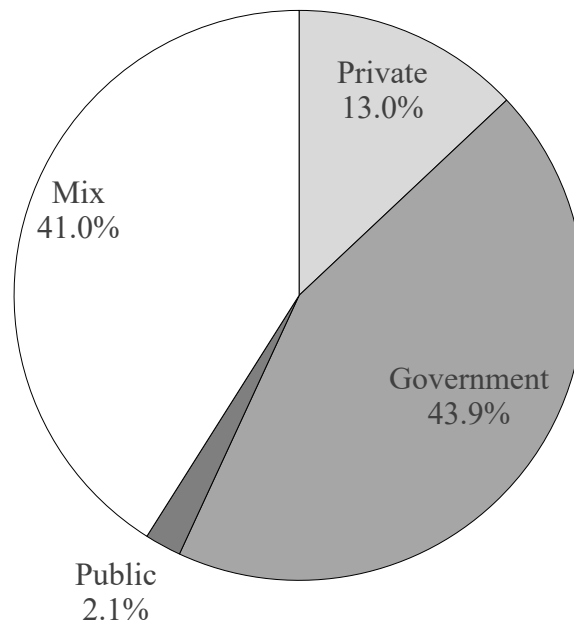
|                                            | Combined<br>Model  | Allegan<br>County  | Ottawa<br>County   | Muskegon<br>County |
|--------------------------------------------|--------------------|--------------------|--------------------|--------------------|
| More frequent and severe storms            | 3.29 (1.41)        | 3.61 (1.36)        | 3.22 (1.40)        | 3.18 (1.43)        |
| Increases in precipitation                 | 3.17 (1.39)        | 3.51 (1.36)        | 3.05 (1.37)        | 3.10 (1.42)        |
| More precipitation as rain than<br>snow    | 3.21 (1.39)        | 3.54 (1.35)        | 3.15 (1.37)        | 3.02 (1.44)        |
| Reduced ice coverage on the Great<br>Lakes | 3.42 (1.42)        | 3.73 (1.33)        | 3.37 (1.42)        | 3.24 (1.45)        |
| More flooding events                       | 3.48 (1.37)        | 3.73 (1.33)        | 3.42 (1.38)        | 3.39 (1.38)        |
| Coastal erosion                            | <b>3.94 (1.23)</b> | <b>4.20 (1.12)</b> | <b>3.83 (1.30)</b> | <b>3.90 (1.18)</b> |
| Increases in extreme temperatures          | 3.54 (1.43)        | 3.79 (1.35)        | 3.45 (1.45)        | 3.51 (1.41)        |

### *Governance*

Participants were asked who they think owns coastal shoreline and who they think is responsible for managing the coastal shoreline in their communities in a “mark all that apply” question (Figure 7, Figure 8). Their responses were grouped into four categories: (1) “Private” which included response options “you” and “your neighbor,” (2) “Government” which included response options “Local Government,” “State Government,” and “Federal Government,” (3) “Public” which included responses that mentioned “the general public” or “everyone” having ownership of the shoreline, and (4) “Mix” which included two or more of the categories previously listed.

Almost half of the mentions (43.9%) regarding ownership of coastal shoreline was either local, state, and/or federal government (Figure 8). This was closely followed by a mix of government, private landowners, or publicly owned shoreline (41.0%). Private landowners were mentioned 13.0% of the time and “the general public” was explicitly mentioned or alluded to 2.1% of the time. When broken down by Resident Types, Lake Residents indicated that they think a mix of private and government entities own the coastal shoreline (Table 8). While a majority Near-lake Residents, Inland Residents, and Municipal Officials said government owns

coastal shoreline. There were no significant differences between the four Resident Types ( $F(3,881)=1.06, p>.05$ ).



**Figure 8.** Response of the participants to the question of who owns coastal shoreline in their community (n=907).

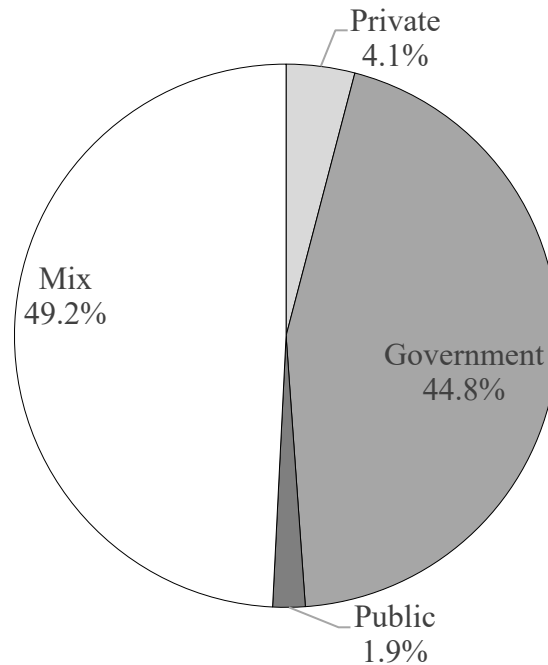
**Table 8.** Responses to the question "Who do you think owns coastal shoreline in your community?" broken down by Resident Type.

| Resident types      | Private | Government | Public | Mix   |
|---------------------|---------|------------|--------|-------|
| Lake Residents      | 26.0%   | 10.0%      | 2.0%   | 62.0% |
| Near-lake Residents | 14.5%   | 47.1%      | 2.7%   | 35.8% |
| Inland Residents    | 8.5%    | 53.6%      | 2.1%   | 35.9% |
| Municipal officials | 6.0%    | 52.0%      | 0.0%   | 42.0% |

"Private" included response options "you" and "your neighbor." "Government" included response options "Local Government," "State Government," and "Federal Government." "Public" included responses that mentioned "the general public" or "everyone" having ownership of the shoreline. "Mix" included two or more of the categories previously listed.

When asked who they think is responsible for managing coastal shoreline in their community, respondents said a mix of government, private landowners, or the general public 49.2% of the time (Figure 9). This was closely followed by either local, state, and/or federal

government (44.8%). Private landowners (“you” or “your neighbor”) was only mentioned 4.1% of the time and “the general public” was explicitly mentioned or alluded to 1.9% of the time. When broken down by Resident Type, all groups seemed to agree that either government or a mix are responsible for managing coastal shoreline (Table 9). There were no significant differences between the four Resident Types ( $F(3,881)=1.89, p>.05$ ).



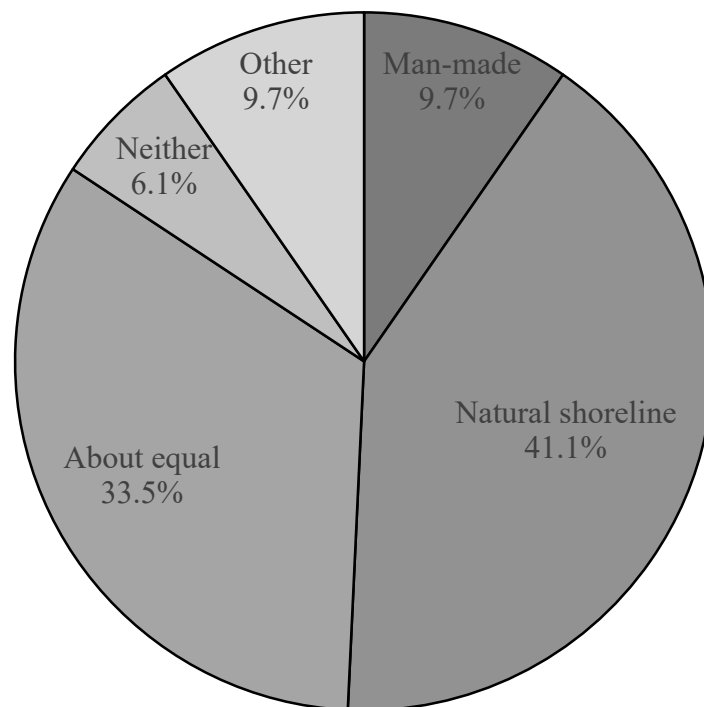
**Figure 9.** Response of the participants to the question of who is responsible for coastal shoreline in their community (n=919).

**Table 9.** Responses to the question "Who do you think is responsible for managing coastal shoreline in your community?" broken down by Resident Type.

| Resident types      | Private | Government | Public | Mix   |
|---------------------|---------|------------|--------|-------|
| Lake Residents      | 6.7%    | 34.0%      | 2.0%   | 57.3% |
| Near-lake Residents | 4.5%    | 42.4%      | 0.9%   | 52.2% |
| Inland Residents    | 3.4%    | 50.6%      | 2.5%   | 43.6% |
| Municipal officials | 1.9%    | 38.5%      | 1.9%   | 57.7% |

“Private” included response options “you” and “your neighbor.” “Government” included response options “Local Government,” “State Government,” and “Federal Government.” “Public” included responses that mentioned “the general public” or “everyone” having ownership of the shoreline. “Mix” included two or more of the categories previously listed.

Respondents were also asked what they think is the best way to manage a receding shoreline (Figure 10). A majority of respondents (41.1%) said a natural shoreline is the best way. This response was closely followed by those who said both a man-made and natural shoreline are about equal (33.5%). Only 9.7%% said they thought a man-made shoreline was the ideal management strategy. 6.1% of respondents said neither was an effective way to manage a receding shoreline. When responses are broken down by Resident Type, Lake Residents were split between man-made structures or man-made structures and natural structures being about equal (Table 10). Near-lake Residents, Inland Residents, and Municipal Officials all preferred natural structures over any of the other options. Lake Residents had significantly different preferences about management strategies compared to Inland Residents and Municipal Officials ( $F(3,881)=7.53, p<.001$ )



**Figure 10.** Response of the participants to the question of what is the best way to manage a receding shoreline (n=844).

**Table 10.** What is the best way to manage a receding shoreline? Frequency of response by Resident Type (Lake, Near-lake, Inland, and Municipal officials).

| <b>Resident types</b> | <b>Man-made</b> | <b>Natural</b> | <b>About equal</b> | <b>Neither</b> |
|-----------------------|-----------------|----------------|--------------------|----------------|
| Lake Residents        | 26.9%           | 33.7%          | 29.8%              | 9.6%           |
| Near-lake Residents   | 7.0%            | 48.7%          | 36.8%              | 7.6%           |
| Inland Residents      | 8.0%            | 46.9%          | 39.6%              | 5.4%           |
| Municipal officials   | 10.9%           | 50.0%          | 32.6%              | 6.5%           |

“Private” included response options “you” and “your neighbor.” “Government” included response options “Local Government,” “State Government,” and “Federal Government.” “Public” included responses that mentioned “the general public” or “everyone” having ownership of the shoreline. “Mix” included two or more of the categories previously listed.

#### *Comparisons between Counties, Resident Types, and Education Levels*

The results from the ANOVAs revealed that between counties, there was a significant difference in concern for severity of risks ( $F(2,855)=6.86$ ,  $p<.001$ ), harm in 10 years ( $F(2,851)=11.51$ ,  $p<.001$ ), harm in 50 years ( $F(2,828)=9.29$ ,  $p<.001$ ), dread ( $F(2,876)=7.05$ ,  $p<.001$ ), health of the Great Lakes ( $F(2,876)=7.65$ ,  $p<.001$ ), concern for public spaces ( $F(2,874)=8.40$ ,  $p<.001$ ). The results from the Tukey post-hoc tests suggest that there are no differences in risk perception between Ottawa and Muskegon Counties, therefore Allegan County is used as a reference group for remaining analyses. There was also a significant difference in concern for severity of risks ( $F(3,854)=6.94$ ,  $p<.001$ ), harm in 10 years ( $F(3,850)=4.96$ ,  $p<.01$ ), expectation from friends ( $F(3,872)=3.88$ ,  $p<.01$ ) and family ( $F(3,873)=8.99$ ,  $p<.001$ ), ability to personally manage risks ( $F(3,877)=3.61$ ,  $p<.05$ ), health of the Great Lakes ( $F(3,875)=4.77$ ,  $p<.01$ ), and concern for private property ( $F(3,870)=30.88$ ,  $p<.001$ ) between Resident Types. The results from the Tukey post-hoc tests revealed that Lake Residents are an appropriate reference group for remaining analyses. Lastly, respondents of different education levels also varied in their concern for severity of coastal risks ( $F(2,855)=7.75$ ,  $p<.001$ ), harm in 10 years ( $F(2,851)=4.61$ ,  $p<.01$ ) and 50 years ( $F(2,828)=6.29$ ,  $p<.01$ ), health of the Great Lakes ( $F(2,876)=3.15$ ,  $p<.05$ ), and concern for private property ( $F(2,871)=3.42$ ,  $p<.05$ ).

Respondents also had significantly different self-reported knowledge scores based on their highest level of education in their ability to separate fact from fiction ( $F(2,876)=4.77$ ,  $p<.01$ ) and expectations from their family ( $F(2,874)=4.69$ ,  $p<.01$ ). The results from the Tukey post-hoc tests suggest that respondents with graduate degrees should be the reference group for all following analyses.

#### *Facets of Risk Perception – Combined Model*

In general, Land Residents are less concerned about coastal risk than Lake Residents ( $\beta=-.45$ ,  $p<.001$ ) (Table 11). The results from the regression analysis also suggest that communities with resilience policies or programs in place are less concerned about coastal risk than their counterparts ( $\beta=-.28$ ,  $p<.01$ ). Furthermore, as the amount of experience with coastal hazards increased over the last five years, so too did respondents' concern about coastal risk ( $\beta=-.04$ ,  $p<.001$ ). Education levels also seemed to have an effect on concern about coastal risk. Both participants with less than an associate's degree ( $\beta=-.33$ ,  $p<.01$ ) and bachelor's degree ( $\beta=-.17$ ,  $p<.05$ ) were less concerned about coastal risk than those with a graduate degree. Males were also less concerned about coastal risk than females ( $\beta=-.34$ ,  $p<.001$ ). There was no significant difference in concern between counties (as a proxy for county size), amount of time respondents owned property in the coastal community, if they are a year-round resident or not, or respondents age.

In general, there were not many significant differences between or within communities' self-reported knowledge related to coastal risk and hazards. Regression analysis suggests that as previous experience with coastal risks increases, respondents' self-reported knowledge about coastal risk also increases ( $\beta=-.22$ ,  $p<.05$ ). It also appears that individuals with bachelor's degrees indicate less knowledge about coastal risk than those with graduate degrees ( $\beta=-.19$ ,  $p<.01$ ). The results from Model 3 suggest that Near-lake Residents ( $\beta=-.22$ ,  $p<.05$ ) and Inland

Residents ( $\beta=-.23$ ,  $p<.01$ ) are less knowledgeable about coastal risk than Lake Residents, however this trend disappears in the final model (Model 4). In the final model, there was no significant difference in knowledge about coastal risk between resident types, counties, amount of time individuals have owned property in a coastal community, year-round residents, income, gender, or age.

