TRIBAL COMMUNITY AND REGIONAL PERSPECTIVES ON CLIMATE CHANGE AND WATER RESOURCES IN THE GREAT LAKES REGION

By

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Preface

This dissertation contains materials currently in review for publication or planned for submission for publication in the near future. This preface describes the status of each chapter's publication and the contributions of individuals other than Andrew T. Kozich.

Chapter 2 is in review at *Tribal College and University Research Journal*, with Andrew T. Kozich as the sole manuscript author. The following students of Keweenaw Bay Ojibwa Community College (KBOCC) assisted with the conducting and transcribing of interviews with members of the Keweenaw Bay Indian Community: Donald Denomie, Shannon DesRochers, Marie Kovach, Stephanie C. Kozich, Nancy Lamb, and Peter Morin.

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Abstract

Just as human behaviors are the main drivers of most environmental problems, changes in human behaviors can contribute to solutions to environmental problems. In this dissertation issues related to climate change and water resources, two of the greatest environmental challenges of our time, were examined in the Great Lakes region of North America. For both issues, perceptions of impacts and support for potential solutions were described and quantified.

Perceptions of climate change and support for mitigation and adaptation strategies were examined at the community level in the Keweenaw Bay Indian Community (KBIC) of northern Michigan. Like many Native American communities, the KBIC is facing potential environmental, economic, and cultural impacts from climate change and its leaders recently passed a formal resolution to address it. Several key themes emerged through 30 semi-structured interviews and 189 respondents of a quantitative mail survey. Tribal members are acutely aware of climate change and its potential wide-ranging impacts, indicating particular concern for culturally-sacred resources such as the region's water. Most agree that Ojibwa values and traditional ecological knowledge need to be emphasized in planning strategies, and support was equally high for potential mitigation and adaptation measures. Findings provide critical insight to KBIC leaders as they develop long-term strategies in support of the recently-passed climate change resolution. The research also adds to the broader literature by introducing indigenous Great Lakes perspectives to discussions of climate change and environmental justice issues facing indigenous cultures worldwide.

Issues related to the sustainability of Great Lakes water resources were examined throughout the region following the same qualitative/quantitative research methodology, with the objective of gaining insight on residents' motivations to conserve household water. This work was also designed with the objective of informing policy, as the Great Lakes Compact, signed into law in 2008, requires Great Lakes states to develop and implement water conservation strategies and report on outcomes every five years. Most previous research related to household water conservation occurred in water-stressed contexts, with little known about residents' conservation intentions in the Great Lakes region. Using the Theory of Planned Behavior as a theoretical base, findings from 43 semi-structured interviews and 186 survey respondents revealed that while residents deeply value the region's water resources, few practice household conservation or plan to do so in the future and few perceive others in the region as conserving water. Beliefs about water-related problems focus more on water quality than supply. Attitudes and perceived norms were the most significant predictors of household water conservation intentions, with few reliable trends involving demographic variables. Findings add to the literature and provide valuable insight to water district managers tasked with meeting conservation objectives.

Both studies in this dissertation effectively incorporated qualitative and quantitative methodology to help fill knowledge gaps in the scientific literature and provide critical information to those involved in the development and implementation of policy measures, which relies on accurate readings of public sentiment to be effective.

Chapter 1: Introduction

This dissertation contains a collection of related articles on human dimensions of climate change and water resources, perhaps the two most pressing (and interrelated) environmental issues of our time. Conducted over a five year period, this research uses parallel methodology in two different contexts, applied to two different topics, to describe human-environment relationships. All aspects of this work contribute to the scientific literature, and both case studies have valuable natural resource management and policy implications, from local to global in scale.

The overall goal of this research is to better understand drivers of human behaviors that impact the environment, including causes of problems and support for potential solutions. Because most environmental problems ultimately result from human behaviors, solutions must begin with an understanding of the values, beliefs, attitudes, and norms that underlie and influence behaviors in the first place. A thorough understanding of relationships between these variables can assist in the development of effective strategies to positively affect behaviors and reduce environmental impacts. Therefore a hopeful outcome of this work is that the addition of each chapter to the scientific literature contributes meaningfully to environmental policy development and implementation.

A unifying theme in this dissertation is the parallel social science methodology used to produce the most thorough insight on the relationships described above. In each case study, semi-structured interviews were conducted to attain rich qualitative findings and reveal perspectives likely to exist across members of the greater population. Key

themes identified in interviews provide a foundation for follow-up quantitative work. After interviews were conducted and analyzed in each case study, a quantitative mail survey was conducted with a sample size robust enough, and a response rate high enough, to support statistical analysis of results and provide findings representative of the greater population. This mixed-methods strategy is considered among the most effective and defensible methodologies for research of this nature.

A second theme across case studies is the novelty of the respective research contexts. For example, while the literature contains an enormous amount of articles on the topics of climate change and household water conservation, few examine these issues through the lens of Native American communities (climate change) or Great Lakes households (water conservation). Therefore, each chapter of this dissertation contributes towards filling important knowledge gaps in the literature.

While the same methodology was used in both case studies, it was applied to vastly different research contexts. Chapters 2 and 3 describe community-based research in a small Native American community with a local population of fewer than 900 enrolled members. By comparison, Chapters 4 and 5 describe research conducted across the general population of a region containing eight U.S. states, one Canadian province, and over 30 million residents. The valuable role of social science in environmental issues is emphasized by the fact that the same mixed-methods approach effectively provides important findings in both case studies despite vast differences of geographic scope, culture, and population size.

Chapters 2 and 3 describe Native American perspectives on climate change, with the key objective of characterizing and quantifying support for mitigation and adaptation strategies. The research was conducted in the Keweenaw Bay Indian Community (KBIC) of Baraga County, Michigan. As an example of the values of the methodology used, interviews findings revealed an important sub-theme involving the cultural significance of the area's water resources (effectively linking this case study to the next). The survey findings described in Chapter 3 provide crucial information for the KBIC Tribal government that recently passed a resolution to begin long-term climate change planning. Thus, the research simultaneously provides benefits to the local community for its impending policy initiatives as well as the global research community concerned with impacts of climate change to indigenous peoples (and many related sub-themes, including issues of environmental justice and the role of traditional ecological knowledge in adaptation planning).

Chapters 4 and 5 examine Great Lakes residents' perspectives related to the region's water resources and the notion of household water conservation. Semi-structured interviews again provided a rich foundation for the entire study, with key themes identified across interviewees. Findings describe the range of perspectives likely to exist across the general population insofar as what the region's residents think about water. Interviews also assisted with the formulation of hypotheses to be tested in the ensuing mail survey. The ultimate goal of this case study was to develop a linear regression model to test the abilities of the Theory of Planned Behavior to explain and predict intentions to conserve household water. The application of the theory in this

context is novel because it has typically only been used in the literature to predict conservation intentions in arid, water-stressed settings. This case study has policy implications as well, as recent interstate and international agreements now require states to develop long-term water conservation plans in light of current and future stressors to the basin's water resources. Like the climate change case study, this research is therefore timely and provides valuable insight to academic researchers, practitioners, and government agency personnel.

Climate change and the sustainability of water resources are both global environmental issues that are directly impacted by human behaviors. They are also highly related phenomena, as hydrologic processes worldwide are already being impacted by changing climate conditions with further negative impacts expected to occur. The synthesis of these research topics into one dissertation is therefore a very appropriate strategy. The use of parallel methodology across case studies adds consistency to the broad research approach and overall goals of the work. Each of the four chapters is prepared for submission to scientific journals (or is already submitted), demonstrating that all chapters individually serve as valuable additions to the scientific literature involving relationships between humans and the environment.

Chapter 2: Climate Change and the Sacredness of Water in Native America: A Case Study in the Keweenaw Bay Indian Community, Michigan, USA[1]

Andrew T. Kozich[2,3]

Abstract

Like other indigenous communities worldwide, Michigan's Keweenaw Bay Indian Community (KBIC) is facing potential environmental, economic, and cultural impacts from climate change. In advance of the KBIC's recently developed long-term planning initiatives, the objective of this study was to gain insight on climate change perspectives within the community through semi-structured interviews. Three key themes emerged from 30 semi-structured interviews: (1) water resources are extremely valued; (2) climate change is happening and will have wide-ranging negative impacts; and (3) support for climate change planning is high and should include traditional ecological knowledge. Findings provide valuable insight for leaders and will serve as a foundation for follow-up quantitative research.

[1]The material contained in this chapter is in review at *Tribal College and University Research Journal.*

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Introduction

There is little doubt across the scientific community that global climate change is occurring and will likely continue into the future (IPCC, 2014; NOAA, 2014; USEPA, 2013). While impacts will likely be felt by all, in some fashion and to some degree, rural communities that are dependent on natural resources are particularly vulnerable (Karl et al., 2009; Lal et al., 2011; Thomas & Twyman, 2005). In the United States, the rural communities that encompass 80% of the landscape have lower income, lower educational attainment, greater dependence on government programs, higher mortality rates, and fewer health and emergency services than urban centers (Lal et al., 2011). These factors, combined with geographic isolation, result in a reduced capacity to overcome negative impacts of climate change.

Native American communities are particularly threatened by impacts of climate change, and are further impaired by limited resources to mitigate, adapt to, or cope with the consequences of climate change when issues such as health, poverty, unemployment, or substance abuse take precedence (Cozzetto et al., 2013; Lynn et al., 2011; Weinhold, 2010). The marginal land bases and geographic isolation of many tribes rival that of most U.S. communities. And while a traditional response of Native communities to environmental change would be to simply move to another area, tribes are now largely restricted to legally-defined locations on reservations, further reducing adaptation options (Houser et al., 2001; Maldonado et al., 2013; Wildcat, 2013).

Lifeways of Native American communities are typically coupled with the environment, and today this relationship is most often recognized through economic

dependence on natural resources (Houser et al., 2001; Krakoff, 2008; Maldonado et al., 2013). Therefore it is easy to surmise how Native communities that rely on agriculture, forests, fisheries, or tourism could be particularly sensitive to environmental change. However, climate change impacts to Native communities could extend much further. Because Native cultures evolved through deeply-intertwined relationships with their environments, entire elements of culture can be irreparably altered when the environment undergoes drastic change (Kozich & Kozich, 2015). For instance, generations of accumulated knowledge, based on intimate familiarity with the environment, may be lost or rendered less relevant (Cochran et al., 2013; Downing & Cuerrier, 2011; Tauli-Corpuz et al., 2009; Turner & Clifton, 2009). Significant aspects of spirituality could be impacted by losses of sacred plant and animal species or traditional food sources (Cochran et al., 2013; Dittmer, 2013; Krakoff, 2008; Lynn et al., 2013). Many words in Native languages, relating directly to features of the local environment, may lose their meaning if the environment changes or the people have to relocate (Cochran et al., 2013; Downing & Cuerrier, 2011). In all, climate change impacts may not only affect Native Americans' livelihoods but their entire ways of living.