**Table 11.** Regression model of the final structural models for Concern (Model 1 and 2) and Knowledge (Model 3 and 4). Model 1 and 3 look at characteristics of the communities and counties, Model 2 and 4 include socio-demographic factors.

| Variables                               | Concern         |                 | Knowledge       |                 |
|-----------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                         | Model 1         | Model 2         | Model 3         | Model 4         |
| <i>County size (ref: Small)</i>         |                 |                 |                 |                 |
| Mixed                                   | -.09 (.11)      | -.03 (.12)      | .01 (.09)       | -.03 (.10)      |
| Large                                   | -.06 (.13)      | .04 (.14)       | .04 (.10)       | .00 (.12)       |
| <i>Resident location (ref: Lake)</i>    |                 |                 |                 |                 |
| Near-lake                               | -.27 (.11)*     | -.20 (.12)      | -.22 (.09)*     | -.10 (.11)      |
| Inland                                  | -.45 (.19)***   | -.32 (.12)**    | -.23 (.08)**    | -.15 (.10)      |
| Municipal officials                     | -.35 (.19)      | -.13 (.20)      | -.26 (.14)      | -.17 (.17)      |
| Resiliency policy                       | -.28 (.10)**    | -.32 (.10)**    | .06 (.08)       | .05 (.09)       |
| Previous experiences                    |                 | .04 (.01)***    |                 | .02 (.01)**     |
| Property ownership time                 |                 | -.03 (.03)      |                 | .04 (.02)       |
| Year-round resident                     |                 | -.16 (.09)      |                 | .10 (.08)       |
| <i>Education (ref: Graduate degree)</i> |                 |                 |                 |                 |
| Associate's degree or less              |                 | -.33 (.11)**    |                 | -.13 (.10)      |
| Bachelor's degree                       |                 | -.17 (.08)*     |                 | -.19 (.07)**    |
| Income                                  |                 | -.05 (.03)      |                 | .01 (.03)       |
| Male                                    |                 | -.34 (.08)***   |                 | -.04 (.07)      |
| Age                                     |                 | .00 (.00)       |                 | .00 (.00)       |
| <i>AIC</i>                              | <i>16276.96</i> | <i>29642.81</i> | <i>16467.31</i> | <i>30833.89</i> |

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$

Regression coefficients listed with standard errors in parentheses.

#### *Facets of Risk Perception – By County*

Inland Residents in Allegan County are less concerned about coastal risk than Lake Residents ( $\beta=-.60$ ,  $p<.001$ ) (Table 12). The results from the regression also suggest that residents with more experience with previous coastal risks are more likely to be concerned about coastal risk ( $\beta=-.03$ ,  $p<.01$ ). Furthermore, those with an Associate's Degree or less are not as concerned

about coastal risk when compared to those with a graduate degree ( $\beta = -.79$ ,  $p < .01$ ). Males are also less concerned about coastal risk than females ( $\beta = -.43$ ,  $p < .01$ ). Interestingly, there were no significant predictors for self-reported knowledge about coastal risk in Allegan County.

In Ottawa County, as amount of previous experience with coastal risk increased, so too did individual's concern about coastal risk ( $\beta = -.05$ ,  $p < .001$ ) and self-reported knowledge about coastal issues ( $\beta = -.03$ ,  $p < .01$ ) (Table 12). Males were also less concerned about coastal risk than females ( $\beta = -.29$ ,  $p < .01$ ). As the amount of time respondents have owned property in their communities increased, so too did their self-reported knowledge about coastal risk ( $\beta = -.07$ ,  $p < .05$ ). Individuals with a bachelor's degree also indicated they were less knowledgeable about coastal risk than those with a graduate degree ( $\beta = -.20$ ,  $p < .05$ ).

Near-lake Residents in Muskegon County reported they are less concerned about coastal risk than Lake Residents ( $\beta = -.61$ ,  $p < .05$ ) (Table 12). Males are also less concerned about coastal risk than females ( $\beta = -.37$ ,  $p < .05$ ). As with the previous counties, as amount of previous experience with coastal risk increases, individuals report more concern ( $\beta = -.03$ ,  $p < .05$ ) and more knowledge ( $\beta = -.04$ ,  $p < .01$ ) about coastal risk.

**Table 12.** Regression models of the final structural models for three counties (Allegan County, Ottawa County, and Muskegon County) of Concern and Knowledge.

| Variables                               | Allegan County      |                       | Ottawa County       |                       | Muskegon County     |                       |
|-----------------------------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|
|                                         | Model 1:<br>Concern | Model 2:<br>Knowledge | Model 3:<br>Concern | Model 4:<br>Knowledge | Model 5:<br>Concern | Model 6:<br>Knowledge |
| <i>Resident location (ref: Lake)</i>    |                     |                       |                     |                       |                     |                       |
| Near-lake                               | -.39 (.20)          | -.20 (.17)            | .05 (.16)           | .12 (.13)             | .61 (.28)*          | -.07 (.24)            |
| Inland                                  | -.60 (.17)***       | -.18 (.14)            | -.15 (.16)          | -.09 (.13)            | -.55 (.28)          | -.05 (.24)            |
| Municipal officials                     | -.39 (.38)          | -.01 (.33)            | .03 (.22)           | -.15 (.18)            | .23 (.51)           | .35 (.47)             |
| Previous experiences                    | .03 (.01)**         | .00 (.01)             | .05 (.01)***        | .03 (.01)**           | .03 (.01)*          | .04 (.01)**           |
| Property ownership time                 | -.03 (.05)          | .08 (.04)             | -.04 (.04)          | .07 (.03)*            | .11 (.06)           | -.02 (.05)            |
| Year-round resident                     | -.11 (.13)          | .15 (.12)             | -.20 (.13)          | .08 (.10)             | -.32 (.19)          | .06 (.17)             |
| <i>Education (ref: Graduate degree)</i> |                     |                       |                     |                       |                     |                       |
| Associate's degree or less              | -.79 (.23)**        | -.08 (.20)            | -.28 (.15)          | -.01 (.13)            | .12 (.20)           | -.09 (.17)            |
| Bachelor's degree                       | -.17 (.13)          | -.20 (.12)            | -.11 (.11)          | -.20 (.09)*           | -.23 (.17)          | -.12 (.16)            |
| Income                                  | -.04 (.06)          | .01 (.06)             | -.03 (.04)          | .01 (.04)             | -.06 (.06)          | -.01 (.05)            |
| Male                                    | -.43 (.13)**        | -.17 (.12)            | -.29 (.11)**        | -.01 (.09)            | -.37 (.16)*         | .03 (.14)             |
| Age                                     | .00 (.01)           | .01 (.01)             | .01 (.00)           | .00 (.00)             | -.00 (.01)          | -.00 (.01)            |
| <i>R</i> <sup>2</sup>                   | .23                 | .10                   | .14                 | .08                   | .19                 | .10                   |
| <i>AIC</i>                              | 8393.22             | 8347.251              | 15015.59            | 15776.81              | 6905.819            | 7165.321              |

\*p < .05; \*\*p < .01; \*\*\*p < .001

Regression coefficients listed with standard errors in parentheses.

## Discussion

In general, Lake Residents are more concerned about coastal risk than Near-lake and Inland Residents. This is most likely because Lake Residents have private property on the lake that is at a much higher risk of flooding and coastal erosion than Inland Residents. This finding supports previous research that suggests direct experience with environmental risks increases an individual's risk perception and concern of those risks (Whitmarsh, 2008). In fact, I found that as the number of previous experiences with coastal risks increased, so too does an individual's risk perception. However, there was no significant difference in self-reported Knowledge about coastal risk, this suggests that although Lake Residents are more concerned about coastal risk, they don't necessarily have more or less knowledge about how to manage coastal risks. The results of the Tukey post-hoc test further show that Lake Residents feel they have less ability to take action to manage coastal risk than Municipal Officials. Furthermore, Lake Residents also think there are less policies in place to help manage coastal risk when compared to Inland Residents and Municipal Officials. This suggests that it is important to focus on decreasing the disconnect in risk perceptions between Lake Residents and Municipal Officials, either by putting in place more beneficial policies or by better educating coastal residents.

Although there were no significant differences in county size, it is noteworthy that the presence of resiliency policy or program had an effect on risk perceptions. It is possible that the community-engaged work done by Resilient Michigan helps residents feel more confident in their abilities to handle current and future unpredictable coastal dynamics. However, it is also possible that residents in these areas are simply not as aware of coastal risk and their community's focus on resilience is mainly the accomplishment of a few municipal officials who prioritize coastal risk.

Individuals who had an education level less than a bachelor's degree (some high school, high school graduate, some college, or associate's degree) were less concerned about coastal risks than those with a graduate degree (master's degree, professional degree, or doctorate degree). This finding also follows previous literature that has found a positive relationship between education level and concern about environmental issues, such as climate change (Dietz, Dan, & Shwom, 2007; Semenza et al., 2008). These previous studies have suggested individual's with higher levels of education are more likely to be open to new ideas and are more likely to change their behavior to help mitigate the impacts of climate change. It may also be that those with higher levels of education have been formally introduced to the complex factors related to the negative impacts of climate change, and therefore are more aware of the issue (Feltman et al., 2017). However, while individuals with less than a bachelor's degree appear to be more concerned about coastal risk, there was no difference in self-reported knowledge about coastal risk. On the other hand, individuals with a bachelor's degree had a self-reported knowledge score that was less than those with a graduate degree. Perhaps this is because those with a bachelor's degree have had enough higher education to better understand the intricacies of climate change, and therefore realize there are a lot of factors they are not equipped to fully understand.

I also found that males are significantly less concerned about coastal risk than non-male respondents. Previous research on climate change perceptions has suggested that men are less concerned about climate change most likely because men self-report being more informed about climate change (Gifford & Comeau, 2011). In other words, males seem to be less concerned about environmental risks because they are more confident in their understanding of the issue, and therefore their ability to deal with negative outcomes.

Interestingly, the only other predictor of Knowledge scores is the amount of time individuals have owned property in the coastal community. As the amount of time individuals

have lived in their coastal communities increases, so too does their self-reported knowledge about coastal risk. This finding supports place-based research that suggests the longer an individual has lived in an area, the more likely they are to develop meaningful relationship to that place (Lewicka, 2011). Perhaps those who have lived in their communities for longer are more invested in the health and resilience of the shoreline. Additionally, people may also feel they know more about their community and the coastline simply because they have lived there for longer and experienced more of the natural lake dynamics.

In the context of Lake Michigan residents, variables including Resident Type, resiliency policy, previous experiences, education levels, and gender all influence Concern about coastal risk. However, only previous experiences and education levels influenced self-reported Knowledge about coastal issues. Furthermore, when looking at the counties individually, only previous experiences explains Concern and Knowledge risk perceptions. As the Knowledge model is explained by less of the independent variables in this study, focusing more on the Concern constructs might be more useful for future research. It is also likely that the Knowledge constructs are explained by other variables that were not investigated for this study. These results add to a growing body of research aimed at understanding the underlying mechanisms that influence coastal risk perceptions.

## CHAPTER 4:

### MOTIVATIONS FOR COASTAL HABITAT STEWARDSHIP

#### **Results**

##### *Combined Model*

Based on the results of the Combined Model, it seems that resident type, amount of previous experience with coastal risk, and time of ownership are all predictors for involvement in a program or organization focused on Great Lakes stewardship (Table 13). In the initial model (Model 1), the odds of involvement in a program or organization are lower for both Near-lake (OR=.55,  $p<.05$ ) and Inland Residents (OR=.43,  $p<.001$ ) than for Lake Residents. Although this trend stays consistent for Inland Residents in the final model (Model 2), any significant differences disappear for Near-lake Residents. In the final model, the odds of involvement are 5% higher as the amount of previous experience with coastal risk increases ( $p<.01$ ). The odds of involvement are also 26% higher the longer participants owned property or lived in a coastal community ( $p<.01$ ). There are no effects of county size, resiliency policy presence, year-round residency status, or socio-demographic factors on involvement in resiliency programs or organizations.

**Table 13.** Logistic regression predicting involvement in program for Combined Model. Odds ratios are presented with standard errors in parentheses.

| <b>Variables</b>                        | <b>Model 1</b> | <b>Model 2</b> |
|-----------------------------------------|----------------|----------------|
| <i>County size (ref: Small)</i>         |                |                |
| Mixed                                   | 1.02 (.25)     | 1.09 (.31)     |
| Large                                   | .85 (.24)      | .89 (.29)      |
| <i>Resident location (ref: Lake)</i>    |                |                |
| Near-lake                               | .55 (.13)*     | .58 (.16)      |
| Inland                                  | .43 (.09)***   | .41 (.11)**    |
| Municipal officials                     | .66 (.26)      | .87 (.39)      |
| Resiliency policy                       | .73 (.16)      | .68 (.17)      |
| Previous experiences                    |                | 1.05 (.02)**   |
| Property ownership time                 |                | 1.26 (.09)**   |
| Year-round resident                     |                | 1.28 (.27)     |
| <i>Education (ref: Graduate degree)</i> |                |                |
| Associate's degree or less              |                | .65 (.18)      |
| Bachelor's degree                       |                | .85 (.17)      |
| Income                                  |                | 1.03 (.08)     |
| Male                                    |                | .74 (.14)      |
| Age                                     |                | .99 (.01)      |
| <i>Pseudo R<sup>2</sup></i>             | .02            | .06            |
| <i>AIC</i>                              | 994.415        | 807.037        |

\*p < .05; \*\*p < .01; \*\*\*p < .001

Odds ratios listed with standard errors in parentheses.

None of the factors related to Concern for coastal risk were significant predictors for involvement in a program or organization (Table 14). However, the odds of involvement for respondents who indicated their friends think it is important they understand something about coastal risk are 44% higher than respondents who indicated their friends do not think it is important (p<.01). Additionally, the odds of involvement for respondents who indicated they are more able to personally manage coastal risk is 20% higher than those who indicated they do not feel they are able to personally manage risk (p<.01). These trends were also seen in the final model (Model 3).

**Table 14.** Logistic regression predicting involvement in a program or organization by Concern and Knowledge. Odds ratios are presented with standard errors in parentheses.

|                               | <b>Model 1:<br/>Concern</b> | <b>Model 2:<br/>Knowledge</b> | <b>Model 3:<br/>Combined</b> |
|-------------------------------|-----------------------------|-------------------------------|------------------------------|
| Health of the GL              | 1.14 (.14)                  |                               | 1.14 (.15)                   |
| Private property              | 1.06 (.08)                  |                               | 1.06 (.09)                   |
| Public spaces                 | 1.24 (.14)                  |                               | 1.13 (.13)                   |
| Severity                      | 1.03 (.12)                  |                               | 1.01 (.12)                   |
| Harm (10 years)               | 1.07 (.15)                  |                               | 1.03 (.15)                   |
| Harm (50 years)               | 1.02 (.14)                  |                               | 1.06 (.16)                   |
| Dread                         | 1.05 (.08)                  |                               | 1.04 (.09)                   |
| Understand information        |                             | 1.11 (.12)                    | 1.01 (.12)                   |
| Separate facts from fiction   |                             | .96 (.11)                     | 1.02 (.12)                   |
| Family                        |                             | 1.25 (.15)                    | 1.20 (.15)                   |
| Friends                       |                             | 1.44 (.18)**                  | 1.40 (.19)*                  |
| Ability to locate information |                             | .96 (.07)                     | .95 (.08)                    |
| Ability to manage risk        |                             | 1.20 (.08)**                  | 1.26 (.09)**                 |
| <i>Pseudo R<sup>2</sup></i>   | .05                         | .06                           | .10                          |
| <i>AIC</i>                    | 989.1966                    | 1053.186                      | 939.7509                     |

\*p < .05; \*\*p < .01; \*\*\*p < .001

Odds ratios listed with standard errors in parentheses.

### *Individual County Models*

When looking at the Resident Type model (Model 1) for Allegan County, it seems that the odds of involvement is lower for both Near-lake (OR=.43, p<.05) and Land Residents (OR=.38, p<.01) than Lake Residents (Table 15). However, this trend disappears when socio-demographic factors are included. In the final model (Model 2), as the length of time individuals have lived in the community increases the odds of involvement increase by 37% (p<.05). The odds of involvement are also 2.78 times higher for year-round residents than non-year-round residents (p<.01). In Ottawa County, the odds of involvement are only lower for Land Residents (OR=.49, p<.05) compared to Lake Residents; this trend is also seen in Model 4. Furthermore, as the number of experiences increases the odds of involvement increase by 12% (p<.001). In Muskegon County, the odds of involvement are lower for both Near-lake Residents (OR=.32, p<.05) and Land Residents (OR=.28, p<.05) than Lake Residents. None of the factors related to

concern for coastal risk or self-reported knowledge of risk were significant predictors for involvement in any of the counties (Table 16).

**Table 15.** Logistic regression by county predicting involvement in a program or organization. Model 1 includes logistic regression controlling for resident locations. Model 2 includes Model 1 and socio-demographic predictors. Odds ratios are presented with standard errors in parentheses.

|                                         | Allegan County |               | Ottawa County |               | Muskegon County |            |
|-----------------------------------------|----------------|---------------|---------------|---------------|-----------------|------------|
|                                         | Model 1        | Model 2       | Model 3       | Model 4       | Model 5         | Model 6    |
| <i>Resident location (ref: Lake)</i>    |                |               |               |               |                 |            |
| Near-lake                               | .43 (.18)*     | .54 (.27)     | .72 (.22)     | .71 (.25)     | .32 (.17)*      | .43 (.27)  |
| Land                                    | .38 (.13)**    | .37 (.16)*    | .49 (.14)*    | .44 (.16)*    | .28 (.14)*      | .30 (.19)  |
| Municipal officials                     | .27 (.24)      | .25 (.24)     | 1.02 (.43)    | 1.25 (.64)    | .82 (.76)       | 1.00 (--)  |
| Previous experience                     |                | .99 (.02)     |               | 1.12 (.03)*** |                 | 1.04 (.04) |
| Ownership time                          |                | 1.37 (.17)*   |               | 1.18 (.11)    |                 | 1.11 (.17) |
| Year-round resident                     |                | 2.78 (1.02)** |               | .96 (.29)     |                 | 1.53 (.81) |
| <i>Education (ref: Graduate degree)</i> |                |               |               |               |                 |            |
| Associate's degree or less              |                | .47 (.28)     |               | .99 (.37)     |                 | .38 (.21)  |
| Bachelor's degree                       |                | .73 (.25)     |               | 1.05 (.29)    |                 | 1.02 (.45) |
| Household income                        |                | .94 (.15)     |               | 1.11 (.12)    |                 | .84 (.12)  |
| Male                                    |                | .50 (.18)*    |               | .76 (.20)     |                 | .67 (.28)  |
| Age                                     |                | 1.02 (.02)    |               | 1.00 (.01)    |                 | .98 (.02)  |
| <i>Pseudo R<sup>2</sup></i>             | .03            | .12           | .02           | .07           | .03             | .09        |
| <i>AIC</i>                              | 325.060        | 263.2128      | 542.1897      | 439.976       | 231.834         | 193.4373   |

\*p < .05; \*\*p < .01; \*\*\*p < .001

Odds ratios listed with standard errors in parentheses.

**Table 16.** Logistic regression by county predicting involvement in a program or organization for Concern and Knowledge factors. Model 1 includes logistic regression controlling for resident locations. Model 2 includes Model 1 and socio-demographic predictors. Odds ratios are presented with standard errors in parentheses.

|                               | Allegan County      |                       | Ottawa County       |                       | Muskegon County     |                       |
|-------------------------------|---------------------|-----------------------|---------------------|-----------------------|---------------------|-----------------------|
|                               | Model 1:<br>Concern | Model 2:<br>Knowledge | Model 1:<br>Concern | Model 2:<br>Knowledge | Model 1:<br>Concern | Model 2:<br>Knowledge |
| Health of the GL              | 1.05 (.27)          |                       | 1.26 (.24)          |                       | .97 (.24)           |                       |
| Private property              | 1.31 (.19)          |                       | .94 (.11)           |                       | .97 (.17)           |                       |
| Public spaces                 | 1.33 (.26)          |                       | 1.14 (.20)          |                       | 1.46 (.37)          |                       |
| Severity                      | .69 (.17)           |                       | 1.20 (.21)          |                       | 1.15 (.27)          |                       |
| Harm (10 years)               | 1.36 (.36)          |                       | .82 (.18)           |                       | 1.30 (.37)          |                       |
| Harm (50 years)               | 1.16 (.33)          |                       | 1.32 (.27)          |                       | .57 (.17)           |                       |
| Dread                         | .91 (.13)           |                       | 1.19 (.15)          |                       | 1.06 (.18)          |                       |
| Understand information        |                     | .93 (.20)             |                     | 1.22 (.18)            |                     | .95 (.25)             |
| Separate facts from fiction   |                     | 1.21 (.25)            |                     | .97 (.16)             |                     | .76 (.18)             |
| Family                        |                     | 1.22 (.26)            |                     | 1.37 (.25)            |                     | 1.05 (.28)            |
| Friends                       |                     | 1.47 (.33)            |                     | 1.37 (.25)            |                     | 1.67 (.48)            |
| Ability to locate information |                     | 1.00 (.15)            |                     | .91 (.10)             |                     | 1.09 (.19)            |
| Ability to manage risk        |                     | 1.15 (.15)            |                     | 1.18 (.12)            |                     | 1.31 (.20)            |
| <i>Pseudo R<sup>2</sup></i>   | .07                 | .07                   | .08                 | .07                   | .03                 | .07                   |
| <i>AIC</i>                    | 296.624             | 312.813               | 466.712             | 517.024               | 224.303             | 227.9206              |

\*p < .05; \*\*p < .01; \*\*\*p < .001

Odds ratios listed with standard errors in parentheses.

### *Motivations for Stewardship*

When individuals were asked what motivated them to become involved with a program or organization that prioritizes Great Lakes coastal region management, conservation, or preservation, the most common response was regarding environmental concerns (23.4%, n=81) (Table 17). Many respondents simply mentioned general “environmental concerns,” but others mentioned issues such as, “the loss of the beach,” “concern for water quality,” or “to preserve the dunes.” Participants also mentioned the fact that they live near the Great Lakes (9.0%, n=31), concerns related to coastal development (8.1%, n=28). Also common were comments about desire to remove pollution or maintain the aesthetics of the coastline (6.9%, n=24), or a moral obligation or responsibility (6.6%, n=23). Slightly less common were comments about personal connections to the area (5.6%, n=20), careers or educational backgrounds related to coastal risk (4.9%, n=17), a desire for knowledge about coastal issues (4.9%, n=17), and those who joined because a family member or friend encouraged them or those who joined for the sense of community (4.9%, n=17).

**Table 17.** Range of motivations for stewardship concepts determined by emergent coding.

| <b>Concept</b>                           | <b>Percentage (n)</b> |
|------------------------------------------|-----------------------|
| Environmental concerns                   | 23.4% (81)            |
| Proximity to lake                        | 9.0% (31)             |
| Issues with development                  | 8.1% (28)             |
| Pollution concerns/Desire for aesthetics | 6.9% (24)             |
| Moral obligation                         | 6.6% (23)             |
| Personal connection                      | 5.8% (20)             |
| Desire for community                     | 4.9% (17)             |
| Desire for knowledge                     | 4.9% (17)             |
| Career/Educational background            | 4.9% (17)             |
| Personal experience with risks           | 3.8% (13)             |
| Lacking government                       | 3.2% (11)             |
| Love for area                            | 2.9% (10)             |
| Good organization                        | 2.6% (9)              |
| Future generations                       | 2.0% (7)              |
| Need to protect coastline                | 2.0% (7)              |
| Community concerns                       | 0.9% (3)              |
| General concern                          | 4.3% (15)             |
| Passive                                  | 2.0% (7)              |
| Other                                    | 1.7% (6)              |

## **Discussion**

Based on the results of both the Combined Model and County Models, it seems that Lake Residents are more involved in a program or organization that is focused on Great Lakes region preservation, conservation, or management than Near-lake or Inland Residents (Table 13). This suggests that proximity to the Great Lakes is related to individual's motivations for stewardship (Whitmarsh, 2008). In general, residents who live closer to the lake, have more previous experiences with coastal risk, and have property in a coastal community are more likely to be involved in a program or organization. This trend is supported by many respondents self-reporting that proximity to the lake is their main motivation for involvement. This suggests that targeting Lake Residents when developing materials communicating or educating local stakeholders to help increase awareness and resilience to coastal risks. It also appears that respondents who have lived in the coastal community for longer periods of time are more

involved. Understandably, a personal connection to the lake, either by proximity or experiences, may be an explanation for involvement in programs or organizations that prioritize coastal habitat stewardship.

That the odds of involvement are also higher as self-reported knowledge factors increase supports the primary tenets of Value-Belief-Norms Theory, suggesting that those who care more about coastal risk and protecting the shoreline will engage in behaviors that align with these values (P. C. Stern, 2000; P. Stern et al., 1999; Stern, Paul C., Dietz, 1994). In other words, it makes sense that people who have coastal environmental values will seek out more information and therefore self-report high knowledge scores about coastal risk. Many participants also mentioned concerns about development and insufficient government action to mitigate coastal risk as a main motivation for involvement. This suggests that there are opportunities for municipal officials and natural resource managers to focus on residents who are concerned about development or lax regulations.

Results portend motivations for involvement in programs or organizations that prioritize coastal resilience are stemming from residents' development and environmental concerns, as well as their internal sense of obligation to protect their coastlines. Programs that speak to this sense of connection and responsibility and that also provide residents with actual methods to mitigate coastal risk are more likely to be successful and organizations that simply try to provide residents with more information. In the case of coastal risk on Lake Michigan, it is likely that people who are already aware of the risks and are concerned are also seeking out knowledge and engaging in resilient behaviors.

In all counties, Land Residents are less involved in programs and organizations when compared to Lake Residents. However, ownership time and year-round resident status are only factors that predict involvement in Allegan County, while previous experiences as a predictive

factor is only seen in Ottawa County. This suggests that resiliency programs need to be specifically tailored to different counties, because motivation for stewardship is different across counties.

## **CHAPTER 5:**

### **CONCLUSIONS**

#### **Limitations**

The goal of this study was to better understand coastal stakeholders' perceptions of risk and motivations for coastal habitat stewardship, however it should be noted that the sample population only consisted of residents willing to participate in the survey. Furthermore, the survey could only be completed online, which may have been an obstacle for some interested residents. Although residents had the opportunity to take the survey over the phone if they preferred, this maybe still have dissuaded some people from participating in the research. As the survey results were anonymous, I could not conduct a non-response survey to investigate potential biases in the sample population. This was an unfortunate side effect of choosing to attempt to reach a larger number of potential participants from multiple communities and counties. However, the survey results should only be confidently described for the socio-demographic sample population and one should proceed with caution when generalizing the results to the coastal region as a whole. Furthermore, Allegan and Ottawa Counties were surveyed in December 2017, directly following a mid-term election which may have made certain issues more salient. In addition, potential municipal official and staff turnover may have also impacted the response rates and responses of this Resident Type. It should also be noted that the survey was conducted during a period of relatively higher water levels and coastal risk perceptions may vary during periods of lower water levels. I also only focused on a few Lake Michigan communities, but coastal shorelines and physical dynamics vary in other Great Lakes. As such, preliminary studies such as this one should be first conducted for the other Great Lakes before making management decisions. It should also be noted that although "climate change" or

“Combined warming” was never explicitly mentioned in the survey, some survey respondents still mentioned negative comments related to their opinions regarding environmental issues.

## **Recommendations**

This research provides insight into the risk perceptions and motivations of Lake Michigan coastal stakeholders. This information is useful to municipal officials and government agencies that hope to target educational programs for a variety of coastal residents to increase overall community resilience. Municipal officials in the specific counties can better understand what their constituents believe and how their beliefs shape their decisions about coastal zone management. While state government organizations can better tailor their educational materials to different Resident Types or communities of varying knowledge about coastal risk. This research also adds to a growing body of literature regarding environmental issues and risk perception, specifically the RISP framework.

Future research could investigate what motivates coastal stakeholders to become involved in a program or organization that prioritizes coastal resilience. As a few respondents mentioned interest in helping beyond participating in the survey, there may be further opportunities to discuss motivations for sustainable management and community needs.

## **APPENDICES**

## APPENDIX A:

### INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

#### **MICHIGAN STATE UNIVERSITY**

#### EXEMPT DETERMINATION

October 22, 2018

To: Heather Ann Triezenberg

Re: **MSU Study ID: STUDY00001557**  
**Principal Investigator: Heather Ann Triezenberg**  
**Category: Exempt 2**  
**Exempt Determination Date: 10/22/2018**

Title: Lake Michigan Stakeholders' Coastal Risk Perceptions and Motivations for Stewardship

Grant Title: Human Dimensions of Coastal Hazards and Resource Management  
Funding Agency: Coastal Zone Management Program through Michigan Dept. of Environmental Quality  
Status: Funded

This study has been determined to be exempt under 45 CFR 46.101(b) 2



**Office of  
Regulatory  
Affairs  
Human Research  
Protection Program**

4000 Collins Road  
Suite 136  
Lansing, MI 48910

517-355-2180  
Fax: 517-432-4503  
Email: [rb@msu.edu](mailto:rb@msu.edu)  
[www.hrpp.msu.edu](http://www.hrpp.msu.edu)

**Principal Investigator (PI) Responsibilities:** The PI assumes the responsibilities for the protection of human subjects in this study as outlined in Human Research Protection Program (HRPP) Manual Section 8-1, Exemptions.

**Continuing Review:** Exempt studies do not need to be renewed.

**Modifications:** In general, investigators are not required to submit changes to the Michigan State University (MSU) Institutional Review Board (IRB) once a research study is designated as exempt as long as those changes do not affect the exempt category or criteria for exempt determination (changing from exempt status to expedited or full review, changing exempt category) or that may substantially change the focus of the research study such as a change in hypothesis or study design. See HRPP Manual Section 8-1, Exemptions, for examples. If the study is modified to add additional sites for the research, please note that you may not begin the research at those sites until you receive the appropriate approvals/permissions from the sites.

**Change in Funding:** If new external funding is obtained for an active study that had been determined exempt, a new initial IRB submission will be required, with limited exceptions.