The negative impacts Native communities face from climate change also represent an issue of environmental justice. Proportionally, Native lifestyles contribute little to the causes of climate change, yet their communities are often the most affected by the consequences (Cordalis & Suagee, 2008; Krakoff, 2008; Lynn et al., 2011; Maldonado et al., 2013; Thomas & Twyman, 2005; Tsosie, 2007; Whyte, 2013). For some Native communities (e.g., Arctic and other coastal tribes), climate change impacts

far exceed losses of natural resources or various aspects of culture; some are facing the ultimate injustice of seeing their homelands literally disappear from the map (Cordalis & Suagee, 2008; Crump, 2008; Krakoff, 2008). Considering the rapidity of environmental changes, the cultural trauma associated with relocation, and the unique and complex legal relationships between tribes and the U.S. government, many are viewing action on this matter as requiring the utmost urgency (Krakoff, 2008; Tsosie, 2007; Whyte, 2013).

While climate change impacts to Arctic, Pacific Northwest, and Southwest Native communities have received the most attention in the scientific literature, less is known about issues facing woodlands-area tribes of the Great Lakes region. In this area, changes have already been documented in air and water temperature, hydrological patterns, timing of seasonal events, occurrence of severe weather events, changes in forest cover types, and invasion of non-native species (Pryor et al., 2014; Schramm & Loehman, 2010; SWP, 2007). In an effort to help fill an important knowledge void, the remainder of this paper focuses on climate change and the Keweenaw Bay Indian Community (KBIC), an Ojibwa tribe from northern Michigan (Figure 2.1).

Climate change poses numerous potential threats to members of the KBIC who rely on predictable environmental conditions for the continuation of sacred and traditional activities. The KBIC is located along the southern shore of Lake Superior, within a delicate climatic zone that transitions between a humid continental climate to the south and a cool boreal climate to the north. Forests in this region are characterized by the southern extent of many culturally-significant plant species that provide food and medicines. Some of the most significant tree species, including sugar maple (*Acer*

saccharum), northern white cedar (*Thuja occidentalis*), and paper birch (*Betula papyrifera*), are expected to be stressed by changing hydrological patterns, warmer temperatures, and the invasion of highly competitive, warmer-climate species from the south (Dickmann & Leefers, 2003; Pryor et al., 2014; Schramm & Loehman, 2010; SWP, 2007). Maple syrup production, a sacred and traditional activity for many Ojibwa, could be impacted by changes in regional forest communities.

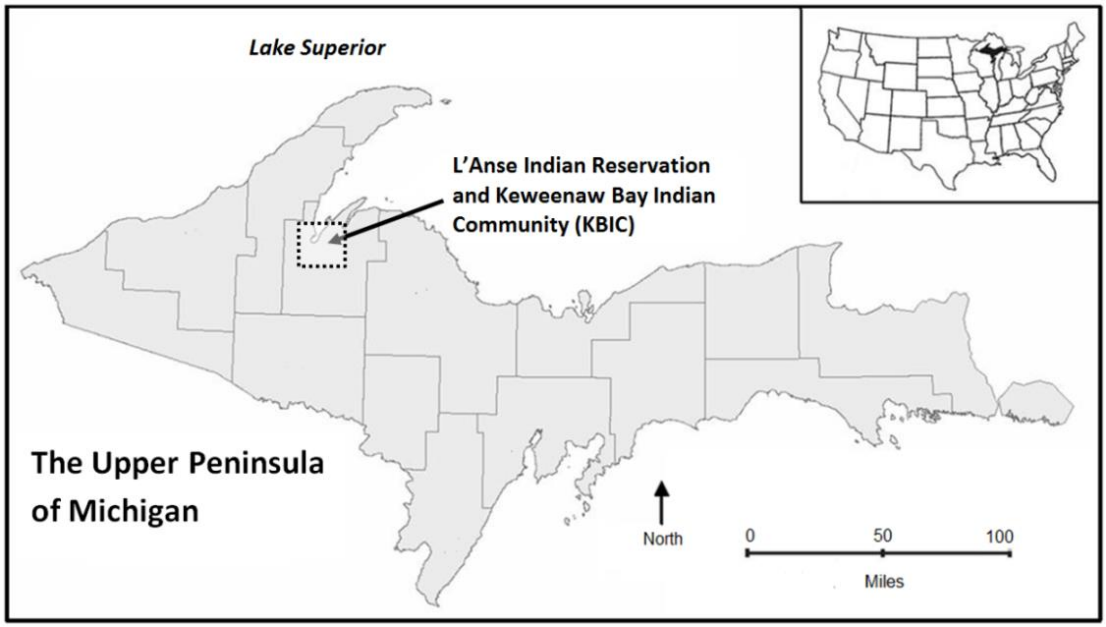

Figure 2.1: The location of the KBIC in Michigan's Upper Penisula (Image: Kozich).

The area's abundant stream and wetland ecosystems provide critical habitat for wild rice (*manomin*). This plant provides valuable nutrition and plays a central role in Ojibwa migration stories. Like maple syrup production, harvesting wild rice is considered a sacred tradition. However, wild rice abundance has already decreased in

many areas, and further losses are expected as a result of altered hydrologic patterns associated with climate change (Schramm & Loehman, 2010; SWP, 2007).

Climate change could severely disrupt the KBIC economy. The community heavily relies on healthy fisheries in nearby Keweenaw Bay and Lake Superior, but the region's waters have already experienced notable changes involving altered temperatures and surface levels (SWP, 2007). Continuing warming of waters could pose serious threats to coldwater fish species, some of which are already in decline. Aquatic ecosystems are being disrupted by the invasion of numerous non-native fish, mussel, and plant species (MDNR, 2015; NTAA, 2009; SWP, 2007). Since non-native invasions are projected to increase with climate change, the local fishing industries and sustenance harvesting supporting numerous KBIC families could be severely impacted. Negative impacts to forest productivity and tourism could be equally likely and detrimental to the KBIC economy (Schramm & Loehman, 2010; SWP, 2007; Voggesser et al., 2013). Clearly there are reasons for the KBIC to be concerned about lifeways of the community in the face of changing climate.

Despite the challenges facing Native communities, they possess knowledge that can uniquely qualify them to take a lead role in climate change adaptation strategies. Traditional ecological knowledge (TEK) has gained increasing merit among climate scientists and policy-makers for its value in understanding past environmental patterns, interpreting current conditions, and planning for the future (Alexander et al., 2011; Berkes & Folke, 2000; Cochran et al., 2013; Vinyeta & Lynn, 2013; Wildcat, 2009; Williams & Hardison, 2013). Many tribes view TEK as an important element of

sovereignty and are now developing and adopting their own climate change adaptation plans.

On April 16 2015, the KBIC Tribal Council unanimously passed Resolution KB-016-2015, "To Establish a Climate Change Adaptation Initiative" (Appendix 1). By doing so, the KBIC joined numerous other tribes nationwide in the recognition that the consensus on climate change is clear and that it could pose substantial threats to Native lifeways. The resolution instructs the KBIC Natural Resources Department to lead a climate change vulnerability assessment as part of planning initiatives and to advise the Council on strategies and policy formulation in conjunction with relevant additional agencies.

This paper summarizes a crucial early step in the KBIC's climate change planning process. In advance of Resolution KB-016-2015, faculty and students of the Keweenaw Bay Ojibwa Community College (KBOCC) Environmental Science Department conducted semi-structured interviews with KBIC Tribal members to assess perspectives on climate change and gauge support for adaptation planning. This research represents the first phase of a broader, mixed-methods project, and to our knowledge is the first such effort in the community. This is a critical first step because climate change will not have homogenous effects across landscapes and therefore assessments of community-level impacts are needed (Duerden, 2004). Since understanding public views is a vital precursor to policy formulation, and policy actions are likely to be effective only if they have the support of the people they impact, this research simultaneously serves the community and adds to the literature by helping fill a notable knowledge void.

Research Design

Work began in late 2013 with the recruitment and training of a team of Keweenaw Bay Ojibwa Community College (KBOCC) student research assistants. We completed a comprehensive literature review, identified research objectives and methodology, and conducted pilot interviews. We formulated the following objectives to guide our work: (1) assess perceptions of climate change among KBIC members; (2) gain insight on how climate change could impact lifestyles of the KBIC; and (3) assess support for long-term mitigation and adaptation strategies.

Data were collected through semi-structured qualitative interviews with enrolled KBIC members. We chose this format with the goal of attaining rich insight to serve as the foundation for follow-up quantitative studies. A systematic random sample was used to invite community members to participate in interviews. With approval of the KBIC Tribal Council, we acquired a mailing list of all enrolled KBIC members age 18 or older residing in Baraga County (892 names), and sent every tenth person on the list a letter requesting participation (Appendix 2b). Fourteen letters were returned undeliverable. Thirty members agreed to be interviewed, resulting in a net response rate of 40%. Interviewees were not compensated for their participation.

Interviews commenced in early 2014. Most were conducted in public meeting places such as the KBIC library, senior citizen center, or KBOCC campus (although some interviews with elders were conducted in interviewees' homes for their comfort and convenience). The semi-structured format promoted full engagement from interviewees, most of whom included stories at their own will to elaborate on points of interest,

expertise, or concern. Interviews contained fifteen questions plus several probing-follow-ups, all correlated to the broader research questions of the project (Appendix 2a). Introductory questions were very conversational in nature and were designed to examine interviewees' cultural perspectives and general environmental values and beliefs before delving into topics specifically related to climate change. Interviews averaged 26 minutes in length and were digitally recorded. Interviewees supplied demographic data on a single-page written form at the conclusion of interviews (Appendix 2d). Student assistants took written notes to supplement audio recordings. Audio files were later transcribed verbatim using GearPlayer 4 transcription software. Transcriptions were then coded and analyzed at the item and pattern level to characterize key themes among participants.

We interviewed sixteen males and fourteen females, with an age range of 18 to 84 (Table 2.1). Ten interviewees identified themselves as elders. The majority (63%) of interviewees possess a high school education or less, while six (20%) completed a Bachelor's degree or higher. Twenty-one (70%) reported an annual income of $30,000 or less and twenty (67%) claimed full or part-time employment. Most employed interviewees work for the Tribe in some capacity, which is not a surprise since the KBIC is the largest employer in Baraga County. Interviewees included current and former Tribal Council members, education/social service professionals, and casino/resort employees. We also interviewed professionals whose day-to-day work puts them in direct contact with the environment, including foresters/loggers, commercial fishermen, wildland firefighters, and employees of the KBIC Natural Resource Department. All

unemployed interviewees described themselves as either retired or tribal college students. Half of interviewees described their political identification as "independent", with the remaining favoring Democratic/liberal identification (40%) over Republican/conservative (10%).

Table 2.1: Descriptive statistics of interviewees.

Category	N	Percent of interviewees
Gender		
Male	16	53%
Female	14	47%
Age		
18-30	8	27%
31-45	8	27%
46-60	8	27%
61 or older	6	20%
Education		
Some high school	3	10%
High school diploma	16	53%
Associate/trade degree	5	17%
Bachelor's degree	3	10%
Master's degree or higher	3	10%
Annual income		
Below $10,000	7	23%
$10,000 to $20,000	6	20%
$20,000 to $30,000	8	27%
$30,000 to $40,000	2	7%
$40,000 to $50,000	6	20%
$50,000 to $75,000	1	3%
Employment		
Employed full or part-time	20	67%
Unemployed/student/retired	10	33%
Political identification		
Democrat/liberal	12	40%
Republican/conservative	3	10%
Independent/other	15	50%

Due to the relatively small sample size (30), we do not assert that interviewees' views are wholly representative of the greater population. However, we are confident that through our sample we captured the diversity of perspectives anticipated to be present among individuals across a wide range of demographic and socio-economic factors (Table 2.1).

Results

Analysis of transcripts resulted in the identification of three key themes expressed by interviewees: (1) water resources are extremely valued; (2) climate change is happening and will have wide-ranging negative impacts; and (3) support for climate change planning is high, and planning should include traditional ecological knowledge. Each theme is elaborated upon in the following paragraphs.

Water resources are extremely valued. Perspectives on the region's water resources are very relevant considering the numerous potential impacts to them that could result from climate change. We began interviews with a series of open-ended questions about the local environment and asked interviewees to elaborate on anything that is particularly special to them. Many interviewees described the area as their ancestral homeland or discussed the significance of its forest resources. However, interviewees focused most intently on the area's water resources, including Lake Superior and the region's numerous streams and wetlands. Twenty-two interviewees (73%), like the one below, named water as the most important natural feature of our area, describing its sacredness to them personally and to the broad community:

> *Just the beauty of it, the lake, the waterfalls, and all the streams. There's just so much nature here. We go out walking by the bay and we also have these beautiful tall trees and it's all remarkable. And the fresh air; you can feel a difference in the air when you go down by the water. I just spend time with the Creator in the outdoors a lot, laying tobacco down by the water and praying, so that's where I go for my therapy in a sense. I love water. It's definitely my spirituality. It helps me to connect. The water is most important. Our sacred animals and plants rely on it, and it is a big part of our culture* (Interviewee #4).

We then asked interviewees to discuss the importance of outdoor recreation, expecting that lifestyles and the environment are intertwined for most residents in the community. Because climate conditions could potentially affect a wide range of outdoor activities, interviewees' responses could help assess broad, lifestyle-altering impacts of climate change. The typical interviewee described several examples of important outdoor recreational activities, and many included stories to emphasize their points. Twenty-five interviewees (83%), such as this one, specifically identified water-related recreation as the most important:

> *We go out we do river walks and stuff like that and we'll will find a waterfall that we've never seen before. And there's usually brook trout so I always carry my pole. Fishing is a big one. I love fishing the rivers, and one of my favorite things to do to do is find a nice little bank and get a fire going and cook outdoors. We're always at the beach and swimming. I enjoy boating and look for any opportunity to go out with someone. Collecting black ash in the swamps for baskets, harvesting wild rice, and stuff like that is important too* (Interviewee #1).

When asked about their greatest local environmental concerns, 22 interviewees (73%) discussed water-related issues as the most pressing. Interviewees shared concern for water quality, surface water levels, water temperature changes, impacts to fish and wildlife, impacts to wetland ecosystems, and reduced snowpack or winter ice cover. Several interviewees described the traditional sacredness of water in Ojibwa culture, supporting their statements with examples from Ojibwa creation or migration stories. Interviewees also discussed contemporary issues involving water that are intertwined with culture, including its importance in ceremonies that carry on today and its role as providing habitat for wild rice, a significant food source. The interviewee below related global water problems to potential local cultural impacts:

> *Water is going to be a really big issue coming up here. I'm afraid of more people wanting our fresh water because there's more and more of a shortage around the rest of the country. And clean water that is the other part too. Lake Superior is still one of the cleanest large fresh water bodies. I'm concerned about the Lake Superior fisheries, our rivers, our wild rice, and being able to keep doing all our cultural activities related to water* (Interviewee #2).

It is important to note that none of our interview questions specifically asked interviewees to discuss water. Responses involving water arose through the context of initial, open-ended questions that were broad in design and intended to gain background insight on interviewees' general relationships with the environment. These topics also occurred early in interview conversations before the topic of climate change was mentioned. Through numerous examples, interviewees illustrated the inseparable relationships between water and Ojibwa culture. Overall, 18 of 30 interviewees made strong connections between water resources and the sustainability of sacred plants and animals or traditional activities such as wild rice harvesting, maple syrup collecting, and fishing.

Climate change is happening and will have wide-ranging negative impacts. Interviewees were near-unanimous in the belief that climate change is already happening in the region; 29 of 30 interviewees agreed it is already underway and one was unsure.

As a follow-up, we asked interviewees if they believe climate change will *continue* happening in the future; 23 said "yes" and seven were unsure. Put another way, none of the 30 interviewees disagreed that climate change is happening or that it will continue into the future.

Climate change awareness appears largely based on observation, as all 30 interviewees stated that they have personally witnessed long-term environmental changes during their lifetimes. Interviewees' responses on this topic were deep and insightful, particularly among elders. Nineteen interviewees, like the one below, specifically described changes they've noted in the intensity or frequency of precipitation events in the region:

> *Well for starters, the weather just seems weird now. The U.P. is known for getting huge amounts of snow in the winter but I noticed the last two winters we didn't get that much. We've had some heat waves and we've had some mild winters now, but I think the first winter I was here it was like 30 below. Last year alone the rain patterns were really weird through the summer, like we had some really long dry spells, then we just got dumped on with rain all at once. It seems like we didn't have any just normal kind of rain. When it rained it poured* (Interviewee #14).

Interviewees also described how seasonal weather patterns in recent years have been different than what they recalled from their childhood. Several interviewees described the changes they've noticed in the timing of seasonal events, discussing both winter and summer weather. Like many interviewees, this one related observations to popular outdoor activities such as swimming:

> *The lengths of the seasons seem different now. I remember winter being much longer, with huge amounts of snow. It doesn't seem as intense anymore and the timing seems to be off. Recent years have been really weird. I remember as a kid we couldn't swim in the lake until mid-to-late August, but now by June the water's warm enough to swim* (Interviewee #13).

Several interviewees made similar comments about seasonal weather patterns and added observations related to corresponding ecological changes. This interviewee linked warmer temperatures to invasions of insects that previously didn't inhabit the region (likely referring to the recent "tick boom" in Michigan noted by researchers):

> *The past five years I would say were so noticeably different than they used to be. Lately we haven't really had winter start until December. Then when summer comes it's like*

> *90 degrees tomorrow and then it stays like that throughout the whole summer. I don't remember that from when I was a kid. And now the different types of bugs we see that come with the hotter weather that we never had before…It's all very concerning to me* (Interviewee #15).

Fishing is an extremely popular activity in the community, and for many KBIC members it holds cultural, recreational, and economic significance. One of our interviewees has been a commercial fisherman for over 30 years, and he provided a powerful, detailed account of changes affecting the Lake Superior whitefish and lake trout fisheries:

> *The lake's pretty warm and right now there's no fish out there. By this time, usually the fish are cold and you can go out there for days. Usually right now you'd get the bottom turning up. Those southwest winds come and start stirring it up and all of a sudden the fish head north. And that's when you get the washing machine effect. It gets all stirred up and gets back to normal at 50 degrees. But it's not happening now. Right now it's 58 and that's too warm for the fish. And we've got northeast winds warming it up even more, dragging down the thermocline. You can tell*

> *month-by-month from what you're getting in your nets. I look at my records at what I was getting back in 1994 or 1995 at this exact time of year. It's unbelievable the amount of fish I was getting back then at this time. It's been changing, and it makes it tough for me to break even* (Interviewee #27).

A long-time recreational fisherman provided a similar account of changes over time in the region's smelt streams. As indicated in this passage, smelting traditions, which are very popular among the KBIC, appear to be affected by environmental changes:

> *I don't know if it's the water temperatures, but back in the day we'd go smelting and we wouldn't even have to work at it. You could dip a couple nets and have a couple 10-gallon buckets ready in about an hour at the most. And then you could sit there and party it up all night. But nowadays you have to go look hard for them. You have to look everywhere and hope to be at the right stream at the right time. It's so unreliable. Back then you could count on them like clockwork, but now you have to chase them down* (Interviewee #21).

Table 2.2: Community-level climate change impacts anticipated by interviewees. Many interviewees listed more than one.

Response	N	Percent of interviewees
Negative impacts to outdoor recreation	14	47%
Negative impacts to fisheries	13	43%
Reduced surface water levels	10	33%
Loss of medicinal plant species	9	30%
Human health impacts	7	23%
Negative impacts to culture (nonspecific)	7	23%
Negative impacts to wild rice	6	20%
Negative impacts to significant wildlife species	6	20%
Negative impacts to maple syrup	6	20%
Impacts to tourism-dependent businesses	6	20%

We asked interviewees to identify specific negative impacts that they anticipate the community could be facing from climate change. Responses were wide-ranging and included cultural, economic, and human health-related impacts in addition to ecological ones (Table 2.2). Many interviewees described more than one impact they anticipate, like this one who summarized several in a concise response:

> *It's not just going to be tree species; it's not just going to be wildlife; it's not just going be fisheries. It's going to affect housing, roads, and drainages too. Public works is going to have to be aware of these changes so they can incorporate them into their projects moving forward. It's going to affect everything to some degree. Health too. And*

> *economic development will be hit. If no one wants to come here to hunt or snowmobile or whatever, we're going to be losing revenue. So it's a tough one. It's not going to be business as usual* (Interviewee #1).

Support for climate change planning is high, and planning should include traditional knowledge. One of the primary objectives with this research was to gain insight on interviewees' opinions related to long-term climate change planning. Across interviewees, we found the overall level of support to be high, as 29 of 30 provided examples of planning strategies the KBIC should consider. Respectively, interviewees tended to focus on one example of a strategy and then go into substantial depth on it. As a result, support for specific strategies was fairly evenly divided across three areas: increasing awareness, investing in renewable energy, and consulting with scientists or other tribes for advice. The interviewee below was one of several who believe the Tribe should focus primarily on educational and outreach activities to increase awareness and influence lifestyle norms across the community:

> *I don't think people are going to change if they don't see other people doing it too. The main thing right now is to be proactive and look into the future, get people involved and get people knowledgeable about it. I think that is the first step definitely. Then the second step would be like*

> *promoting the change and actually getting people buying in and doing it. It would be huge* (Interviewee #3).

Several interviewees, like the one below, focused on research and investment in renewable energy sources and described examples of renewable energy developments the Tribe should examine:

> *Alternate energies, solar power, wind energy, all those need to be researched more heavily. There's also ways to produce fuel for our cars using wood. And there are plenty of ways to sustainably manage forests. There are plenty of ways to produce energy that would make a difference. Put some geothermal heat here or something over there just to show that we're trying to incorporate this. Maybe not to fully sustain the place on green energy, but why not put a couple things in? A couple solar panels would help cut costs plus it would show that we're trying to do this. And a lot of people don't realize how hilly this region is. We're set up pretty good for wind power. There are areas around here where the wind blows like crazy. It doesn't take much of a breeze to turn those propellers. They build them pretty light. Blow on it and it will be spinning* (Interviewee #8).