**Reportable Events:** If issues should arise during the conduct of the research, such as unanticipated problems that may involve risks to subjects or others, or any problem that may increase the risk to the human subjects and change the category of review, notify the IRB office promptly. Any complaints from participants that may

## APPENDIX B:

### SURVEY INVITATION NUMBERS AND RESPONSE RATES

**Table 18.** Survey invitation numbers and response rates for Pooled Counties.

|                           | <b>Lake Residents</b> | <b>Near-lake Residents</b> | <b>Inland Residents</b> | <b><i>Total</i></b> |
|---------------------------|-----------------------|----------------------------|-------------------------|---------------------|
| <b>Invitations mailed</b> | 602                   | 1,816                      | 6,002                   | 8,420               |
| <b>Responses</b>          | 168                   | 255                        | 501                     | 924                 |
| <b>Response rate %</b>    | 27.9%                 | 14.0%                      | 8.3%                    | 11.0%               |

Municipal official responses (n=56)

**Table 19.** Survey invitation numbers and response rates for Allegan County.

|                           | <b>Lake Residents</b> | <b>Near-lake Residents</b> | <b>Inland Residents</b> | <b><i>Total</i></b> |
|---------------------------|-----------------------|----------------------------|-------------------------|---------------------|
| <b>Invitations mailed</b> | 203                   | 387                        | 1750                    | 2,340               |
| <b>Responses</b>          | 54                    | 49                         | 151                     | 254                 |
| <b>Response rate %</b>    | 26.6%                 | 12.7%                      | 8.6%                    | 10.9%               |

Municipal official responses (n=7)

**Table 20.** Survey invitation numbers and response rates for Ottawa County.

|                           | <b>Lake Residents</b> | <b>Near-lake Residents</b> | <b>Inland Residents</b> | <b><i>Total</i></b> |
|---------------------------|-----------------------|----------------------------|-------------------------|---------------------|
| <b>Invitations mailed</b> | 350                   | 1,078                      | 2,750                   | 4,178               |
| <b>Responses</b>          | 88                    | 135                        | 226                     | 449                 |
| <b>Response rate %</b>    | 25.1%                 | 12.5%                      | 8.2%                    | 10.7%               |

Municipal official responses (n=41)

**Table 21.** Survey invitation numbers and response rates for Muskegon County.

|                           | <b>Lake Residents</b> | <b>Near-lake Residents</b> | <b>Inland Residents</b> | <b><i>Total</i></b> |
|---------------------------|-----------------------|----------------------------|-------------------------|---------------------|
| <b>Invitations mailed</b> | 49                    | 351                        | 1502                    | 1,902               |
| <b>Responses</b>          | 21                    | 70                         | 119                     | 210                 |
| <b>Response rate %</b>    | 42.9%                 | 19.9%                      | 7.9%                    | 11.0%               |

Municipal official responses (n=8)

## APPENDIX C:

### QUALTRICS SURVEY

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#### Start of Block: Informed Consent

**Q1 - INFORMED CONSENT - What is the purpose of this research study?** The purpose of this study is to understand Lake Michigan community members' coastal risk perceptions and motivations for coastal habitat stewardship. We hope to understand what community members think, why they have these perceptions, and the implications for coastal community resiliency. **Why am I being asked to participate?** You are being asked to participate because you are a resident of a Lake Michigan coastal community and therefore have valuable perspectives and experiences that are important to this study. You are being asked to participate in an online survey, with multiple choice and open-ended questions, that takes about 15 minutes or less to complete. **Are there any benefits to participating?** You will not benefit directly from participating in this research study. However, this study will be used to inform topics of interest for future educational materials that can be more closely tailored to community members' needs. **Are there any risks associated with participation?** We believe the risks associated with your participation in this research study are low, but may be psychological or social because you will be asked to reflect upon your perceptions and experiences as a coastal community member. However, please be assured that your participation in this research study is completely voluntary and the survey results are anonymous. If at anytime you do not wish to answer a question or you wish to discontinue the survey there are no economic or social repercussions. **Are there any costs or compensation for this study?** There is no costs to your for participating in this study other than your time to complete the interview. You will not be compensated for participating in this study. **What if I have a question?** This research study (STUDY100001557) was approved by the MSU Institutional Review Board on October 22, 2018. If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher Heather Triezenberg via email [vanden64@msu.edu](mailto:vanden64@msu.edu) or phone (517)-353-5508, or regular mail Michigan Sea Grant/MSU Extension/Fisheries & Wildlife Department, 1405 S. Harrison Road, Suite 305, East Lansing, MI 48824. If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail [irb@msu.edu](mailto:irb@msu.edu) or regular mail at 4000 Collins Road, Suite 136, Lansing, MI 48910. **By completing this survey, I agree to participate in this evaluation study and confirm that I am 18 years or older.**

**COMMUNITY** is defined as your local Lake Michigan coastal city, township, or village in Michigan, where you own property.

#### End of Block: Informed Consent

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**Start of Block: Access code**

Q2 Please enter your access code, provided at the top of your address label.

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**End of Block: Access code**

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**Start of Block: Areas of concern**

Q3 Please indicate how concerned you are about the following risks to your community in the next TEN years. (Please choose one option per statement.)

|                                                   | Not at all<br>concerned<br>(1) | Slightly<br>concerned<br>(3) | Moderately<br>concerned<br>(4) | Very<br>concerned<br>(10) | Extremely<br>concerned<br>(11) | Unsure<br>(15)        |
|---------------------------------------------------|--------------------------------|------------------------------|--------------------------------|---------------------------|--------------------------------|-----------------------|
| More frequent<br>and severe<br>storms (1)         | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| Increases in<br>precipitation (2)                 | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| More<br>precipitation as<br>rain than snow<br>(3) | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| Reduced ice<br>cover on the<br>Great Lakes (4)    | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| More flooding<br>events (5)                       | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| Coastal erosion<br>(6)                            | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |
| Increases in<br>extreme<br>temperatures (7)       | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>     | <input type="radio"/>          | <input type="radio"/> |

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Q4 Please indicate how concerned you are about the following risks to your community in the next FIFTY years. (Please choose one option per statement.)

|                                                   | Not at all<br>concerned<br>(1) | Slightly<br>concerned<br>(2) | Moderately<br>concerned<br>(3) | Very<br>concerned<br>(4) | Extremely<br>concerned<br>(5) | Unsure<br>(8)         |
|---------------------------------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|-------------------------------|-----------------------|
| More frequent<br>and severe<br>storms (1)         | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| Increases in<br>precipitation (2)                 | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| More<br>precipitation as<br>rain than snow<br>(3) | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| Reduced ice<br>cover on the<br>Great Lakes (4)    | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| More flooding<br>events (5)                       | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| Coastal erosion<br>(6)                            | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| Increases in<br>extreme<br>temperatures<br>(7)    | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |

Q5 Are there other environmental coastal issues you believe are a risk to your community?  
(Please type answer below.)

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## End of Block: Areas of concern

## Start of Block: Risk Perception

Q6 How serious of a threat are environmental coastal risks to your community? (Please choose one option.)

- ☐ Not at all serious (10)
- ☐ Slightly serious (4)
- ☐ Moderately serious (5)
- ☐ Very serious (6)
- ☐ Extremely serious (7)
- ☐ Unsure (8)

Q7 How much do you think coastal risks will harm your community? (Please choose one option.)

|                                                                                              | Not<br>at<br>all<br>(1) | Slightly (3)          | Moderately<br>(4)     | Very much<br>so (5)   | Extremely<br>so (2)   | Unsure (6)            |
|----------------------------------------------------------------------------------------------|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| How much do you think coastal risks will harm your community in the next TEN years?<br>(1)   | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| How much do you think coastal risks will harm your community in the next FIFTY years?<br>(2) | <input type="radio"/>   | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

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**End of Block: Risk Perception**

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**Start of Block: Concern/Knowledge/Behavioral Control**

Q8 The following statements are related to your perception of environmental coastal risks. Please indicate the degree to which you agree or disagree with the following statements.

|                                                                                          | Strongly<br>disagree<br>(1) | Slightly<br>disagree (2) | Neither<br>agree nor<br>disagree (3) | Slightly<br>agree (4) | Strongly<br>agree (5) |
|------------------------------------------------------------------------------------------|-----------------------------|--------------------------|--------------------------------------|-----------------------|-----------------------|
| Information about coastal risks makes me feel worried. (1)                               | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| I understand information about coastal risks. (4)                                        | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| When it comes to information about coastal risks, I can separate facts from fiction. (5) | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| My family expects that I know something about coastal risks. (6)                         | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| My friends expect that I know something about coastal risks. (7)                         | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| I can easily locate information about coastal risks. (8)                                 | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| I am personally able to take action to manage coastal risks. (9)                         | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |
| There are policies in place that allow my community to manage coastal risks. (11)        | <input type="radio"/>       | <input type="radio"/>    | <input type="radio"/>                | <input type="radio"/> | <input type="radio"/> |

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**End of Block: Concern/Knowledge/Behavioral Control**

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**Start of Block: Motivations for Stewardship**

Q9 Please indicate your level of concern for the Great Lakes coastal region. (Please choose one option per question.)

|                                                                                                              | Not at all<br>concerned<br>(1) | Slightly<br>concerned<br>(2) | Moderately<br>concerned<br>(3) | Very<br>concerned<br>(4) | Extremely<br>concerned<br>(5) | Unsure<br>(6)         |
|--------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------|--------------------------------|--------------------------|-------------------------------|-----------------------|
| How concerned are you about the health of your community's coastal shoreline? (1)                            | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| How concerned are you that coastal risks could affect private property (eg. your home, your land, etc.)? (2) | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |
| How concerned are you that coastal risks could affect public spaces (eg. public parks, schools, etc.)? (3)   | <input type="radio"/>          | <input type="radio"/>        | <input type="radio"/>          | <input type="radio"/>    | <input type="radio"/>         | <input type="radio"/> |

Q10 How much do you think human activities (eg. economic development, recreational activities, etc.) will increase coastal risks? (Please choose one option.)

- ☐ Not at all (1)
  - ☐ Slightly (2)
  - ☐ Moderately (3)
  - ☐ Very much so (4)
  - ☐ Extremely so (5)
  - ☐ Unsure (6)
- 

Q11 Have you ever been involved in a program or organization whose primary goal was Great Lakes coastal region management, conservation, or preservation? (Please mark all that apply.)

- ☐ No (2)
  - ☐ Unsure (3)
  - ☐ Yes, dues paying member (4)
  - ☐ Yes, volunteer (8)
  - ☐ Yes, followed on social media (eg. Facebook, Instagram, Twitter, etc.) (5)
  - ☐ Yes, donated money (6)
  - ☐ Yes, attended a meeting or event (7)
  - ☐ Other (1) \_\_\_\_\_
-

Q12 If yes, what program(s) or organization(s) have you been involved with? (Please type answer below.)

---

Q13 If yes, what motivated you to become involved with the program(s) or organization(s)? (Please type answer below.)

---

**End of Block: Motivations for Stewardship**

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**Start of Block: Previous Experience**

Q14 Has your community experienced any of the following events in the last 5 years?

|  | Please indicate yes or no. |        | If yes, how many times? |
|--|----------------------------|--------|-------------------------|
|  | Yes (1)                    | No (2) | # (1)                   |
|  |                            |        |                         |

|                                   |                       |                       |  |
|-----------------------------------|-----------------------|-----------------------|--|
| Severe coastal flooding event (1) | <input type="radio"/> | <input type="radio"/> |  |
| Severe inland flooding event (5)  | <input type="radio"/> | <input type="radio"/> |  |
| Coastal erosion event (2)         | <input type="radio"/> | <input type="radio"/> |  |
| Extreme winter storm event (3)    | <input type="radio"/> | <input type="radio"/> |  |
| Other (4)                         | <input type="radio"/> | <input type="radio"/> |  |
| Other (6)                         | <input type="radio"/> | <input type="radio"/> |  |
| Other (7)                         | <input type="radio"/> | <input type="radio"/> |  |

End of Block: Previous Experience

---

Start of Block: Owns shoreline

Q15 Please identify who you think owns coastal shoreline in your community. (Please mark all that apply.)

- ☐ The public (9)
- ☐ Private property that I own (1)
- ☐ Private property owned by another (2)
- ☐ Local government (3)
- ☐ State government (4)
- ☐ Federal government (5)
- ☐ Non-governmental organization (8)
- ☐ Other (6) \_\_\_\_\_
- ☐ Unsure (7)

End of Block: Owns shoreline

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Start of Block: Responsible for shoreline

Q16 Who do you think is responsible for managing your community's shoreline? (Please mark all that apply.)

- ☐ You (1)
- ☐ Your Neighbor (2)
- ☐ Local Government (3)
- ☐ State Government (4)
- ☐ Federal Government (5)
- ☐ Non-governmental organization (8)
- ☐ Other (6) \_\_\_\_\_
- ☐ Unsure (7)

End of Block: Responsible for shoreline

---

Start of Block: Manage shoreline

Q17 Which is the best way to manage a receding shoreline? (Please choose one option.)

- ☐ Man-made, physical barrier (eg. seawall, etc.) (15)
- ☐ Natural shoreline (eg. plants, etc.) (16)
- ☐ About equal (20)
- ☐ Neither (17)
- ☐ Other (18) \_\_\_\_\_
- ☐ Unsure (19)

End of Block: Manage shoreline

---

Start of Block: Resident

Q18 Are you a year-round resident, part-time resident, or visitor of this community? (Please choose one option.)

- ☐ Year-round resident (1)
  - ☐ Part-time resident (eg. snowbird) (2)
  - ☐ Visitor (eg. renter, tourist) (4)
  - ☐ Other (3) \_\_\_\_\_
- 

Q19 What type of resident do you most identify with in your Lake Michigan community? (Please choose one option.)

- ☐ Lake-front property (1)
  - ☐ Private beach access, but not lake-front property (2)
  - ☐ Coastal community resident, but no private beach access or lake-front property (3)
  - ☐ Other (4) \_\_\_\_\_
-

Q20 How long have you or your family owned a property in your Lake Michigan community?  
(Please choose one option.)

- ☐ 5 years or less (1)
- ☐ 6-10 years (2)
- ☐ 11-20 years (3)
- ☐ 21-49 years (4)
- ☐ 50 years or more (5)

**End of Block: Resident**

---

**Start of Block: Socio-Demographic Characteristics**

Q21 Are you of Hispanic, Latinx, or Spanish origin?

- ☐ Yes (1)
  - ☐ No (2)
-

Q22 What is your race? (Please mark all that apply.)

- ☐ American Indian or Alaskan Native (1)
  - ☐ Arab or Middle Eastern (2)
  - ☐ Asian or South Asian (3)
  - ☐ Black or African American (4)
  - ☐ Native Hawaiian or Pacific Islander (5)
  - ☐ White (Non-Hispanic) (6)
  - ☐ Other (7) \_\_\_\_\_
- 

Q23 What is your highest level of education? (Please choose one.)

- ☐ High school or less (1)
  - ☐ Some college (2)
  - ☐ Associate's degree (3)
  - ☐ Bachelor's degree (4)
  - ☐ Master's degree (5)
  - ☐ Professional degree (6)
  - ☐ Doctorate degree (7)
-

Q24 What is your annual household income before taxes? (Please choose one.)

- ☐ Less than \$20,000 (1)
  - ☐ \$20,000-\$34,999 (2)
  - ☐ \$35,000-\$49,999 (3)
  - ☐ \$50,000-\$74,999 (4)
  - ☐ \$75,000-\$99,999 (5)
  - ☐ Over \$100,000 (6)
- 

Q25 What is your zip code of your Lake Michigan community property? (Please type below.)

---

Q26 What is your birth year? (Please type below.)

---

Q27 What is your gender?

- ☐ Male (1)
- ☐ Female (2)
- ☐ Other (4) \_\_\_\_\_

**End of Block: Socio-Demographic Characteristics**

---

**Start of Block: NEP**

Q28 New Ecological Paradigm. This scale is used to assess people's basic beliefs about humanity's relationship with nature. Please indicate the degree to which you agree or disagree with the following statements.

|                                                                                                   | Strongly disagree<br>(1) | Slightly disagree (3) | Neither agree nor disagree (4) | Slightly agree (5)    | Strongly agree (8)    |
|---------------------------------------------------------------------------------------------------|--------------------------|-----------------------|--------------------------------|-----------------------|-----------------------|
| We are approaching the limit of the number of people the earth can support. (1)                   | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| Humans have the right to modify the natural environment to suit their needs. (2)                  | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| When humans interfere with nature it often produces disastrous consequences. (3)                  | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| Human intelligence will ensure that we do NOT make the earth unlivable. (4)                       | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| Humans are severely abusing the environment. (5)                                                  | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| The earth has plenty of natural resources if we just learn how to develop them. (6)               | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| Plants and animals have as much right as humans to exist. (7)                                     | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| The balance of nature is strong enough to cope with the impacts of modern industrial nations. (8) | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |
| Despite our special abilities humans are still subject to the laws of nature. (9)                 | <input type="radio"/>    | <input type="radio"/> | <input type="radio"/>          | <input type="radio"/> | <input type="radio"/> |

The so-called "ecological crisis" facing humankind has been greatly exaggerated. (10)

|                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

The earth is like a spaceship with very limited room and resources. (11)

|                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

Humans were meant to rule over the rest of nature. (12)

|                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

The balance of nature is very delicate and easily upset. (13)

|                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

If things continue on their present course, we will soon experience a major ecological catastrophe. (14)

|                       |                       |                       |                       |                       |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|

End of Block: NEP

Start of Block: Anything else?