Collectively, interviewees elaborated much more on mitigation strategies than adaptation strategies; few described steps specifically related to planning for adjustments to inevitable changes (and those who did typically only made reference to the management of Tribal forests or fishery operations). However, 29 of 30 interviewees indicated that traditional ecological knowledge (TEK) has an important role in the planning process. Of these, 18 described how efforts to promote and share TEK could help re-connect the community with its traditional environmental values and behaviors. Many interviewees, like the one below, alluded to the traditional regard for future generations as being a necessary component of climate change planning:

> *We didn't call natives the stewards of the land for no reason. And if you look back, all of the centuries and thousands of years that we've been here, we've always believed in sustaining our resources, no matter what they are. We always believed in only taking as much as we need, and you make sure you do it in a way that you promote the continued growth for future generations. We need to get back to that. But as American people now we are selfish, and it's about politics and money, and because of that we might screw ourselves in the future by not supporting the seven generations theor*y (Interviewee #21).

Nine interviewees discussed how the Tribe's collective TEK, particularly that of elders, should be combined with modern science to create effective strategies for the community. One interviewee emphasized the importance of listening to those whose knowledge could contribute meaningfully to solutions:

> *First, I think our council should just be listening. I think they should listen to the scientists and to our people at natural resources that are studying this. And listen to the elders who have noticed a lot more than the rest of us. Maybe then they can lead the way and make sure we can all adapt and survive. If you think about history, we should be the ones with the understanding of how to do stuff like this. We should be the ones who can figure this stuff out* (Interviewee #30).

Overall, 25 of 30 interviewees stated that they are concerned about the negative impacts climate change could have on the community. As a concluding question, we asked interviewees what sources they rely on for information on climate change. The top responses were roughly evenly split between television, the internet, and general word-of-mouth. Although interviewees appeared reasonably informed on climate change topics, only eight stated that they receive climate change information from science

journals, government reports, or local scientists or educators. Nonetheless, as the preceding section illustrates, interviewees had considerable insights to share on the topic.

Discussion

Although the effects of climate change may not yet be as obvious in the Great Lakes region as they are in other Native American communities, findings show that interviewees in the KBIC are keenly aware of many climate change concepts and possible impacts to the community despite relatively low levels of educational attainment across our interview sample. In keeping with traditional ecological knowledge, it appears that interviewees' perspectives on climate change are formed largely through direct interaction with the environment, observation of changes, and word-of-mouth information sharing. The insight they shared provides richness that speaks to all three of our initial research objectives.

Assess perceptions of climate change among the KBIC. Interviewees were in near-agreement that climate change is occurring, as evidenced by the 29 of 30 who stated so in interviews (one was unsure). Interviewees drew from numerous lines of evidence to support their beliefs, mostly based on personal observation of environmental changes they've noticed in the area. Interviewees were typically long-term residents who spend substantial amounts of time outdoors engaged in a variety of recreational, cultural, and professional activities, and the stories they shared indicate that their beliefs were based on personal observation and stories of others' observations. Many, for example, cited changes they've noticed in weather patterns, features of water bodies, or involving the

plant and animal species of the area (e.g., many shared observations involve fish). This body of knowledge, collected through accumulated direct observations and shared by word-of-mouth across the community, is reflective of traditional ecological knowledge. Many researchers agree that this type of insight from Native communities could be extremely valuable in broader climate change planning initiatives (Alexander et al., 2011; Berkes & Folke, 2000; Cochran et al., 2013; Vinyeta & Lynn, 2013; Wildcat, 2009; Williams & Hardison, 2013).

While interviewees were very aware that climate change is happening, few cited scientific reports or spoke in scientific language to support their beliefs. For example, phrases like "greenhouse gases" or "fossil fuel emissions" were rarely spoken in interviews. While many admitted that they didn't fully understand the scientific details involved, most attributed climate change to human activities and effectively linked warmer temperatures to altered weather patterns and disturbed ecological processes. The fact that many interviewees proposed mitigation solutions involving alternative energy sources indicates the awareness of a link between energy consumption and climate change, even if most interviewees did not explicitly describe it.

Gain insight on how climate change could impact lifestyles of the KBIC. Interviewees cited many examples of the ways that climate change could negatively impact lifeways within the community, and most were very concerned about how these changes could affect future generations. Interviewees discussed numerous ecological impacts, threats to human health, and negative impacts to the community's economy that relies largely on fishing, recreation, and tourism. Many interviewees' concerns integrated

cultural aspects, typically involving traditional foods, sacred plant and animal species, or impacts to traditional outdoor activities that persist as important aspects of life across the community.

Perhaps most notably, interviewees' deeply-held values towards water emerged at numerous points throughout many interviews. A key finding from this research is the extent to which the region's water resources characterize lifestyles for traditional and non-traditional community members alike. While some focused on fishing, outdoor recreation, or day-to-day activities to illustrate the importance of water resources, others emphasized its sacred place in traditional Ojibwa culture. Many used examples from traditional stories to link changing water conditions to disruptions of deeply-held Ojibwa cultural values. Some remarked that if climate change continues, changes to water resources would affect Native communities such as the KBIC more than typical non-Native communities, considering the cultural impacts involved. Sentiments of this sort speak to the many environmental justice aspects of climate change, agreeing with numerous researchers who believe Native communities will bear a disproportionate burden of future climate change scenarios (Cordalis & Suagee, 2008; Krakoff, 2008; Lynn et al., 2011; Maldonado et al., 2013; Thomas & Twyman, 2005; Tsosie, 2007; Whyte, 2013; Wildcat, 2013).

Assess support for long-term mitigation and adaptation strategies. Speaking to this objective, we found most interviewees well-versed in examples of ways that the Tribe could emerge as a leader in climate change response strategies. The development of renewable energy sources drew considerable attention among interviewees, with many

expressing particular support for the implementation of wind and solar technologies on the reservation. Others discussed their support for educational/outreach efforts by the Tribe to increase climate change awareness among the community. The strongest theme to emerge related to this objective, however, is that nearly all interviewees discussed the need to incorporate traditional knowledge in the Tribe's planning process. Many interviewees, agreeing with researchers nationwide, suggested that traditional knowledge holds an important place alongside modern science in the search for solutions. The engagement of elders was identified repeatedly as a necessary component. These insights will prove most valuable to the KBIC Tribal Council as they develop a climate change action plan for the community.

This research has many valuable outcomes. On the local scale, findings will serve as a foundation for future work by providing richness to help guide the development of a follow-up quantitative mail survey to be conducted in the community. While interview findings are rich and insightful, they represent merely a preliminary stage of the broader research project with findings that are not intended to be generalizable to the community as a whole. A follow-up survey, by comparison, will involve a much higher sample size and will allow for statistical analyses of results. By combining qualitative and quantitative ("mixed-methods") research, we will equip the KBIC Tribal Council with the insight necessary to confidently proceed with effective long-term climate change planning. This is the primary objective of our broad research project. A thorough awareness of the community's perspectives will help ensure that policy actions will be supported and effective.

On the global and national scales, perhaps most importantly, our findings help fill a notable knowledge gap related to climate change and indigenous communities. At the time of this research, few articles in the scientific literature examined climate change through the lens of Great Lakes Native cultures. This work helps introduce these communities, particularly the KBIC, to conversations on this important topic. Other tribes may benefit from outcomes of the KBIC's upcoming climate change planning process. Since climate change is a global phenomenon, a greater number of voices will more thoroughly illustrate challenges and can potentially help develop culturally-relevant adaptation strategies.

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Chapter 3: Climate Change Perspectives and Policy Support in a Great Lakes Native American Community[1]

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Abstract

In recognition of potential negative impacts to its environment, economy, and culture, Michigan's Keweenaw Bay Indian Community (KBIC) recently passed a formal resolution to develop a climate change planning initiative. This paper summarizes the second phase of mixed-methods research describing Tribal members' perspectives on climate change and support for long-term policy actions. Through a quantitative mail survey we found that members are acutely aware of climate change, wish to prioritize culture in planning initiatives, and are equally supportive of mitigation and adaptation measures. Our findings provide vital insight to KBIC leaders and adds to the broader literature by introducing Native Great Lakes perspectives to discussions of climate change and environmental justice issues facing indigenous cultures worldwide.

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Introduction

The global scientific community overwhelmingly agrees that climate change is occurring and will continue into the future unless drastic measures are taken (IPCC, 2014; Melillo et al., 2014; NOAA, 2014; USEPA, 2013). Although negative impacts will be widespread, they will not be evenly distributed. Indigenous communities of the world contribute relatively little to the causes of climate change compared to the more populous, carbon-intense, industrialized societies of the world (IPCC, 2014; IUCN, 2008; NWF, 2011; Tauli-Corpuz, 2009). Nonetheless they are expected to be disproportionally affected by drastic environmental changes, with many communities already heavily burdened by compromised lifeways and limited resources to adapt (Cordalis & Suagee, 2008; Krakoff, 2008; Lynn et al., 2011; Maldonado et al., 2013; NWF, 2011; Thomas & Twyman, 2005; Tsosie, 2007; Whyte, 2013). One of the prominent environmental justice issues of our time is the disproportionate burden of climate change on indigenous peoples of the world.

Like many rural communities of the U.S., Native American communities are expected to face greater climate change burdens than urban centers because they rely more heavily on natural resources and government assistance programs, have lower per capita income, lower educational attainment, and fewer health and emergency services (Duerden, 2004; Karl et al., 2009; Lal et al., 2011; Thomas & Twyman, 2005). These disadvantages are magnified for Native communities whose limited resources are already stressed by issues related to education, health, poverty, unemployment, or substance abuse (Cozzetto et al., 2013; Lynn et al., 2011; NWF, 2011; Weinhold, 2010).

Historically, many Native communities would respond to environmental changes by relocating, but today most tribes are restricted to legally-defined locations on reservations and tribal lands and therefore have fewer adaptation options (Houser et al., 2001; Maldonado et al., 2013; Wildcat, 2013).

Native communities could find entire aspects of culture threatened by climate change, and in many instances this reality is already unfolding (Cochran et al., 2013; Cordalis & Suagee, 2008; Downing & Cuerrier, 2011; Houser et al., 2001; Lynn et al., 2013; Turner & Clifton, 2009; Wildcat, 2009). Relationships between Native communities and their surroundings are typically very deep, with culture evolving in conjunction with the environment. Languages, traditional stories, survival strategies, and generations of accumulated knowledge are tied to familiarity with (and sacredness of) tribes' homelands. Spiritual values are intertwined with the natural resources of the area, such as water, plant and animal species, and traditional food sources. In addition to possible cultural impacts, tribes' economic dependence on natural resources such as agriculture, forestry, fishing, or tourism renders them particularly vulnerable to environmental changes (Houser et al., 2001; Krakoff, 2008; Maldonado et al., 2013). From cultural traditions to economic livelihoods, all aspects of Native lifeways appear susceptible to negative impacts of climate change.

The climate change vulnerability of Native communities has only recently received attention in the scientific literature and has focused predominantly on Arctic, U.S. southwest, and northwest Pacific coast regions. These areas feature relatively high Native populations and are facing among the most visible display of climate-related

environmental changes on the continent (Cordalis & Suagee, 2008; IPCC, 2014; NOAA, 2014). Arctic communities are experiencing melting glaciers, reduced sea ice, thawing permafrost, coastal erosion, and the most drastic air temperature increases of anywhere on earth (IPCC, 2014; NOAA, 2014). The results of these extreme and rapid environmental changes include diminished food sources, thawing of traditionally-frozen travel routes, and losses of homelands to the encroaching sea (ACIA, 2004; Cochran et al., 2013; Cruikshank, 2001; Crump, 2008; Downing & Cuerrier, 2011; Duerden, 2004; Ford et al., 2008; NTAA 2009). Plant and animal communities are being altered in response to changing abiotic conditions. Tribes in the U.S. southwest, by comparison, are contending with reduced water supplies in an already arid environment which has resulted in many contested water rights (Cordalis & Suagee, 2008). Historic droughts and heat waves in recent years have impacted traditional agriculture and have intensified invasions of non-native species and losses of biodiversity (Cordalis & Suagee, 2008; Cozzetto et al., 2013; Finan et al., 2002; NTAA, 2009). In the northwest Pacific coast region, altered environmental conditions are affecting Native communities that depend on the region's rich natural resources for their livelihoods. Impacts to salmon populations are a rising concern noted in the literature, with recent environmental changes affecting the abundance, location, and migration timing of these particularly sacred fish species (Dittmer, 2013; Turner & Clifton, 2009).

Specific impacts of climate change to tribes in other U.S. regions such as the Great Lakes have been largely overlooked in the scientific literature. Changes to the region's air and water temperatures, hydrological patterns, timing of seasonal events, and

frequency of extreme weather have been widely noted and are suspected to be the result of global climate change (Melillo et al., 2014; Pryor et al., 2014; Schramm & Loehman, 2010; SWP, 2007). Resulting impacts to forest, wetland, and aquatic communities are expected to include altered structure and species composition and invasions of warmer-climate non-native species (Dickmann & Leefers, 2003; Pryor et al., 2014; Schramm & Loehman, 2010; SWP, 2007). While there appears to be little doubt about possible ecological outcomes, few have linked these outcomes to potential threats they would pose to Native Anishinaabe (Ojibwa) communities that rely on familiar resources and predictable environmental conditions for the continuation of sacred and traditional activities.

Water is particularly sacred to Anishinaabe communities, as themes involving water are prevalent in creation and migration stories and many other enduring cultural traditions (Benton-Banai, 1988; Densmore, 1979). Abundant stream and wetland ecosystems provide critical habitat for wild rice, a sacred plant that provides valuable nutrition and plays a central role in Anishinaabe migration stories. Many additional sacred plant species, including northern white cedar (*Thuja occidentalis*), rely on wetland habitats for their survival. Great Lakes waters also support numerous culturally-significant fish species that provide sustenance and contribute substantially to tribes' local economies.

The limited literature indicates that Great Lakes Anishinaabe communities are justifiably concerned about climate change, and specifically about impacts to water resources (Cave et al., 2011; Kozich, 2016; Plummer et al., 2009). Populations of sacred

wild rice and northern white cedar have already decreased in many areas; further losses are expected as a result of altered hydrologic patterns associated with climate change (Schramm & Loehman, 2010; SWP, 2007). Declining coldwater fish populations are another concern, particularly with the continued warming of surface waters and ecological disruptions caused by the invasions of numerous non-native fish, mussel, and plant species (Kozich, 2016; MDNR, 2015; NTAA, 2009; SWP, 2007). Since non-native invasions are projected to increase with climate change, the commercial fishing and sustenance reliance that supports many Great Lakes Anishinaabe families could be severely impacted.

The region's forests contain key resources such as the numerous plant species used for traditional medicines, foods, and utility items. For instance, paper birch (*Betula papyrifera*) is used for traditional canoe-making, black ash (*Fraxinus nigra*) is highly regarded for making baskets and other goods, and sugar maple (*Acer saccharum*) supports the syrup-making that is a revered traditional activity for Native communities across the region. Like northern white cedar, all of these tree species are threatened by climate change. Paper birch approaches the southern extent of its range in this region and is expected to be stressed by changing hydrological patterns, warmer temperatures, and the migration of more competitive species from the south (Dickmann & Leefers, 2003; Pryor et al., 2014; Schramm & Loehman, 2010). Black ash populations are threatened by the invasive emerald ash borer (*Agrilus planipennis*) that is now encroaching from all directions (Schramm & Loehman, 2010). And while sugar maple is not expected to disappear from the area, its populations are likely to decline as a result of the northward

migration of highly-competitive, warmer-climate species such as oaks (Dickmann & Leefers, 2003). If changes to the region's forest communities continue as anticipated, impacts to culturally-significant animal species that inhabit them can be expected to follow, likely impacting traditional hunting and trapping activities (Kozich & Kozich, 2015; Schramm & Loehman, 2010).

Increasing attention has recently been paid to the values of Native traditional ecological knowledge (TEK) in climate change planning. Generations of accumulated knowledge could greatly enhance our understanding of past environmental patterns, interpretation of current conditions, and development of adaptation and mitigation strategies (Alexander et al., 2011; Berkes & Folke, 2000; Cochran et al., 2013; Vinyeta & Lynn, 2013; Wildcat, 2009; Williams & Hardison, 2013). Many tribes view TEK as an important element of sovereignty and are now developing and adopting their own climate change adaptation plans.

Climate change impacts facing Native communities have been widely acknowledged, as have Native peoples' potential contributions to solutions. Nonetheless, the scientific literature has a substantial knowledge gap regarding quantitative studies of Native perspectives. Few surveys have focusing exclusively on Native communities have evidently been published; relevant research typically involves qualitative findings from interviews, symposia, or working group meetings (Cave at al., 2011; Kozich, 2016; Plummer et al., 2009; Turner & Clifton, 2009). These studies show consistent findings on Natives' climate change awareness, concerns, observations of negative impacts, and traditional knowledge that may contribute to solutions. The only quantitative survey

related to this topic was conducted by Smith et al. (2014), who compared Native and non-Native views on climate change in rural Nevada and found higher degrees of awareness, concern, familiarity with local impacts, and belief in human causes among Native respondents than non-Native respondents.

The remainder of this paper examines climate change impacts through the lens of the Keweenaw Bay Indian Community (KBIC), an Anishinaabe Tribe of northern Michigan (Figure 3.1). The KBIC is a federally-recognized tribe and signatory to two solemn treaties of peace with the U.S., in recognition of their status as a sovereign nation (KBIC, 2013). The *1842 Treaty with the Chippewa* reserved existing rights of hunting, fishing, gathering, and worship within more than 10 million acres of ceded land and water territory for their people (7 Stat., 591:1842). The *1854 Treaty with the Chippewa* established the L'Anse Indian Reservation, containing approximately 59,000 acres of land in Michigan's Upper Peninsula (10 Stat., 1109:1854), primarily located in Baraga County at the base of the Keweenaw Peninsula (Figure 3.1). Later legislation created the Tribe's governing structure, with the Tribal Council elected by KBIC members and tasked with overall governance of the community.

In April 2015, the KBIC Tribal Council unanimously passed Resolution KB-016-2015, "To Establish a Climate Change Adaptation Initiative" (Appendix 1). With this action the KBIC joined many tribes nationwide in the recognition that climate change poses substantial environmental, economic, cultural, and human health threats and that the development of adaptation strategies is critical. The resolution instructs relevant Tribal departments to conduct a climate change vulnerability assessment as part of long-

term planning initiatives and advise the Council at regular intervals on strategies and policy formulation. The resolution inherently makes a statement about sovereignty and environmental justice through its concern for the natural resources to which the Tribe is guaranteed rights by the Treaty of 1842 (Gagnon, 2016). It further reflects the KBIC's adherence to the traditional "seventh generation" principle common to many Native American cultures, in which decisions are made with utmost consideration of seven generations of future people (Gagnon, 2016).

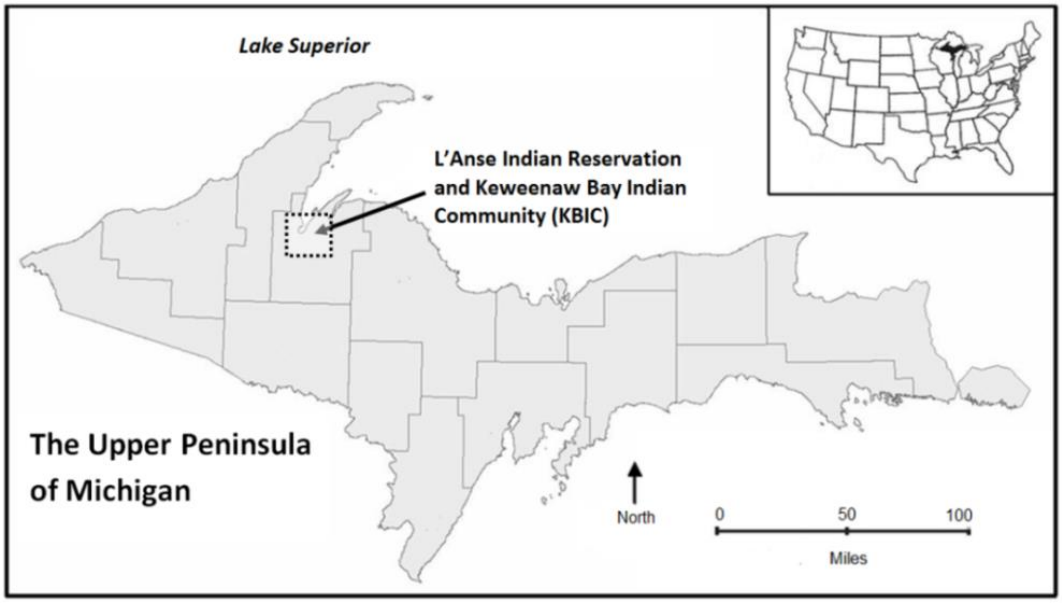

Figure 3.1: The location of the KBIC in Michigan's Upper Penisula (Image: Kozich).

This paper summarizes quantitative survey research that contributes to the KBIC's climate change planning process. Building on previous qualitative findings (Kozich, 2016), our objective is to provide the KBIC Tribal Council with insight on the community's awareness and understanding of climate change concepts, opinions on

potential ecological, economic, cultural, and human health impacts, and details about support for long-term planning initiatives. The work reflects collaboration across Tribal departments to assist the Council with the most effective long-term planning strategies. An understanding of public views is a vital precursor to policy formulation, and enactment of policy measures is likely to be effective only if policies have the support of those they impact. While the literature contains few similarly-designed studies of Native perspectives on climate change, the limited findings indicate that Native communities tend to be acutely aware of environmental changes and have significant concerns about ramifications (Cave et al., 2011; Ford, 2008; Kozich, 2016; Plummer at al., 2009; Smith et al., 2014). This work therefore simultaneously serves the community and adds to the scientific literature by sharing Great Lakes Native perspectives on the important topic of climate change.