Q29 Is there anything else you would like us to know? (Please type answer below.)

|  |
|--|
|  |
|  |
|  |
|  |
|  |

End of Block: Anything else?

## APPENDIX D:

### CODEBOOK

**Table 22.** Codebook.

| Variable name | Survey question                                                                   | Response options     | Code | Proportion (n) |
|---------------|-----------------------------------------------------------------------------------|----------------------|------|----------------|
| id_new        | New ID                                                                            | -                    | -    | -              |
| id_orig       | Original ID                                                                       | -                    | -    | -              |
| q2            | Access code                                                                       | -                    | -    | -              |
| county        | County                                                                            | Allegan County       | 1    | 26.04% (262)   |
|               |                                                                                   | Ottawa County        | 2    | 49.80% (501)   |
|               |                                                                                   | Muskegon County      | 3    | 22.07% (222)   |
|               |                                                                                   | Unknown              | 97   | 2.09% (21)     |
| loc           | Resident Type                                                                     | Lake Resident        | 1    | 16.70% (168)   |
|               |                                                                                   | Inland Resident      | 2    | 25.35% (255)   |
|               |                                                                                   | Land Resident        | 3    | 49.80% (501)   |
|               |                                                                                   | Municipal Official   | 4    | 5.67% (57)     |
|               |                                                                                   | Other                | 96   | .89% (9)       |
|               |                                                                                   | Unknown              | 97   | 1.59% (16)     |
| storm10       | How concerned are you about more frequent and severe storms in the next 10 years? | Not at all concerned | 1    | 17.40% (175)   |
|               |                                                                                   | Slightly concerned   | 2    | 19.38% (195)   |
|               |                                                                                   | Moderately concerned | 3    | 26.44% (266)   |
|               |                                                                                   | Very concerned       | 4    | 22.07% (222)   |
|               |                                                                                   | Extremely concerned  | 5    | 12.62% (127)   |
|               |                                                                                   | Unsure               | 98   | 0.80% (8)      |
|               |                                                                                   | Missing              | 99   | 1.29% (13)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                        | Response options     | Code | Proportion (n) |
|---------------|----------------------------------------------------------------------------------------|----------------------|------|----------------|
| precip10      | How concerned are you about increases in precipitation in the next 10 years?           | Not at all concerned | 1    | 20.52% (206)   |
|               |                                                                                        | Slightly concerned   | 2    | 21.22% (213)   |
|               |                                                                                        | Moderately concerned | 3    | 29.68% (298)   |
|               |                                                                                        | Very concerned       | 4    | 16.93% (170)   |
|               |                                                                                        | Extremely concerned  | 5    | 8.86% (89)     |
|               |                                                                                        | Unsure               | 98   | 1.59% (16)     |
|               |                                                                                        | Missing              | 99   | 1.20% (12)     |
| rainsnow10    | How concerned are you about more precipitation as rain than snow in the next 10 years? | Not at all concerned | 1    | 18.54% (186)   |
|               |                                                                                        | Slightly concerned   | 2    | 20.34% (204)   |
|               |                                                                                        | Moderately concerned | 3    | 27.42% (275)   |
|               |                                                                                        | Very concerned       | 4    | 18.44% (185)   |
|               |                                                                                        | Extremely concerned  | 5    | 10.97% (110)   |
|               |                                                                                        | Unsure               | 98   | 3.49% (35)     |
|               |                                                                                        | Missing              | 99   | 0.80% (8)      |
| icecov10      | How concerned are you about reduced ice cover on the Great Lakes in the next 10 years? | Not at all concerned | 1    | 15.84% (159)   |
|               |                                                                                        | Slightly concerned   | 2    | 14.64% (147)   |
|               |                                                                                        | Moderately concerned | 3    | 25.10% (252)   |
|               |                                                                                        | Very concerned       | 4    | 24.20% (243)   |
|               |                                                                                        | Extremely concerned  | 5    | 17.03% (171)   |
|               |                                                                                        | Unsure               | 98   | 2.39% (24)     |
|               |                                                                                        | Missing              | 99   | 0.80% (8)      |
| flood10       | How concerned are you about more flooding events in the next 10 years?                 | Not at all concerned | 1    | 13.77% (138)   |
|               |                                                                                        | Slightly concerned   | 2    | 18.36% (184)   |
|               |                                                                                        | Moderately concerned | 3    | 24.05% (241)   |
|               |                                                                                        | Very concerned       | 4    | 24.85% (249)   |
|               |                                                                                        | Extremely concerned  | 5    | 17.07% (171)   |
|               |                                                                                        | Unsure               | 98   | 1.10% (11)     |
|               |                                                                                        | Missing              | 99   | 0.80% (8)      |

Table 22 (cont'd)

| Variable name | Survey question                                                                     | Response options     | Code | Proportion (n) |
|---------------|-------------------------------------------------------------------------------------|----------------------|------|----------------|
| eros10        | How concerned are you about coastal erosion in the next 10 years?                   | Not at all concerned | 1    | 4.49% (45)     |
|               |                                                                                     | Slightly concerned   | 2    | 9.77% (98)     |
|               |                                                                                     | Moderately concerned | 3    | 19.94% (200)   |
|               |                                                                                     | Very concerned       | 4    | 27.22% (273)   |
|               |                                                                                     | Extremely concerned  | 5    | 36.89% (370)   |
|               |                                                                                     | Unsure               | 98   | 0.70% (7)      |
|               |                                                                                     | Missing              | 99   | 1.00% (10)     |
| temp10        | How concerned are you about increases in extreme temperatures in the next 10 years? | Not at all concerned | 1    | 13.36% (134)   |
|               |                                                                                     | Slightly concerned   | 2    | 15.25% (153)   |
|               |                                                                                     | Moderately concerned | 3    | 23.33% (234)   |
|               |                                                                                     | Very concerned       | 4    | 21.24% (213)   |
|               |                                                                                     | Extremely concerned  | 5    | 24.33% (244)   |
|               |                                                                                     | Unsure               | 98   | 1.69% (17)     |
|               |                                                                                     | Missing              | 99   | 0.80% (8)      |
| storm50       | How concerned are you about more frequent and severe storms in the next 50 years?   | Not at all concerned | 1    | 14.89% (149)   |
|               |                                                                                     | Slightly concerned   | 2    | 14.59% (146)   |
|               |                                                                                     | Moderately concerned | 3    | 21.08% (211)   |
|               |                                                                                     | Very concerned       | 4    | 19.78% (198)   |
|               |                                                                                     | Extremely concerned  | 5    | 26.57% (266)   |
|               |                                                                                     | Unsure               | 98   | 1.70% (17)     |
|               |                                                                                     | Missing              | 99   | 1.40% (14)     |
| precip50      | How concerned are you about increases in precipitation in the next 50 years?        | Not at all concerned | 1    | 16.08% (161)   |
|               |                                                                                     | Slightly concerned   | 2    | 15.18% (152)   |
|               |                                                                                     | Moderately concerned | 3    | 23.18% (232)   |
|               |                                                                                     | Very concerned       | 4    | 18.78% (188)   |
|               |                                                                                     | Extremely concerned  | 5    | 22.28% (223)   |
|               |                                                                                     | Unsure               | 98   | 3.10% (31)     |
|               |                                                                                     | Missing              | 99   | 1.40% (14)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                        | Response options     | Code | Proportion (n) |
|---------------|----------------------------------------------------------------------------------------|----------------------|------|----------------|
| rainsnow50    | How concerned are you about more precipitation as rain than snow in the next 50 years? | Not at all concerned | 1    | 15.18% (152)   |
|               |                                                                                        | Slightly concerned   | 2    | 15.48% (155)   |
|               |                                                                                        | Moderately concerned | 3    | 21.08% (211)   |
|               |                                                                                        | Very concerned       | 4    | 19.98% (200)   |
|               |                                                                                        | Extremely concerned  | 5    | 22.68% (227)   |
|               |                                                                                        | Unsure               | 98   | 4.10% (41)     |
|               |                                                                                        | Missing              | 99   | 1.50% (15)     |
| icecov50      | How concerned are you about reduced ice cover on the Great Lakes in the next 50 years? | Not at all concerned | 1    | 13.99% (140)   |
|               |                                                                                        | Slightly concerned   | 2    | 12.39% (124)   |
|               |                                                                                        | Moderately concerned | 3    | 18.88% (189)   |
|               |                                                                                        | Very concerned       | 4    | 20.18% (202)   |
|               |                                                                                        | Extremely concerned  | 5    | 30.17% (302)   |
|               |                                                                                        | Unsure               | 98   | 3.20% (32)     |
|               |                                                                                        | Missing              | 99   | 1.20% (12)     |
| flood50       | How concerned are you about more flooding events in the next 50 years?                 | Not at all concerned | 1    | 11.88% (119)   |
|               |                                                                                        | Slightly concerned   | 2    | 12.77% (128)   |
|               |                                                                                        | Moderately concerned | 3    | 19.96% (200)   |
|               |                                                                                        | Very concerned       | 4    | 21.46% (215)   |
|               |                                                                                        | Extremely concerned  | 5    | 30.64% (307)   |
|               |                                                                                        | Unsure               | 98   | 1.90% (19)     |
|               |                                                                                        | Missing              | 99   | 1.40% (14)     |
| eros50        | How concerned are you about coastal erosion in the next 50 years?                      | Not at all concerned | 1    | 5.69% (57)     |
|               |                                                                                        | Slightly concerned   | 2    | 9.08% (91)     |
|               |                                                                                        | Moderately concerned | 3    | 15.57% (156)   |
|               |                                                                                        | Very concerned       | 4    | 21.76% (218)   |
|               |                                                                                        | Extremely concerned  | 5    | 44.71% (448)   |
|               |                                                                                        | Unsure               | 98   | 2.10% (21)     |
|               |                                                                                        | Missing              | 99   | 1.10% (11)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                     | Response options      | Code | Proportion (n) |
|---------------|-------------------------------------------------------------------------------------|-----------------------|------|----------------|
| temp50        | How concerned are you about increases in extreme temperatures in the next 50 years? | Not at all concerned  | 1    | 12.42% (124)   |
|               |                                                                                     | Slightly concerned    | 2    | 12.93% (129)   |
|               |                                                                                     | Moderately concerned  | 3    | 16.73% (167)   |
|               |                                                                                     | Very concerned        | 4    | 18.64% (186)   |
|               |                                                                                     | Extremely concerned   | 5    | 35.47% (354)   |
|               |                                                                                     | Unsure                | 98   | 2.51% (25)     |
|               |                                                                                     | Missing               | 99   | 1.30% (13)     |
| oth1050       | Are there other environmental issues you believe are a risk to your community?      | [Open-ended question] | -    | -              |
| serious       | How serious of a threat are coastal risks to your community?                        | Not at all serious    | 1    | 5.52% (53)     |
|               |                                                                                     | Slightly serious      | 2    | 14.57% (140)   |
|               |                                                                                     | Somewhat serious      | 3    | 27.16% (261)   |
|               |                                                                                     | Very serious          | 4    | 30.28% (291)   |
|               |                                                                                     | Extremely serious     | 5    | 18.21% (175)   |
|               |                                                                                     | Unsure                | 98   | 2.60% (25)     |
|               |                                                                                     | Missing               | 99   | 1.66% (16)     |
| harm10        | How much do you think coastal risks will harm your community in 10 years?           | Not at all            | 1    | 7.37% (71)     |
|               |                                                                                     | Slightly              | 2    | 20.33% (196)   |
|               |                                                                                     | Moderately            | 3    | 29.88% (288)   |
|               |                                                                                     | Very much so          | 4    | 26.97% (260)   |
|               |                                                                                     | Extremely so          | 5    | 10.17% (98)    |
|               |                                                                                     | Unsure                | 98   | 3.73% (36)     |
|               |                                                                                     | Missing               | 99   | 1.56% (15)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                     | Response options           | Code | Proportion (n) |
|---------------|-------------------------------------------------------------------------------------|----------------------------|------|----------------|
| harm50        | How much do you think coastal risks will harm your community in 50 years?           | Not at all                 | 1    | 5.09% (49)     |
|               |                                                                                     | Slightly                   | 2    | 10.07% (97)    |
|               |                                                                                     | Moderately                 | 3    | 17.96% (173)   |
|               |                                                                                     | Very much so               | 4    | 27.00% (260)   |
|               |                                                                                     | Extremely so               | 5    | 32.09% (309)   |
|               |                                                                                     | Unsure                     | 98   | 6.02% (58)     |
|               |                                                                                     | Missing                    | 99   | 1.77% (17)     |
| dread         | Information about coastal risks makes me feel worried.                              | Strongly disagree          | 1    | 11.98% (115)   |
|               |                                                                                     | Slightly disagree          | 2    | 8.44% (81)     |
|               |                                                                                     | Neither agree nor disagree | 3    | 22.29% (214)   |
|               |                                                                                     | Slightly agree             | 4    | 33.96% (326)   |
|               |                                                                                     | Strongly agree             | 5    | 20.31% (195)   |
|               |                                                                                     | Missing                    | 99   | 3.02% (29)     |
| unstd         | I understand information about coastal risks.                                       | Strongly disagree          | 1    | 1.87% (18)     |
|               |                                                                                     | Slightly disagree          | 2    | 6.76% (65)     |
|               |                                                                                     | Neither agree nor disagree | 3    | 13.53% (130)   |
|               |                                                                                     | Slightly agree             | 4    | 43.29% (416)   |
|               |                                                                                     | Strongly agree             | 5    | 31.43% (302)   |
|               |                                                                                     | Missing                    | 99   | 3.12% (30)     |
| factfict      | When it comes to information about coastal risks, I can separate fact from fiction. | Strongly disagree          | 1    | 1.46% (14)     |
|               |                                                                                     | Slightly disagree          | 2    | 6.35% (61)     |
|               |                                                                                     | Neither agree nor disagree | 3    | 15.10% (145)   |
|               |                                                                                     | Slightly agree             | 4    | 36.88% (354)   |
|               |                                                                                     | Strongly agree             | 5    | 37.19% (357)   |
|               |                                                                                     | Missing                    | 99   | 3.02% (29)     |