Research Design

We followed previous qualitative research by developing a mail survey with three key objectives: (1) describe perceptions of climate change among KBIC members; (2) gain insight on how climate change could potentially impact lifeways of the KBIC; and (3) assess support for long-term mitigation and adaptation strategies. The survey questionnaire and protocols were designed in conjunction with research partners from the KBIC Natural Resource Department, KBIC Forestry Department, and Michigan Technological University Department of Social Sciences. Keweenaw Bay Ojibwa

Community College (KBOCC) Business and Environmental Science majors provided assistance with survey mailing and data entry.

In July 2015 the KBIC Enrollment Office provided an updated mailing list of our target population – all enrolled KBIC members 18 years of age or older residing in Baraga County, Michigan. The list contained 897 names with addresses. From this list we conducted a systematic random sample to select members to be mailed survey questionnaires (excluding KBIC Tribal Council members and individuals directly involved with the research project). The final list of survey recipients contained 370 names and addresses. Because the unit of analysis was the person and not the household, multiple individuals from the same household may have received (and completed) survey questionnaires.

The survey was carried out following established multiple-mailing protocols (Becker, 1998; Dillman, 1978). The initial mailing commenced on July 27, 2015 and the final mailing on September 7, 2015, with the three mailings spaced approximately three weeks apart. Survey packages for each mailing contained a cover letter (Appendix 3a), a questionnaire (Appendix 3b), and an addressed, pre-stamped return envelope. On all mailings, envelopes were hand-addressed with the objective of increasing the response rate (Becker, 1998). The only stimulus altered between the three mailings was the wording of the cover letter. No incentives were offered for completion of the survey. Nine survey packages were returned undeliverable (coded "non-contact"), resulting in an effective sample size of 361.

Table 3.1: Demographic details of survey respondents (N=189 unless otherwise noted).

Category	Respondents (N)	% of respondents
Gender		
Male	90	47.6%
Female	99	52.4%
Town of residence		
Baraga	97	51.3%
L'Anse	88	46.6%
Other	4	2.1%
Years lived in Baraga County (total)		
10 or less	12	6.4%
11 to 20	28	14.9%
More than 20	148	78.7%
Size of home		
1 or 2 bedrooms	40	21.2%
3 bedrooms	110	58.2%
4 or more bedrooms	39	20.6%
Members of household		
1	25	13.2%
2	53	28.0%
3	36	19.0%
4	56	29.6%
5 or more	19	10.1%
Additional housing details		
Lives in Tribal housing	62	32.8%
Has air conditioning or central air in home	87	46.0%
Household annual income		
Less than $20,000	37	20.8%
$20,000 to $40,000	75	42.1%
$40,000 to $60,000	38	21.3%
$60,000 to $80,000	20	11.2%
More than $80,000	8	4.5%
Educational attainment		
Some high school	21	11.1%
High school diploma	110	58.2%
Some college	36	19.0%
Bachelor Degree or higher	22	11.7%
Political identification (N=178)		
Republican	23	12.9%
Democratic	83	46.7%
Independent	67	37.6%

The 189 completed surveys we received yielded a response rate of 52.4%. Survey data were entered and analyzed using IBM's SPSS statistical software. Key demographic traits of respondents were fairly reflective of the target population. For instance, respondents' average age was 44.8 (target population: 45.8), with 39.7% above age 55 (target population: 36.1%) and thus considered elders. Respondents' gender distribution was 47.6% male and 52.4% female (target population: 48.5% male; 51.5% female). Regarding town of residence, 51.3% of respondents lived in Baraga and 46.6% in L'Anse (target population: 56.8% Baraga; 42.0% L'Anse). In other instances demographic attributes of the target population were unknown and therefore we cannot infer representativeness of our sample. For instance, 131 respondents (69.3%) completed a high school diploma or less and 112 (62.9%) reported an annual household income of $40,000 or less. Political identification was decidedly left-leaning; 83 respondents (46.7%) who shared their political identification described themselves as democrats, 67 (36.8%) as independents, and 23 (12.6%) as republicans. Most respondents were long-term residents, with 78.7% reporting having lived in the area for longer than 20 years (Table 3.1).

Most survey items were structured using 5-point Likert scales (1 = strongly disagree; 5 = strongly agree). For items asking respondents to rate their level of concern for various environmental topics, a 5-point ordinal scale was used (1 = not concerned; 5 = very concerned). Appendix 3b contains the complete survey questionnaire.

We took several measures to test for non-response bias. Fifteen non-respondents were contacted by telephone and answered a sub-set of key survey questions. These

individuals were very similar across demographic variables to those who completed the mailed questionnaire (Table 3.2). Additionally, t-test examinations confirmed that their mean responses on the subset of survey items did not differ significantly from those who completed the mailed questionnaire (Table 3.3). We then compared support for climate change planning across early respondents, late respondents, and phone-contacted non-respondents, with the assumption that significant differences could indicate bias. Again, no significant differences were found based on response time. As a final question for phone-contacted non-respondents, we asked why they did not complete the mailed questionnaire. The most common answers were that they "lost it" (40%), "did not see it in the mail" (33%), or "did not have the time to complete it" (20%); none remarked on the nature of the survey topic(s) in their reason as to why they did not complete the survey. Combined with our robust sample size and satisfactory response rate, these tests indicate that non-response bias does not exist and that survey findings are reliable and representative of the community as a whole.

Table 3.2: Comparison of survey respondents and phone-contacted non-respondents.

Demographic variable	Respondents (N=189)	Non-respondents (N=15)
Average age	48.4	47.4
Percent elder	39.7	40.0
Percent male	47.6	53.3
Most common educational attainment	H.S. diploma	H.S. diploma
Most common household income range	$20,000 to $40,000	$20,000 to $40,000
Percent democrat	46.7	43.9

Table 3.3: Comparison of responses to a sub-set of survey items between questionnaire respondents and phone-contacted non-respondents.

Survey question	Mean answer, respondents (N=189)*	Mean answer, non-respondents (N=15)*	P-value
Protection of the environment should be a top priority for the community	4.71	4.67	0.8235
We need to ensure a healthy environment for future generations	4.86	4.60	0.0770
Climate change is already happening	4.40	4.33	0.7296
Climate change is caused by human activities	4.25	4.33	0.7285
Government leaders are doing enough to address climate change	2.11	2.27	0.5637
Climate change could negatively affect our Ojibwa culture	3.98	3.93	0.8243
Climate change could negatively affect our KBIC economy	3.94	4.20	0.2552
We should focus on ways to adapt to climate change	4.29	4.33	0.8507
We should focus on ways to reduce human influence on climate change	4.28	4.33	0.8407
We should ensure that traditional knowledge has a key role in planning	4.40	4.60	0.3481
We should take as many steps as needed to address climate change in long-term planning	4.37	4.47	0.6569

1 = strongly disagree; 2 = somewhat disagree; 3 = neither agree nor disagree; 4 = somewhat agree; 5 = strongly agree

Results

Analysis of survey results yielded important findings across four key thematic areas: (1) lifeways are intertwined with the environment, and environmental concern is high; (2) climate change is happening and is a major problem; (3) cultural values should be incorporated in planning; and (4) support for long-term planning is very high for both adaptation and mitigation measures. Findings from each theme are elaborated on in the following paragraphs.

Lifeways are intertwined with the environment, and environmental concern is high. The first section of the questionnaire contained several general questions intended to gauge respondents' general environmental values. We asked about participation in 13 specific outdoor activities to infer personal and cultural environmental connections, and 10 garnered participation from over 50% of respondents (fishing, swimming, boating, hunting, recreational vehicle use, camping, hiking, sight-seeing, gathering, and powwow attendance). Over 80% eat locally-harvested fish, wild game, berries, and maple syrup. More than two-thirds of respondents reported that they spend ten hours or more per week (on average) outdoors in the spring, summer, and fall. These findings indicate that outdoor activities are highly valued and that respondents are likely to personally observe environmental changes based on their high degree of environmental engagement.

Table 3.4: Climate change concerns for select environmental attributes (N=189).

Attribute	Mean response*	Std. deviation	Mode*
Water quality	4.57	0.864	5
Fisheries	4.46	0.855	5
Rivers and streams	4.45	0.907	5
Lake levels	4.42	0.888	5
Forests	4.38	0.842	5
Medicinal plant species	4.29	0.964	5
Sacred animal species	4.28	0.969	5
Wetlands	4.19	0.947	5
Traditional food sources	4.15	0.913	5
Hunting/game species	4.07	0.981	5

1 = not concerned; 5 = very concerned

In another section of the questionnaire we provided a list of 24 local environmental attributes that the literature indicates could be susceptible to negative impacts from climate change. Respondents were asked to rate their level of concern for these attributes in light of climate change. Using a 5-point ordinal scale (1 = not concerned; 5 = very concerned), the mean level of concern was greater than 4 for 20 of the 24 attributes listed. Table 3.4 lists respondents' concern for a sub-set of these attributes. As an example of the typical response distribution to these items, the histogram in Figure 3.2 shows the frequency of responses to concern for outdoor recreation (mean = 4.33; mode = 5).

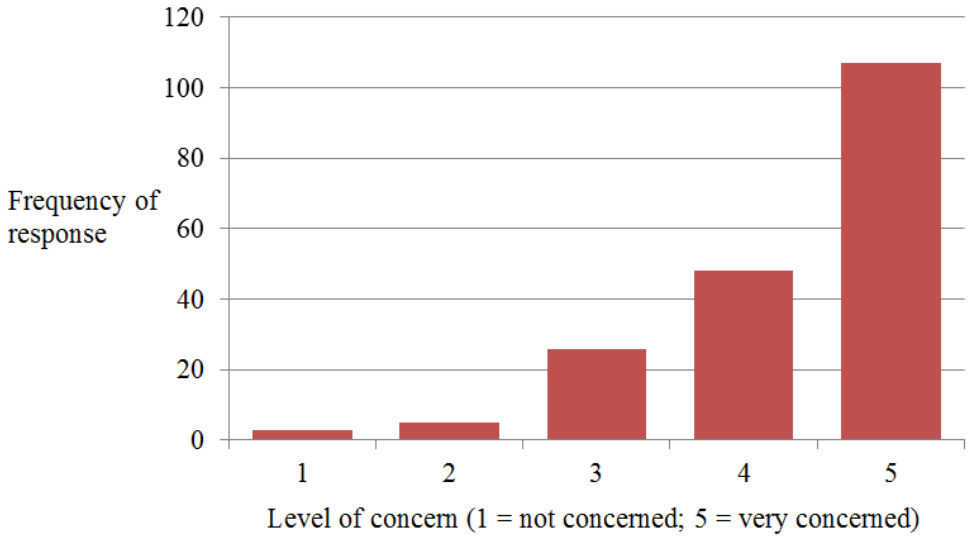

Figure 3.2: Frequency of responses for concern for outdoor recreation (N=189).

To test for internal consistency, we combined seven relevant item topics (air quality, water quality, lake levels, fisheries, wetlands, rivers and streams, and forests) into

a multi-dimensional construct to assess respondents' overall level of concern for negative environmental impacts of climate change. The resulting Cronbach's alpha of .953 indicates an extremely high level of inter-correlations across these items and a degree of concern that is both deep and broad. Altogether these results indicate that respondents are very engaged with the environment, are well-positioned to notice changes, and through their concerns recognize many examples of potential negative impacts climate change could have on local environmental attributes.

Climate change is happening and is a major problem. Respondents appear to be fully aware of the existence and potential impacts of climate change. Ninety percent reported that climate change is happening, 92% reported personally observing changes in local weather patterns in their lifetime, and only 20% believed worries about climate change were exaggerated. They were also generally clear on the causes of climate change with 80% reporting that it is human-induced but only about 60% identifying fossil fuel combustion as a leading cause. Trust in climate science was high with 62% believing scientists understand the problem and 75% agreeing scientists should advise leaders on actions to address it. Yet, trust in government efforts to combat climate change was low with fewer than 18% believing politicians understand climate change and less than 9% agreeing government is doing enough to address it. Survey responses indicate that KBIC members appear to have a clear understanding of the causes and potential impact of climate change but feel more must be done for science to inform government action to combat it.

Based on previous findings among KBIC interviewees, the survey contained items asking respondents to indicate their level of concern for several non-ecological potential climate change impacts, such as human health, community infrastructure, heating/cooling costs, transportation costs, tourism-dependent businesses, and the Tribe's economy in general. The literature indicates that these types of impacts disproportionally imperil many Native communities and are the impacts they typically have the fewest resources to overcome. Respondents expressed high and consistent concern for these potential impacts, regardless of threats that currently exist, indicating that perceptions of risk are widespread and encompass numerous contexts. The mean responses to all items in this section were greater than 4 on a 5-point scale (1 = not concerned; 5 = very concerned), with modes of 5 for all items (Table 3.5).

Table 3.5: Concern for potential non-ecological impacts of climate change (N=189).

Concern area	Mean response*	Std. deviation	Mode*
KBIC economy in general	4.30	0.911	5
Extreme weather events	4.26	1.006	5
Heating/cooling costs	4.23	0.895	5
Human health	4.15	0.999	5
Transportation costs	4.11	0.947	5
Community infrastructure	4.10	0.914	5
Tourism-dependent businesses	4.06	1.014	5

1 = not concerned; 5 = very concerned

The questionnaire contained several items related to indoor air quality because the literature shows that indoor air quality typically decreases as ambient air temperature

increases. Over half of respondents (54%) reported that they live in homes without air conditioning or central air; under warming summer conditions these residents would likely be susceptible to increased problems related to mold, insects, humidity, and other threats that would compromise their health and comfort. Many reported already experiencing various indoor air-related problems (Table 3.6). When asked to describe current conditions inside their homes, over 68% of respondents stated that their home is already too difficult or expensive to keep cool during the summer. These findings should be particularly concerning to KBIC leaders, as many community members appear ill-equipped to adapt to climate change without substantial investments in housing improvements. This is another example of environmental justice issues facing indigenous communities; our findings indicate that, compared to affluent households, the KBIC has many residents at potential risk from heat related issues because they lack the resources to adapt through the purchase of home cooling systems.

Table 3.6: Indoor air problems currently experienced by respondents (N=189).

Indoor air problem	Percent reporting problem
Home is poorly insulated; difficult to heat/cool	68.8
Residents experience headaches, fatigue, or dizziness	50.3
Humidity is too high in summer	43.4
Insects/pests in home	41.8
Too much dust in home	35.4
Residents experience respiratory problems	30.7

Cultural values should be incorporated in planning. Across numerous survey items, respondents consistently indicated the importance of links between traditional

culture and the environment and concern for the ways that climate change could potentially disrupt these links. In response to separate questions, over 95% of respondents agreed that Ojibwa cultural opportunities are important to maintain, cultural identity needs to be maintained in the community, and that Ojibwa culture is intertwined with the environment. Nearly 75% of respondents agreed that climate change could negatively affect Ojibwa culture (likely as a result of negative impacts to culturally-significant facets of the environment). Concern for future generations of Tribal members, a traditionally-sacred value among most Native cultures (as described earlier), was well-expressed by respondents. Over 96% of respondents agreed that the Tribe needs to ensure a healthy environment for future generations of KBIC members. Concern for future generations specifically in light of climate change was similarly high, as over 87% of respondents ranked their concern at either a 4 or a 5 on a 5-point scale (mean = 4.57; mode = 5).

Respondents articulated their wishes for the integration of culture in long-term climate change planning through responses to a series of survey items. Using a 5-point Likert scale, we asked respondents to indicate their level of support for various policy measures the Tribe could potentially adopt. Over 90% of respondents supported prioritizing the survival of sacred plant and animal species in long-term planning (mean = 4.52; mode = 5). Over 82% strongly supported the creation of a group of KBIC specialists to advise the Tribal Council in planning (mean = 4.21; mode = 5). Over 88% supported ensuring that traditional Ojibwa knowledge has a key role in climate change planning (mean = 4.40; mode = 5). Although these results may seem unsurprising, they

indicate that respondents wish to have the Tribe's unique cultural perspectives incorporated into climate change planning in a manner that would be highly unlikely on larger scales in non-Native contexts. The Tribe's development of its own climate change strategies is an assertion of sovereignty, and responses to these survey items demonstrate the importance of implementing planning that integrates the unique culture of the community.

Support for long-term planning is very high for both adaptation and mitigation measures. We asked two summary questions regarding whether or not Tribal leaders should take steps to address climate change. In response to the first item, over 86% supported the Tribe taking "as many steps as needed to address climate change in long-term planning" (mean = 4.37; mode = 5). To test for consistency, a second item was reverse-structured and assessed support for the Tribe taking "no action at this time." Only 7.9% of respondents supported the no-action option (mean = 1.81; mode = 1). Respondents appear clear in their support for leadership action on climate change.

We then asked respondents to indicate their level of support for several specific actions the Tribe could potentially consider adopting. Five of these actions were adaptation measures and included an emphasis on managing natural resources to prepare for inevitable environmental changes (Table 3.7). Respondents were then asked to indicate their level of support for six examples of mitigation measures, focusing mostly on energy and efficiency issues. As Table 3.7 shows, support was very high across all potential policy strategies, as respondents articulated very similar support for adaptation and mitigation measures alike.

Table 3.7: Support for climate change adaptation and mitigation measures (N=189).

Adaptation measures	Percent support	Mean response*	Mode*
Focus on ways to adapt to climate change	88.4	4.29	5
Manage forests to prepare for environmental change	90.5	4.49	5
Manage fisheries to prepare for environmental change	90.4	4.52	5
Prioritize the survival of sacred plant and animal species	89.4	4.52	5
Prepare for possible human health impacts	89.4	4.41	5
Mitigation measures			
Focus on ways to reduce human influence on climate change	85.2	4.28	5
Create initiatives for environmentally-friendly energy sources	91.5	4.61	5
Increase locally-grown food sources	89.3	4.44	5
Increase the availability of public transportation	74.0	4.12	5
Invest in home efficiency improvements for KBIC members	95.2	4.60	5
Offer incentives for reductions in energy use	91.5	4.54	5

1 = strongly oppose; 5 = strongly support

Discussion

Our research adds to the limited literature involving climate change and Native American communities and complements previous work that found Native communities to be very aware of and concerned about climate change (Cave et al., 2011; Ford, 2008; Kozich, 2016; Plummer et al., 2009; Smith et al., 2014). Our first key objective was to describe climate change perceptions among KBIC members; survey findings show a very high degree of awareness and the belief that it is already happening in the area. The finding that 90% of respondents believe climate change is happening is likely related to personal observations, considering the high degrees of outdoor recreation reported by respondents and the claim by 92% of respondents that they have personally observed

changes in weather patterns during their lifetimes. These findings strongly augment previous qualitative research in the community that contained in-depth stories and examples by interviewees about substantial environmental changes observed in the area (Kozich, 2016). Our findings also agree with previous research that found Native Americans to have a fuller awareness of the human causes of climate change than the American public in general (Smith et al., 2014; Vaidyanathan, 2015). However, while 80% of respondents believe human activities are causing climate change, only 60% identified fossil fuel emissions as the leading driver, indicating a possible need for educational outreach in the community for the development and support of mitigation strategies the Tribe may choose to adopt.

Our second key objective was to gain insight on how climate change could potentially impact lifeways within the community. Respondents expressed substantial concern for a wide range of negative impacts from climate change. The high engagement in outdoor activities, including recreational and traditional cultural activities and sustenance harvesting, demonstrates that the links between Ojibwa culture and the environment remain very strong. Considering the awareness of climate change, then, it is not surprising that concerns for negative impacts to these activities were well-articulated by respondents. Concern for negative impacts to important facets of Ojibwa culture was widely reported, with respondents identifying potential threats to water resources, sacred plant and animal species, and traditional activities such as fishing and gathering. Respondents also made astute links between climate change and numerous other facets of life that could be described as non-ecological and non-cultural, including potential

negative impacts to human health, community infrastructure, tourism, and the KBIC economy in general. The numerous potential impacts identified by respondents largely mirror those that scientists anticipate occurring in the Great Lakes region in the future (Dickmann & Leefers, 2003; Melillo et al., 2014; Pryor et al., 2014; Schramm & Loehman, 2010; SWP, 2007). These findings indicate a strong concern that environmental changes associated with climate change could directly and negatively affect community members' day-to-day lives in numerous ways. Previous research in the community found interviewees to identify a similar range of potential impacts, but survey findings revealed a much higher proportion of respondents expressing concern for these impacts (Kozich, 2016).

Our final objective, perhaps relating most critically to future KBIC policy initiatives, was to assess support for long-term climate change adaptation and mitigation strategies in the community. Previous qualitative findings revealed substantial interest by interviewees in mitigation measures such as the development of wind and solar energy production by the Tribe, with few mentions of adaptation strategies outside of the management of forests and fisheries in anticipation of environmental changes (Kozich, 2016). However, survey respondents expressed almost equal support for mitigation and adaptation strategies through several measures. The questionnaire asked respondents to rank their level of support through general statements such as "focus on ways to adapt to climate change" and "focus on ways to reduce human influence on climate change." Following each of these statements, a series of additional items contained specific examples of actions the Tribe may take, such as adopting alternative energy sources,

managing natural resources in preparation of environmental change, and preparing for human health impacts. Support of all actions was consistently high. Perhaps the focus on mitigation strategies by previous interviewees resulted from the fact that interview questions were asked in a semi-structured format, without providing examples of possible policy actions, and interviewees gravitated towards familiar, visible actions such as the installation of solar panels or wind turbines (Kozich, 2016). Survey respondents, by comparison, were provided 12 specific examples of policy actions to consider, perhaps enlightening respondents on the variety of possible actions that would better-prepare the community for a changing climate. Regardless, KBIC leadership will benefit from knowing that all potential policy measures posed in the survey garnered substantial and near-equal support among respondents.