Table 22 (cont'd)

| Variable name | Survey question                                              | Response options           | Code | Proportion (n) |
|---------------|--------------------------------------------------------------|----------------------------|------|----------------|
| fam           | My family expects that I know something about coastal risks. | Strongly disagree          | 1    | 4.38% (42)     |
|               |                                                              | Slightly disagree          | 2    | 6.36% (61)     |
|               |                                                              | Neither agree nor disagree | 3    | 30.76% (295)   |
|               |                                                              | Slightly agree             | 4    | 29.51% (283)   |
|               |                                                              | Strongly agree             | 5    | 25.86% (248)   |
|               |                                                              | Missing                    | 99   | 3.13% (30)     |
| fr            | My friends expect that I know something about coastal risks. | Strongly disagree          | 1    | 4.49% (43)     |
|               |                                                              | Slightly disagree          | 2    | 5.85% (56)     |
|               |                                                              | Neither agree nor disagree | 3    | 32.25% (309)   |
|               |                                                              | Slightly agree             | 4    | 35.28% (338)   |
|               |                                                              | Strongly agree             | 5    | 18.89% (181)   |
|               |                                                              | Missing                    | 99   | 3.24% (31)     |
| infoloc       | I can easily locate information about coastal risks.         | Strongly disagree          | 1    | 6.46% (62)     |
|               |                                                              | Slightly disagree          | 2    | 18.02% (173)   |
|               |                                                              | Neither agree nor disagree | 3    | 21.77% (209)   |
|               |                                                              | Slightly agree             | 4    | 35.00% (336)   |
|               |                                                              | Strongly agree             | 5    | 15.63% (150)   |
|               |                                                              | Missing                    | 99   | 3.13% (30)     |
| permang       | I am personally able to take action to manage coastal risks. | Strongly disagree          | 1    | 20.17% (194)   |
|               |                                                              | Slightly disagree          | 2    | 25.47% (245)   |
|               |                                                              | Neither agree nor disagree | 3    | 25.78% (248)   |
|               |                                                              | Slightly agree             | 4    | 20.69% (199)   |
|               |                                                              | Strongly agree             | 5    | 4.78% (46)     |
|               |                                                              | Missing                    | 99   | 3.12% (30)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                                                 | Response options           | Code | Proportion (n) |
|---------------|-----------------------------------------------------------------------------------------------------------------|----------------------------|------|----------------|
| policies      | There are policies in place that allow my community to manage coastal risks.                                    | Strongly disagree          | 1    | 17.40% (167)   |
|               |                                                                                                                 | Slightly disagree          | 2    | 20.31% (195)   |
|               |                                                                                                                 | Neither agree nor disagree | 3    | 38.54% (370)   |
|               |                                                                                                                 | Slightly agree             | 4    | 18.02% (173)   |
|               |                                                                                                                 | Strongly agree             | 5    | 2.50% (24)     |
|               |                                                                                                                 | Missing                    | 99   | 3.23% (31)     |
| health        | How concerned are you about the health of your community's coastal shoreline?                                   | Not at all concerned       | 1    | 2.90% (28)     |
|               |                                                                                                                 | Slightly concerned         | 2    | 9.54% (92)     |
|               |                                                                                                                 | Moderately concerned       | 3    | 20.02% (193)   |
|               |                                                                                                                 | Very concerned             | 4    | 34.44% (332)   |
|               |                                                                                                                 | Extremely concerned        | 5    | 28.84% (278)   |
|               |                                                                                                                 | Unsure                     | 98   | 0.62% (6)      |
|               |                                                                                                                 | Missing                    | 99   | 3.63% (35)     |
| prv           | How concerned are you that coastal risks could affect private property (eg. your home, your land, etc.)?        | Not at all concerned       | 1    | 13.41% (129)   |
|               |                                                                                                                 | Slightly concerned         | 2    | 17.78% (171)   |
|               |                                                                                                                 | Moderately concerned       | 3    | 22.45% (216)   |
|               |                                                                                                                 | Very concerned             | 4    | 20.48% (197)   |
|               |                                                                                                                 | Extremely concerned        | 5    | 21.31% (205)   |
|               |                                                                                                                 | Unsure                     | 98   | 1.04% (10)     |
|               |                                                                                                                 | Missing                    | 99   | 3.53% (34)     |
| pub           | How concerned are you that coastal risks could affect public spaces (eg. public parks, schools, streets, etc.)? | Not at all concerned       | 1    | 5.09% (49)     |
|               |                                                                                                                 | Slightly concerned         | 2    | 11.84% (114)   |
|               |                                                                                                                 | Moderately concerned       | 3    | 22.43% (216)   |
|               |                                                                                                                 | Very concerned             | 4    | 28.66% (276)   |
|               |                                                                                                                 | Extremely concerned        | 5    | 27.41% (264)   |
|               |                                                                                                                 | Unsure                     | 98   | 0.93% (9)      |
|               |                                                                                                                 | Missing                    | 99   | 3.63% (35)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                                                                                       | Response options      | Code | Proportion (n) |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------|----------------|
| humact        | How much do you think human activities (eg. economic development, recreational activities, etc.) will increase coastal risks?                         | Not at all            | 1    | 5.29% (51)     |
|               |                                                                                                                                                       | Slightly              | 2    | 15.15% (146)   |
|               |                                                                                                                                                       | Moderately            | 3    | 19.71% (190)   |
|               |                                                                                                                                                       | Very much so          | 4    | 29.25% (282)   |
|               |                                                                                                                                                       | Extremely so          | 5    | 25.31% (244)   |
|               |                                                                                                                                                       | Unsure                | 98   | 1.66% (16)     |
|               |                                                                                                                                                       | Missing               | 99   | 3.63% (35)     |
| inv           | Have you ever been involved in a program or organization whose primary goal was Great Lakes coastal region management, conservation, or preservation? | Yes                   | 1    | 32.90% (307)   |
|               |                                                                                                                                                       | No                    | 0    | 60.56% (565)   |
|               |                                                                                                                                                       | Other                 | 96   | 0.21% (2)      |
|               |                                                                                                                                                       | Unsure                | 98   | 3.22% (30)     |
|               |                                                                                                                                                       | Missing               | 99   | 3.11% (29)     |
| prgorg_txt    | If yes, what program(s) or organization(s)?                                                                                                           | [Open-ended response] | -    | -              |
| motivate_txt  | If yes, what motivated you to become involved with the program(s) or organization(s)?                                                                 | [Open-ended response] | -    | -              |
| cflood_exp    | Has your community experienced coastal flooding events in the last 5 years?                                                                           | Yes                   | 1    | 14.20% (115)   |
|               |                                                                                                                                                       | No                    | 0    | 85.80% (695)   |
| iflood_exp    | Has your community experienced inland flooding events in the last 5 years?                                                                            | Yes                   | 1    | 32.85% (273)   |
|               |                                                                                                                                                       | No                    | 0    | 67.15% (558)   |
| eros_exp      | Has your community experienced coastal erosion events in the last 5 years?                                                                            | Yes                   | 1    | 65.88% (583)   |
|               |                                                                                                                                                       | No                    | 0    | 34.12% (302)   |
| storm_exp     | Has your community experienced extreme winter storm events in the last 5 years?                                                                       | Yes                   | 1    | 60.38% (512)   |
|               |                                                                                                                                                       | No                    | 0    | 39.62% (336)   |

Table 22 (cont'd)

| Variable name | Survey question                                                                                       | Response options                              | Code | Proportion (n) |
|---------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|----------------|
| own           | Please identify who you think owns coastal shoreline in your community. Mark all that apply.          | Private                                       | 1    | 11.72% (113)   |
|               |                                                                                                       | Government                                    | 2    | 39.63% (382)   |
|               |                                                                                                       | Public                                        | 3    | 1.87% (18)     |
|               |                                                                                                       | Mix                                           | 4    | 37.03% (357)   |
|               |                                                                                                       | Other                                         | 96   | 0.83% (8)      |
|               |                                                                                                       | Unsure                                        | 98   | 3.42% (33)     |
|               |                                                                                                       | Missing                                       | 99   | 5.50% (53)     |
| resp          | Who do you think is responsible for managing your community's coastal shoreline? Mark all that apply. | Private                                       | 1    | 3.73% (36)     |
|               |                                                                                                       | Government                                    | 2    | 40.98% (395)   |
|               |                                                                                                       | Public                                        | 3    | 1.76% (17)     |
|               |                                                                                                       | Mix                                           | 4    | 45.02% (434)   |
|               |                                                                                                       | Other                                         | 96   | 0.41 (4)       |
|               |                                                                                                       | Unsure                                        | 98   | 3.01% (29)     |
|               |                                                                                                       | Missing                                       | 98   | 5.08% (49)     |
| mang_shore    | Which is a better way to manage a receding shoreline?                                                 | Man-made physical barrier (eg. seawall, etc.) | 1    | 8.09% (78)     |
|               |                                                                                                       | Natural shoreline (eg. plants, etc.)          | 2    | 34.44% (332)   |
|               |                                                                                                       | About equal                                   | 3    | 28.11%         |
|               |                                                                                                       | Neither                                       | 4    | 5.08% (49)     |
|               |                                                                                                       | Other                                         | 96   | 8.09% (78)     |
|               |                                                                                                       | Unsure                                        | 98   | 11.51% (111)   |
|               |                                                                                                       | Missing                                       | 99   | 4.67% (45)     |
| res_time      | Are you a full-time resident, part-time resident, or visitor of your Lake Michigan community?         | Year-round resident                           | 1    | 70.02% (675)   |
|               |                                                                                                       | Part-time resident                            | 2    | 21.58% (208)   |
|               |                                                                                                       | Visitor                                       | 3    | 1.04% (10)     |
|               |                                                                                                       | Other                                         | 96   | 2.90% (28)     |
|               |                                                                                                       | Missing                                       | 99   | 4.46% (43)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                                  | Response options                                                               | Code | Proportion (n) |
|---------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|------|----------------|
| res_loc       | What type of resident do you most identify with in this community?                               | Lake-resident                                                                  | 1    | 24.69% (238)   |
|               |                                                                                                  | Private beach access, but not lake-front property                              | 2    | 13.90% (134)   |
|               |                                                                                                  | Coastal community resident, but no private beach access or lake-front property | 3    | 51.14% (493)   |
|               |                                                                                                  | Other                                                                          | 96   | 5.08% (49)     |
|               |                                                                                                  | Missing                                                                        | 99   | 5.19% (50)     |
| own_time      | How long have you or your family owned property in the community where you received this survey? | 5 years or less                                                                | 1    | 15.15% (146)   |
|               |                                                                                                  | 6-10 years                                                                     | 2    | 11.83% (114)   |
|               |                                                                                                  | 11-20 years                                                                    | 3    | 16.80% (162)   |
|               |                                                                                                  | 21-49 years                                                                    | 4    | 28.63% (276)   |
|               |                                                                                                  | 50 years or more                                                               | 5    | 22.51% (217)   |
|               |                                                                                                  | 5 years or less                                                                | 99   | 5.08% (49)     |
| hisp          | Are you of Spanish, Hispanic, or Latinx origin?                                                  | Yes                                                                            | 1    | 96.36% (874)   |
|               |                                                                                                  | No                                                                             | 0    | 1.54% (14)     |
|               |                                                                                                  | Missing                                                                        | 99   | 2.09% (19)     |
| race          | What is your race? Mark all that apply.                                                          | American Indian or Alaskan Native                                              | NA   | 0.0% (0)       |
|               |                                                                                                  | Arab or Middle Eastern                                                         | 1    | 0.21% (2)      |
|               |                                                                                                  | Asian or South Asian                                                           | 2    | 0.10% (1)      |
|               |                                                                                                  | Black or African American                                                      | 3    | 0.21% (2)      |
|               |                                                                                                  | Native Hawaiian or Pacific Islander                                            | NA   | 0.0% (0)       |
|               |                                                                                                  | Mixed race                                                                     | 4    | 1.24% (12)     |
|               |                                                                                                  | White (non-Hispanic)                                                           | 5    | 85.79% (827)   |
|               |                                                                                                  | Other                                                                          | 96   | 3.11% (30)     |
|               |                                                                                                  | Missing                                                                        | 99   | 9.34% (90)     |

Table 22 (cont'd)

| Variable name | Survey question                                                             | Response options           | Code | Proportion (n) |
|---------------|-----------------------------------------------------------------------------|----------------------------|------|----------------|
| educ          | What is your highest level of education?                                    | High school or less        | 1    | 2.29% (21)     |
|               |                                                                             | Some college               | 2    | 9.68% (89)     |
|               |                                                                             | Associate's                | 3    | 6.09% (56)     |
|               |                                                                             | Bachelor's                 | 4    | 36.56% (336)   |
|               |                                                                             | Master's                   | 5    | 26.12% (240)   |
|               |                                                                             | Professional's             | 6    | 9.47% (87)     |
|               |                                                                             | Doctorate's                | 7    | 8.27% (76)     |
|               |                                                                             | Missing                    | 99   | 1.52% (14)     |
| inc           | What is your annual household income before taxes?                          | Less than \$20,000         | 1    | 1.30% (11)     |
|               |                                                                             | \$20,000 to \$34,000       | 2    | 4.38% (37)     |
|               |                                                                             | \$35,000 to \$49,000       | 3    | 7.10% (60)     |
|               |                                                                             | \$50,000 to \$74,000       | 4    | 15.15% (128)   |
|               |                                                                             | \$75,000 to \$99,000       | 5    | 16.80% (142)   |
|               |                                                                             | More than \$100,000        | 6    | 51.36% (434)   |
|               |                                                                             | Missing                    | 99   | 3.91% (33)     |
| zip           | Lake Michigan community zip code?                                           | [Open-ended response]      | -    | -              |
| birthyr       | What is your birth year?                                                    | [Open-ended response]      | -    | -              |
| gend          | What is your gender?                                                        | Male                       | 1    | 56.48% (536)   |
|               |                                                                             | Female                     | 2    | 37.83% (359)   |
|               |                                                                             | Other                      | 96   | 0.42% (4)      |
|               |                                                                             | Missing                    | 99   | 5.27% (50)     |
| nep1          | We are approaching the limit of the number of people the earth can support. | Strongly disagree          | 1    | 12.97% (125)   |
|               |                                                                             | Slightly disagree          | 2    | 13.38% (129)   |
|               |                                                                             | Neither agree nor disagree | 3    | 23.13% (223)   |
|               |                                                                             | Slightly agree             | 4    | 26.14% (252)   |
|               |                                                                             | Strongly agree             | 5    | 18.46% (178)   |
|               |                                                                             | Missing                    | 99   | 5.91% (57)     |

Table 22 (cont'd)

| Variable name | Survey question                                                              | Response options           | Code | Proportion (n) |
|---------------|------------------------------------------------------------------------------|----------------------------|------|----------------|
| nep2          | Humans have the right to modify the natural environment to suit their needs. | Strongly disagree          | 1    | 20.75% (200)   |
|               |                                                                              | Slightly disagree          | 2    | 30.91% (298)   |
|               |                                                                              | Neither agree nor disagree | 3    | 15.87% (153)   |
|               |                                                                              | Slightly agree             | 4    | 21.58% (208)   |
|               |                                                                              | Strongly disagree          | 5    | 4.77% (46)     |
|               |                                                                              | Missing                    | 99   | 6.12% (59)     |
| nep3          | When humans interfere with nature it often produces disastrous consequences. | Strongly disagree          | 1    | 4.88% (47)     |
|               |                                                                              | Slightly disagree          | 2    | 8.09% (78)     |
|               |                                                                              | Neither agree nor disagree | 3    | 13.17% (127)   |
|               |                                                                              | Slightly agree             | 4    | 36.10% (348)   |
|               |                                                                              | Strongly disagree          | 5    | 31.85% (307)   |
|               |                                                                              | Missing                    | 99   | 5.91% (57)     |
| nep4          | Human intelligence will ensure that we do NOT make the earth unlivable.      | Strongly disagree          | 1    | 15.87% (153)   |
|               |                                                                              | Slightly disagree          | 2    | 26.53% (254)   |
|               |                                                                              | Neither agree nor disagree | 3    | 22.61% (218)   |
|               |                                                                              | Slightly agree             | 4    | 21.58% (208)   |
|               |                                                                              | Strongly disagree          | 5    | 6.95% (67)     |
|               |                                                                              | Missing                    | 99   | 6.64% (64)     |
| nep5          | Humans are severely abusing the environment.                                 | Strongly disagree          | 1    | 6.54% (63)     |
|               |                                                                              | Slightly disagree          | 2    | 9.13% (88)     |
|               |                                                                              | Neither agree nor disagree | 3    | 7.68% (74)     |
|               |                                                                              | Slightly agree             | 4    | 28.53% (275)   |
|               |                                                                              | Strongly disagree          | 5    | 42.12% (406)   |
|               |                                                                              | Missing                    | 99   | 6.02% (58)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                               | Response options           | Code | Proportion (n) |
|---------------|-----------------------------------------------------------------------------------------------|----------------------------|------|----------------|
| nep6          | The earth has plenty of natural resources if we just learn how to develop them.               | Strongly disagree          | 1    | 12.24% (118)   |
|               |                                                                                               | Slightly disagree          | 2    | 18.36% (177)   |
|               |                                                                                               | Neither agree nor disagree | 3    | 17.95% (173)   |
|               |                                                                                               | Slightly agree             | 4    | 29.56% (258)   |
|               |                                                                                               | Strongly disagree          | 5    | 15.04% (145)   |
|               |                                                                                               | Missing                    | 99   | 6.85% (66)     |
| nep7          | Plants and animals have as much right as humans to exist.                                     | Strongly disagree          | 1    | 6.12% (59)     |
|               |                                                                                               | Slightly disagree          | 2    | 7.88% (76)     |
|               |                                                                                               | Neither agree nor disagree | 3    | 12.86% (124)   |
|               |                                                                                               | Slightly agree             | 4    | 23.44% (226)   |
|               |                                                                                               | Strongly disagree          | 5    | 43.46% (419)   |
|               |                                                                                               | Missing                    | 99   | 6.22% (60)     |
| nep8          | The balance of nature is strong enough to cope with the impacts of modern industrial nations. | Strongly disagree          | 1    | 39.83% (384)   |
|               |                                                                                               | Slightly disagree          | 2    | 30.91% (298)   |
|               |                                                                                               | Neither agree nor disagree | 3    | 11.62% (112)   |
|               |                                                                                               | Slightly agree             | 4    | 8.20% (79)     |
|               |                                                                                               | Strongly disagree          | 5    | 3.01% (29)     |
|               |                                                                                               | Missing                    | 99   | 6.43% (62)     |
| nep9          | Despite our special abilities humans are still subject to the laws of nature.                 | Strongly disagree          | 1    | 1.56% (15)     |
|               |                                                                                               | Slightly disagree          | 2    | 1.45% (14)     |
|               |                                                                                               | Neither agree nor disagree | 3    | 4.77% (46)     |
|               |                                                                                               | Slightly agree             | 4    | 29.88% (288)   |
|               |                                                                                               | Strongly disagree          | 5    | 56.12% (541)   |
|               |                                                                                               | Missing                    | 99   | 6.22 (60)      |

Table 22 (cont'd)

| Variable name | Survey question                                                                  | Response options           | Code | Proportion (n) |
|---------------|----------------------------------------------------------------------------------|----------------------------|------|----------------|
| nep10         | The so-called “ecological crisis” facing humankind has been greatly exaggerated. | Strongly disagree          | 1    | 43.26 (417)    |
|               |                                                                                  | Slightly disagree          | 2    | 17.53% (169)   |
|               |                                                                                  | Neither agree nor disagree | 3    | 11.93% (115)   |
|               |                                                                                  | Slightly agree             | 4    | 13.17% (127)   |
|               |                                                                                  | Strongly disagree          | 5    | 7.68% (74)     |
|               |                                                                                  | Missing                    | 99   | 6.43% (62)     |
| nep11         | The earth is like a spaceship with very limited room and resources.              | Strongly disagree          | 1    | 7.99% (77)     |
|               |                                                                                  | Slightly disagree          | 2    | 14.32% (138)   |
|               |                                                                                  | Neither agree nor disagree | 3    | 22.72% (219)   |
|               |                                                                                  | Slightly agree             | 4    | 27.49% (265)   |
|               |                                                                                  | Strongly disagree          | 5    | 20.64% (199)   |
|               |                                                                                  | Missing                    | 99   | 6.85% (66)     |
| nep12         | Humans were meant to rule over the rest of nature.                               | Strongly disagree          | 1    | 37.03% (357)   |
|               |                                                                                  | Slightly disagree          | 2    | 18.15% (175)   |
|               |                                                                                  | Neither agree nor disagree | 3    | 18.78% (181)   |
|               |                                                                                  | Slightly agree             | 4    | 11.93% (115)   |
|               |                                                                                  | Strongly disagree          | 5    | 7.37% (71)     |
|               |                                                                                  | Missing                    | 99   | 6.74% (65)     |
| nep13         | The balance of nature is very delicate and easily upset.                         | Strongly disagree          | 1    | 3.11% (30)     |
|               |                                                                                  | Slightly disagree          | 2    | 10.58% (102)   |
|               |                                                                                  | Neither agree nor disagree | 3    | 11.93% (115)   |
|               |                                                                                  | Slightly agree             | 4    | 34.13% (329)   |
|               |                                                                                  | Strongly disagree          | 5    | 34.13% (329)   |
|               |                                                                                  | Missing                    | 99   | 6.12% (59)     |

Table 22 (cont'd)

| Variable name | Survey question                                                                                     | Response options           | Code | Proportion (n) |
|---------------|-----------------------------------------------------------------------------------------------------|----------------------------|------|----------------|
| nep14         | If things continue on their present course, we will soon experience a major ecological catastrophe. | Strongly disagree          | 1    | 8.30% (80)     |
|               |                                                                                                     | Slightly disagree          | 2    | 8.71% (84)     |
|               |                                                                                                     | Neither agree nor disagree | 3    | 14.73% (142)   |
|               |                                                                                                     | Slightly agree             | 4    | 28.01% (270)   |
|               |                                                                                                     | Strongly agree             | 5    | 34.13% (329)   |
|               |                                                                                                     | Missing                    | 99   | 6.12% (59)     |
| last_txt      | Is there anything else you would like us to know?                                                   | [Open-ended question]      | -    | -              |

## APPENDIX E:

### SOCIO-DEMOGRAPHIC SURVEY DATA AND CENSUS DATA

*Census data comes from the American Community Survey (5-year estimates, 2013-2017) conducted by the U.S. Census Bureau.*

**Table 23.** Socio-demographic survey data compared to census data for gender.

|        | <b>General Survey</b> | <b>General Census</b> |
|--------|-----------------------|-----------------------|
| Male   | 59.9%                 | 49.6%                 |
| Female | 39.7%                 | 50.4%                 |
| Other  | 0.4%                  | -                     |

**Table 24.** Socio-demographic survey data compared to census data for gender by county.

|        | <b>Allegan Survey</b> | <b>Allegan Census</b> | <b>Ottawa Survey</b> | <b>Ottawa Census</b> | <b>Muskegon Survey</b> | <b>Muskegon Census</b> |
|--------|-----------------------|-----------------------|----------------------|----------------------|------------------------|------------------------|
| Male   | 63.6%                 | 49.9%                 | 61.7%                | 49.3%                | 52.2%                  | 49.7%                  |
| Female | 36.4%                 | 50.1%                 | 38.2%                | 50.7%                | 45.9%                  | 50.3%                  |
| Other  | 0.0%                  | -                     | 0.0%                 | -                    | 1.9%                   | -                      |

**Table 25.** Socio-demographic survey data compared to census data for age.

|              | <b>General<br/>Survey</b> | <b>General<br/>Census</b> |
|--------------|---------------------------|---------------------------|
| <b>18-24</b> | 0.7%                      | 14.7%                     |
| <b>25-34</b> | 3.4%                      | 15.8%                     |
| <b>35-44</b> | 6.9%                      | 15.6%                     |
| <b>45-64</b> | 45.6%                     | 34.6%                     |
| <b>65-84</b> | 41.6%                     | 16.7%                     |
| <b>85+</b>   | 1.9%                      | 2.5%                      |

**Table 26.** Socio-demographic survey data compared to census data for age by county.

|              | <b>Allegan Survey</b> | <b>Allegan Census</b> | <b>Ottawa Survey</b> | <b>Ottawa Census</b> | <b>Muskegon<br/>Survey</b> | <b>Muskegon<br/>Census</b> |
|--------------|-----------------------|-----------------------|----------------------|----------------------|----------------------------|----------------------------|
| <b>18-24</b> | 0.4%                  | 10.6%                 | 0.9%                 | 18.3%                | 0.5%                       | 11.5%                      |
| <b>25-34</b> | 0.4%                  | 15.3%                 | 4.0%                 | 15.5%                | 5.6%                       | 16.6%                      |
| <b>35-44</b> | 4.5%                  | 15.9%                 | 7.7%                 | 15.5%                | 8.1%                       | 15.7%                      |
| <b>45-64</b> | 51.6%                 | 38.0%                 | 42.8%                | 32.5%                | 45.5%                      | 35.9%                      |
| <b>65-84</b> | 41.0%                 | 18.0%                 | 42.3%                | 15.6%                | 39.9%                      | 17.7%                      |
| <b>85+</b>   | 2.0%                  | 2.1%                  | 2.3%                 | 2.7%                 | 0.5%                       | 2.6%                       |

**Table 27.** Socio-demographic survey data compared to census data for highest level of education.

|                                    | <b>General<br/>Survey</b> | <b>General<br/>Census</b> |
|------------------------------------|---------------------------|---------------------------|
| High school or less                | 2.2%                      | 41.6%                     |
| Some college or Associate's degree | 16.2%                     | 35.0%                     |
| Bachelor's degree                  | 37.4%                     | 16.2%                     |
| Graduate or professional degree    | 44.2%                     | 7.2%                      |

**Table 28.** Socio-demographic survey data compared to census data for highest level of education by county.

|                                    | <b>Allegan<br/>Survey</b> | <b>Allegan<br/>Census</b> | <b>Ottawa<br/>Survey</b> | <b>Ottawa<br/>Census</b> | <b>Muskegon<br/>Survey</b> | <b>Muskegon<br/>Census</b> |
|------------------------------------|---------------------------|---------------------------|--------------------------|--------------------------|----------------------------|----------------------------|
| High school or less                | 0.7%                      | 48.2%                     | 2.3%                     | 36.2%                    | 3.8%                       | 45.9%                      |
| Some college or Associate's degree | 12.3%                     | 31.3%                     | 15.5%                    | 35.3%                    | 22.6%                      | 37.1%                      |
| Bachelor's degree                  | 41.3%                     | 14.0%                     | 35.4%                    | 19.8%                    | 37.5%                      | 11.8%                      |
| Graduate or professional degree    | 45.6%                     | 6.5%                      | 46.8%                    | 8.7%                     | 36.1%                      | 5.1%                       |

**Table 29.** Socio-demographic survey data compared to census data for race.

|                                     | <b>General<br/>Survey</b> | <b>General<br/>Census</b> |
|-------------------------------------|---------------------------|---------------------------|
| American Indian or Alaskan Native   | 0.0%                      | 0.5%                      |
| Arab or Middle Eastern              | 0.2%                      | -                         |
| Asian or South Asian                | 0.1%                      | 1.6%                      |
| Black or African American           | 0.2%                      | 5.1%                      |
| Native Hawaiian or Pacific Islander | 0.0%                      | 0.0%                      |
| White (Non-Hispanic)                | 94.4%                     | 88.0%                     |
| Two or more races                   | 1.5%                      | 3.0%                      |
| Other                               | 3.5%                      | 1.8%                      |

**Table 30.** Socio-demographic survey data compared to census data for race by county.

|                                     | <b>Allegan<br/>Survey</b> | <b>Allegan<br/>Census</b> | <b>Ottawa<br/>Survey</b> | <b>Ottawa<br/>Census</b> | <b>Muskegon<br/>Survey</b> | <b>Muskegon<br/>Census</b> |
|-------------------------------------|---------------------------|---------------------------|--------------------------|--------------------------|----------------------------|----------------------------|
| American Indian or Alaskan Native   | 0.0%                      | 0.5%                      | 0.0%                     | 0.3%                     | 0.0%                       | 0.6%                       |
| Arab or Middle Eastern              | 0.0%                      | -                         | 0.2%                     | -                        | 0.5%                       | -                          |
| Asian or South Asian                | 0.0%                      | 0.6%                      | 0.0%                     | 2.7%                     | 0.5%                       | 0.5%                       |
| Black or African American           | 0.4%                      | 1.4%                      | 0.0%                     | 1.4%                     | 0.5%                       | 13.6%                      |
| Native Hawaiian or Pacific Islander | 0.0%                      | 0.02%                     | 0.0%                     | 0.0%                     | 0.0%                       | 0.0%                       |
| White (Non-Hispanic)                | 94.7%                     | 94.4%                     | 95.6%                    | 90.0%                    | 91.0%                      | 80.7%                      |
| Two or more races                   | 2.0%                      | 2.3%                      | 0.9%                     | 2.5%                     | 2.5%                       | 4.1%                       |
| Other                               | 2.8%                      | 0.9%                      | 3.3%                     | 3.0%                     | 5.0%                       | 0.5%                       |

**Table 31.** Socio-demographic survey data compared to census data for annual income before taxes.

|                     | <b>General<br/>Survey</b> | <b>General<br/>Census</b> |
|---------------------|---------------------------|---------------------------|
| Less than \$20,000  | 1.4%                      | 19.5%                     |
| \$20,000-\$34,999   | 4.5%                      | 9.8%                      |
| \$35,000-\$49,999   | 7.2%                      | 14.5%                     |
| \$50,000-\$74,999   | 15.9%                     | 21.1%                     |
| \$75,000-\$99,999   | 17.6%                     | 13.5%                     |
| More than \$100,000 | 53.5%                     | 21.7%                     |

**Table 32.** Socio-demographic survey data compared to census data for annual income before taxes by county.

|                     | <b>Allegan<br/>Survey</b> | <b>Allegan<br/>Census</b> | <b>Ottawa<br/>Survey</b> | <b>Ottawa<br/>Census</b> | <b>Muskegon<br/>Survey</b> | <b>Muskegon<br/>Census</b> |
|---------------------|---------------------------|---------------------------|--------------------------|--------------------------|----------------------------|----------------------------|
| Less than \$20,000  | 0.5%                      | 17.8%                     | 1.4%                     | 15.7%                    | 2.6%                       | 26.2%                      |
| \$20,000-\$34,999   | 2.7%                      | 9.2%                      | 4.2%                     | 8.6%                     | 7.4%                       | 11.9%                      |
| \$35,000-\$49,999   | 6.7%                      | 15.2%                     | 5.3%                     | 13.5%                    | 11.6%                      | 15.5%                      |
| \$50,000-\$74,999   | 11.2%                     | 21.9%                     | 15.0%                    | 21.0%                    | 23.8%                      | 20.8%                      |
| \$75,000-\$99,999   | 12.6%                     | 14.9%                     | 20.1%                    | 14.8%                    | 18.0%                      | 10.4%                      |
| More than \$100,000 | 66.4%                     | 21.0%                     | 53.9%                    | 26.3%                    | 36.5%                      | 15.2%                      |

## APPENDIX F:

### ALLEGAN AND OTTAWA COUNTY RESIDENT RECRUITMENT MATERIALS

#### **MICHIGAN STATE UNIVERSITY**

November 30, 2018

Dear Lake Michigan Community Resident,

We invite you to participate in a study conducted by Michigan State University (MSU) to learn about perceptions of coastal risk and motivations for coastal habitat management. You were chosen to participate in this study because you live in or own property in a Lake Michigan community. Information from this study will help the Michigan's Coastal Zone Management Program, MSU Extension, Michigan Sea Grant, and partners improve education workshops and management related to environmental coastal risks.

If you would like to participate in this study, please type the link to the survey below in your internet browser and input your access code, the numbers located at the top of your address label. This survey should take about 15 minutes or less. Your participation in the survey is completely voluntary and you may skip a question or withdraw at any time without penalty. Your responses are important to us and we would like to hear from everyone who receives this questionnaire. Your answers will be kept confidential. Your name and address will never be associated with your responses in any way and your privacy will be protected to the maximum extent allowable by law. Your completion of the questionnaire means that you voluntarily agree to participate in this research.

MSU's Human Research Protection Program (HRPP) approved this study (STUDY100001557) on October 22, 2018. You may contact HRPP at 517-355-2180, [irb@msu.edu](mailto:irb@msu.edu), or 4000 Collins Road, Suite 136, Lansing, MI 48910 with any questions about your role as a participant. Please do not hesitate to contact us if you have any questions about this study.



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Natural Resources Bldg,  
East Lansing, MI 48824

517/355-4478  
FAX: 517/432-1699

<http://bit.do/LakeMichiganMSU>

Thank you for your assistance with this study.

Sincerely,

Handwritten signature of Julia Whyte in blue ink.

**Julia Whyte**  
Graduate Research Assistant  
Department of Fisheries and Wildlife  
Michigan State University  
[whytejul@msu.edu](mailto:whytejul@msu.edu)

Handwritten signature of Heather Triezenberg in blue ink.

**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
[vanden64@msu.edu](mailto:vanden64@msu.edu)  
(517)-353-5508

December 7, 2018

**MICHIGAN STATE  
UNIVERSITY**

Dear Lake Michigan Community Resident,

Last week, we mailed you a letter inviting you to participate in a study being conducted by Michigan State University (MSU) to learn about community members' perceptions of coastal risk and motivations for coastal habitat management. If you have already completed the online survey, thank you very much for your help with this study. If you have not yet completed it, we would greatly appreciate it if you would take a few minutes to consider participating in our research.

If you would like to participate in this study, please type the link below in your internet browser and input your access code, the numbers located at the top of your address label. Your participation is voluntary, but please note your responses are very important to us. Your completion of the online survey means that you voluntarily agree with consent to participate in this research.

<http://bit.do/LakeMichiganMSU>

Sincerely,

..  
**Julia Whyte**  
Graduate Research Assistant  
Michigan State University  
Department of Fisheries and Wildlife  
whytejul@msu.edu  


**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
vanden64@msu.edu  
517-353-5508

**Julia Whyte**  
Department of Fisheries and Wildlife  
115 Manly Miles Bldg.  
1405 S. Harrison Rd.  
East Lansing, MI 48823

*Warren Dunes State Park, Michigan  
Photo by Julia Whyte*

# MICHIGAN STATE UNIVERSITY

December 21, 2018

Dear Lake Michigan Community Resident,

We recently sent you a postcard inviting you to participate in a study being conducted by Michigan State University (MSU) to learn about community members' perceptions of risks and motivations for coastal habitat management. Information from this study will help the Michigan Coastal Zone Management Program, MSU Extension, Michigan Sea Grant, and partners improve educational workshops and management strategies related to environmental coastal risks and hazards.

Your participation in this survey is voluntary, and you may skip a question or withdraw at any time without penalty. Your responses are very important to us. We would like to hear from everyone who receives an invitation to participate in this online survey. Your answers will be kept confidential. Your name and address will never be associated with your responses in any way and your privacy will be protected to the maximum extent allowable by law. If you would like to participate in this study, please type the link below in your internet browser and input your access code, the numbers located at the top of your address label. The survey should take about 15 minutes or less to complete. Your completion of this online survey means that you voluntarily agree with consent to participate in this research.



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MSU's Human Research Protection Program (HRPP) approved this study (STUDY100001557) on October 22, 2018. You may contact HRPP at 517-355-2180, [irb@msu.edu](mailto:irb@msu.edu), or 4000 Collins Road, Suite 136, Lansing, MI 48910 with any questions about your role as a participant. Please do not hesitate to contact us if you have any questions about this study.

<http://bit.do/LakeMichiganMSU>

Thank you for your assistance with this study.

Sincerely,

Handwritten signature of Julia Whyte in cursive.

**Julia Whyte**  
Graduate Research Assistant  
Department of Fisheries and Wildlife  
Michigan State University  
[whytejul@msu.edu](mailto:whytejul@msu.edu)

Handwritten signature of Heather Triezenberg in cursive.

**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
[vanden64@msu.edu](mailto:vanden64@msu.edu)  
(517)-353-5508

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equal-opportunity employer.

December 28, 2018

**MICHIGAN STATE  
UNIVERSITY**

Dear Lake Michigan Community Resident,

We are contacting you once more to encourage your participation in a research study being conducted by Michigan State University to learn more about community members' perception of coastal risks and motivations for coastal habitat management. If you already completed the online survey, thank you very much for your help with the study. If you have not yet completed it, we would appreciate it if you would take a few minutes to consider participating in this research.

If you would like to participate in this study, please type the link below in your internet browser and input your access code, the numbers located at the top of your address label. Your completion of this online survey means that you voluntarily agree with consent to participate in this research.

<http://bit.do/LakeMichiganMSU>

Sincerely,



**Julia Whyte**  
Graduate Research Assistant  
Michigan State University  
Department of Fisheries and Wildlife  
whytejul@msu.edu  
[Redacted]



**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
vanden64@msu.edu  
517-353-5508

**Julia Whyte**  
**Department of Fisheries and Wildlife**  
115 Manly Miles Bldg.  
1405 S. Harrison Rd.  
East Lansing, MI 48823

Warren Dunes State Park, Michigan  
Photo by Julia Whyte

## APPENDIX G:

### MUSKEGON COUNTY RESIDENT RECRUITMENT MATERIALS

#### MICHIGAN STATE UNIVERSITY

March 22, 2019

Dear Muskegon County Resident,

We invite you to participate in a study conducted by Michigan State University (MSU) to learn about perceptions of coastal risk and motivations for coastal habitat management. You were chosen to participate in this study because you live in or own property in a Lake Michigan community. Information from this study will help the Michigan's Coastal Zone Management Program, MSU Extension, Michigan Sea Grant, and partners improve education workshops and management related to environmental coastal risks.

If you would like to participate in this study, please type the link to the Qualtrics survey below in your internet browser and input your access code, the numbers located at the top of your address label. You may also take the survey over the phone with Julia Whyte (978-621-8496) if you prefer. The survey should take about 15 minutes or less.

Your participation in the survey is completely voluntary and you may skip a question or withdraw at any time without penalty. Your responses are important to us and we would like to hear from everyone who receives this questionnaire. Your answers will be kept confidential. Your name and address will never be associated with your responses in any way and your privacy will be protected to the maximum extent allowable by law. Your completion of the questionnaire means that you voluntarily agree to participate in this research. If you have any questions about our research, please contact Julia Whyte directly. If you have concerns about the ethics or methods of this study please contact MSU's Human Research Protection Program.



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517/355-4478  
FAX: 517/432-1699

<http://tinyurl.com/LakeMichiganMSU>

Thank you for your assistance with this study.

Sincerely,

A handwritten signature of Julia Whyte in black ink.

**Julia Whyte**  
Graduate Research Assistant  
Department of Fisheries and Wildlife  
Michigan State University  
whytejul@msu.edu  
[Redacted]

A handwritten signature of Heather Triezenberg in black ink.

**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
vanden64@msu.edu  
(517)-353-5508

MSU's Human Research Protection Program (HRPP) approved this study (STUDY100001557) on October 22, 2018. You may contact HRPP at 517-355-2180, [hrb@msu.edu](mailto:hrb@msu.edu), or 4000 Collins Road, Suite 136, Lansing, MI 48910 with any questions about your role as a participant. Please do not hesitate to contact us if you have any questions about this study.

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March 29, 2019

Dear Lake Michigan Community Resident,

Last week, we mailed you a letter inviting you to participate in a study being conducted by Michigan State University (MSU) to learn about community members' perceptions of coastal risk and motivations for coastal habitat management. If you have already completed the online survey, thank you very much for your help with this study. If you have not yet completed it, we would greatly appreciate it if you would take a few minutes to consider participating in our research.

If you would like to participate in this study, please type the link below in your internet browser and input your access code, the numbers located at the top of your address label. You may also take this survey over the phone with Julia Whyte (978-621-8496). Your participation is voluntary, but please know your responses are very important to us. Your completion of the online survey means that you voluntarily agree with consent to participate in this research.

<http://tinyurl.com/LakeMichiganMSU>

Sincerely,

**Julia Whyte**  
Graduate Research Assistant  
Michigan State University  
Department of Fisheries and Wildlife  
whytejul@msu.edu

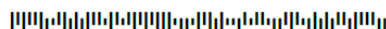
**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
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Department of Fisheries and Wildlife  
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**MICHIGAN STATE  
UNIVERSITY**

**Julia Whyte**  
Department of Fisheries and Wildlife  
115 Manly Miles Bldg.  
1405 S. Harrison Rd.  
East Lansing, MI 48823



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Warren Dunes State Park, Michigan  
Photo by Julia Whyte

# MICHIGAN STATE UNIVERSITY

April 12, 2019

Dear Muskegon County Resident,

We recently sent you a postcard inviting you to participate in a study being conducted by Michigan State University (MSU) to learn about community members' perceptions of risks and motivations for coastal habitat management. If you have already completed the online survey, thank you very much for your participation in this study. If you have not yet done so, please take time today to consider participating in this research. Information from this study will help the Coastal Zone Management Program, MSU Extension, Michigan Sea Grant, and partners improve educational workshops and management strategies related to environmental coastal risks and hazards.

Your participation in this survey is voluntary, and you may skip a question or withdraw at any time without penalty. Your responses are very important to us. We would like to hear from everyone who receives an invitation to participate in this online survey. Your answers will be kept confidential. Your name and address will never be associated with your responses in any way and your privacy will be protected to the maximum extent allowable by law.

If you would like to participate in this study, please type the link to the Qualtrics survey below in your internet browser and input your access code, the numbers located at the top of your address label. You may also take this survey over the phone with Julia Whyte (978-621-8496). This survey should take about 15 minutes or less. If you have any questions about our research, please contact Julia Whyte directly. If you have concerns about the ethics or methods of this study please contact MSU's Human Research Protection Program.



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FAX: 517/432-1699

<http://tinyurl.com/LakeMichiganMSU>

Thank you for your assistance with this study.

Sincerely,

A handwritten signature in cursive script that reads "Julia Whyte".

**Julia Whyte**  
Graduate Research Assistant  
Department of Fisheries and Wildlife  
Michigan State University  
[whytejul@msu.edu](mailto:whytejul@msu.edu)  
[Redacted]

A handwritten signature in cursive script that reads "Heather O. Triezenberg".

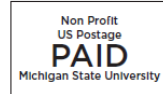
**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
[vanden64@msu.edu](mailto:vanden64@msu.edu)  
(517)-353-5508

MSU's Human Research Protection Program (HRPP) approved this study (STUDY100001557) on October 22, 2018. You may contact HRPP at 517-355-2180, [hrb@msu.edu](mailto:hrb@msu.edu), or 4000 Collins Road, Suite 136, Lansing, MI 48910 with any questions about your role as a participant. Please do not hesitate to contact us if you have any questions about this study.

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May 1, 2019

MICHIGAN STATE  
UNIVERSITY



Dear Muskegon County Resident,

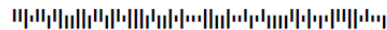
We are contacting you once more to encourage your participation in a research study being conducted by Michigan State University to learn more about community members' perception of coastal risks and motivations for coastal habitat management. If you already completed the online survey, thank you very much for your help with the study. If you have not yet completed it, we would appreciate it if you would take a few minutes to consider participating in this research.

**Julia Whyte**  
Department of Fisheries and Wildlife  
115 Manly Miles Bldg.  
1405 S. Harrison Rd.  
East Lansing, MI 48823

If you would like to participate in this study, please type the link below in your internet browser and input your access code, the numbers located at the top of your address label. You may also take this survey over the phone with Julia Whyte (978-621-8496). Your completion of this online survey means that you voluntarily agree with consent to participate in this research. .

<http://tinyurl.com/LakeMichiganMSU>

\*\*\*\*\*AUTO\*\*5-DIGIT 49425 1 1



Sincerely,

**Julia Whyte**  
Graduate Research Assistant  
Michigan State University  
Department of Fisheries and Wildlife  
whytejul@msu.edu

**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
vanden64@msu.edu  
517-353-5508

Warren Dunes State Park, Michigan  
Photo by Julia Whyte

## APPENDIX H:

### MUNICIPAL OFFICIALS EXAMPLE RECRUITMENT MATERIALS

#### **MICHIGAN STATE UNIVERSITY**

April 26, 2019

Dear City of Muskegon Municipal Official or Staff,

We invite you to participate in a study conducted by Michigan State University (MSU) to learn about perceptions of coastal risk and motivations for coastal habitat management. You were chosen to participate in this study because you are a municipal official or staff person of a Lake Michigan community. Information from this study will help the Michigan's Coastal Zone Management Program, MSU Extension, Michigan Sea Grant, and partners improve education workshops and management related to environmental coastal risks.

If you would like to participate in this study, please type the link to the Qualtrics survey below in your internet browser and input your **access code: 12000**. You may also take the survey over the phone with Julia Whyte (978-621-8496) if you prefer. The survey should take about 15 minutes or less.

Your participation in the survey is completely voluntary and you may skip a question or withdraw at any time without penalty. Your responses are important to us and we would like to hear from everyone who receives this questionnaire. Your answers will be kept confidential. Your name and address will never be associated with your responses in any way and your privacy will be protected to the maximum extent allowable by law. Your completion of the questionnaire means that you voluntarily agree to participate in this research. If you have any questions about our research, please contact Julia Whyte directly. If you have concerns about the ethics or methods of this study please contact MSU's Human Research Protection Program.



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517/355-4478  
FAX: 517/432-1699

<http://tinyurl.com/LakeMichiganMSU>

Thank you for your assistance with this study.

Sincerely,

A handwritten signature in blue ink that reads "Julia Whyte".

**Julia Whyte**  
Graduate Research Assistant  
Department of Fisheries and Wildlife  
Michigan State University  
whytejul@msu.edu

A handwritten signature in blue ink that reads "Heather A. Triezenberg".

**Heather Triezenberg, Ph.D**  
Extension Specialist and Program Leader  
Michigan State University Extension,  
Michigan Sea Grant  
Department of Fisheries and Wildlife  
vanden64@msu.edu  
(517)-353-5508

MSU's Human Research Protection Program (HRPP) approved this study (STUDY100001557) on October 22, 2018. You may contact HRPP at 517-355-2180, [irb@msu.edu](mailto:irb@msu.edu), or 4000 Collins Road, Suite 136, Lansing, MI 48910 with any questions about your role as a participant. Please do not hesitate to contact us if you have any questions about this study.

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## REFERENCES

## REFERENCES

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