Tribal leadership should also note that respondents expressed strong support for the involvement of scientists, collaboration across Tribal departments, the development of community outreach programs to increase climate change awareness, and the assurance that traditional knowledge plays a role in planning. If the tribe adopts policy actions, leaders will need to incorporate expected environmental changes into the management objectives of many departments besides natural resources, including housing, health, education, and public works departments. Based on survey findings showing respondents to be supportive of all potential policy actions listed in the questionnaire, leaders can be confident that their actions should largely be supported by those they affect.

The ability of KBIC leaders to take action on climate change reflects an assertion of sovereignty through self-management on the critical issue of climate change. Although climate change is a global phenomenon, many jurisdictions are taking policy steps on their own in light of limited federal government action. The KBIC has the opportunity to join several other proactive tribes across the U.S. in the implementation of policy measures to minimize human influence on climate and prepare for inevitable impacts of it. In previous research, KBIC members provided statements suggesting that Native knowledge can lead the way on the important issue of climate change, and survey findings support that view (Kozich, 2016).

This work provides valuable insight for numerous scales. Building on previous qualitative research, survey findings provide robust quantitative data to confidently advise the KBIC Tribal Council on matters involving long-term climate change planning. Nationally, other Native American communities can benefit from KBIC perspectives as they consider adopting their own climate change strategies. Currently, Native communities of the Great Lakes region are underrepresented in the scientific literature on climate change, and little quantitative research has been conducted in Native communities nationwide. Thus our findings address a substantial knowledge gap that similar follow-up research in other Native communities can help continue to fill. Action on climate change requires international effort, but community-level actions will be additionally required. Those being considered by the KBIC can serve as an example to create culturally-relevant policies for tribal communities nationwide.

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Chapter 4: An Examination of Perspectives on Water Resources across Residents of the Great Lakes Region[1]

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Abstract

As global water availability becomes an issue of increasing concern, it is critical to understand human-water relationships in advance of potential shortages. Household water use has been widely studied in arid contexts where conservation is likely a salient issue among residents, but not in contexts where water is less of an immediate concern. We used semi-structured interviews to assess perspectives on regional water resources and household conservation intentions in the Great Lakes region of North America. Interviewees deeply value the region's water resources, but few practice household conservation or plan to do so in the future and few perceive others in the region as conserving water. Beliefs about water-related problems focus more on water quality than supply. Findings will be used to inform an upcoming quantitative mail survey to explain household water conservation motivations based on the Theory of Planned Behavior.

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Introduction

The Great Lakes basin of North America is one of the most water-rich regions of the world. Fresh water characterizes the region's unique ecosystems, holds cultural significance to many residents, and supports vital economic activities such as commercial fishing and shipping, recreation, tourism, and agriculture (GLIN, 2014; Kozich, 2016; Kozich et al., 2016; USEPA, 2014). However while water is regionally abundant, local-scale shortages are occurring due to contamination, increasing human demands, and impacts from climate change (GLIN, 2014; Marshall & Randhir, 2008; Patz et al., 2008; Reeves, 2010). With over 30 million residents dependent on Great Lakes water resources and recent policy actions identifying the need for conservation, it is critical to understand residents' viewpoints on water-related issues (Floress et al., 2015; USEPA, 2014). This paper examines the ways Great Lakes residents think about regional water resources, with emphasis on variables related to household water conservation.

In times of water scarcity, households' importance in regional water conservation planning can be disproportionately high compared to their actual share of water use. In most water management districts, household use represents a small percentage of total water withdrawn. For example, the "public water supply" sector that includes residential, commercial, and industrial use accounted for 13% of total water withdrawn in the Great Lakes basin in 2013 (Great Lakes Regional Water Use Database, 2015). However, households are often considered the most able to adopt conservation measures and are typically the first asked to reduce use in times of shortage through measures such as lawn-watering restrictions, drought-tolerant landscaping requirements, and penalties for

high use (Harlan et al., 2009; USEPA, 2015; Wittwer, 2015). Household water use, particularly outdoors, is also likely the sector that is most visible to politicians, policy-makes, and the general public, rendering households an easier target for cutbacks compared to economically-critical, less visible use sectors such as agriculture, industry, or energy (Wittwer, 2015). Therefore, the household use sector may cumulatively hold the greatest potential for water savings on a regional basis. Water district managers would thus greatly benefit from insight on factors that influence households' motivations to conserve.

The importance of household conservation in the Great Lakes region is also now heightened because conservation is a key component of the 2008 Great Lakes-St. Lawrence River Basin Water Resources Compact ("Great Lakes Compact"). The Compact is a state and federal law that details how regional stakeholders will work collaboratively to ensure the sustainability of Great Lakes water resources (Council of Great Lakes Governors, 2015; Great Lakes-St. Lawrence River Basin Water Resources Compact, 2008). According to the Compact, each of the eight states bounding the Great Lakes must develop and submit a water conservation plan every five years (Great Lakes-St. Lawrence River Basin Water Resources Compact, 2008). Insight on households' water conservation perceptions and behaviors is therefore critical for agency personnel tasked with developing and implementing these plans. It is currently unclear how households are likely to respond to calls for the conservation of water resources that are often considered unlimited.

Across contextual applications, examinations of household water use reveal few consistent trends describing who conserves water and why. Studies often report conflicting relationships between household water use and traditionally-examined demographic variables like age, gender, household income, and educational attainment (Fielding et al., 2012; Hurlimann et al., 2009; Jorgensen et al., 2009; Russell & Fielding, 2010). For instance, while many researchers have found higher-income households to use more water, others have found that they are more likely to conserve because they can afford to install water-saving appliances or fixtures (Millock & Nauges, 2006; Lam, 1999). Some have found older residents more inclined towards household water conservation but others have found them to use more because they spend more time in the home (Fielding et al., 2012; Lyman, 1992). Women tend to be more environmentally-conscious than men but they may use more water because they typically take longer and more frequent showers (Domene & Sauri, 2006; Makki et al., 2011). The most consistent demographic trend related to household water use is that families living in large homes containing more people are typically the highest water users (Aitken et al., 1994; Beal et al., 2011; De Oliver, 1999; Domene & Sauri, 2006; Fielding et al., 2012; Gilg & Barr, 2006; Gregory & Di Leo, 2003; Harlan et al., 2009; Jeffrey & Gearey, 2006; Makki et al., 2011; Renwick & Archibald, 1998; Renwick & Green, 2000; Richter & Stamminger, 2012; Willis et al., 2011; Zhang & Brown, 2005).

The inconsistency of demographic variables to explain household water use has recently led to the call for predictive models (and potential solutions) that emphasize socio-psychological frameworks (Farrelly & Brown, 2011; Floress et al., 2015;

Heberlein, 2012; Randolph & Troy, 2008; Russell & Fielding, 2010). Frameworks of this sort typically include measures of conservation ability, personal habits, and water-related beliefs, norms, and attitudes. To date, however, such research involving household water use is limited to water-stressed contexts where supply is likely a salient issue among residents (Corral-Verdugo et al., 2002, 2003, 2008; Clark & Finley, 2007; Graymore & Wallis, 2010; Harlan et al., 2009; Kenney et al., 2008; Lam, 1999, 2006; Pumphrey et al., 2008; Randolph & Troy, 2008; Trumbo & O'Keefe, 2001; Willis et al., 2011). In these contexts, linkages have been found between conservation intentions and socio-psychological variables but it is unknown if the same linkages exist in contexts that are less water-stressed (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001; Willis et al., 2011). Some researchers also regard such studies as reactionary because they focus on behaviors related to pre-existing water problems; proactive research, on the other hand, could provide insight on behaviors in advance of potential problems and therefore contribute more meaningfully to preventative strategies (Beal et al., 2011; Farrelly & Brown, 2011; Hurlimann et al., 2009; Jorgensen et al., 2009). This point is especially relevant for the Great Lakes region, as agencies are poised to develop and implement water conservation plans mandated by the Great Lakes Compact. Clearly several gaps exist in the literature related to our understanding of water conservation motivations, thereby limiting the ability of water district managers to effectively promote conservation behaviors among users. Clarity on relationships between demographic variables, socio-psychological variables, and conservation intentions for any given

context would provide water management personnel with powerful insight toward reaching conservation goals.

The broad objective of our research was to more fully understand the range of variables that influence intentions to conserve household water in the Great Lakes region. The first stage of this process, described in this paper, involved a qualitative examination of potential conservation-influencing variables that may be applied to an established theoretical framework in follow-up quantitative research. We chose the Theory of Planned Behavior (TPB) as the framework to be used in an ensuing mail survey, so the themes examined in the initial qualitative stage relate to the key TPB variables and the background factors that may potentially influence them (Ajzen, 1991; Fishbein & Ajzen, 2010). Figure 4.1 shows the simplified conceptual model we created for this exploratory stage of the work.

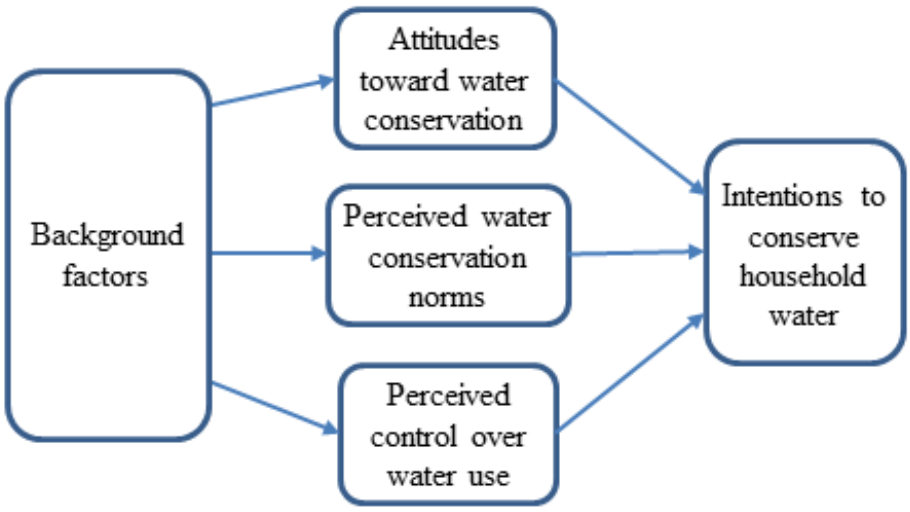

Figure 4.1: Conceptual model based on the Theory of Planned Behavior (modified from Ajzen, 1991; Fishbein & Ajzen, 2010).

As applied to household water conservation, the TPB predicts that intentions to conserve will be high for individuals who perceive themselves as having control over their water use (i.e., the ability to conserve), perceive normative pressures to conserve, and have a positive attitude toward conservation (Figure 4.1). These three variables are in turn influenced by a wide range of underlying background factors. In addition to several traditional demographic variables that represent background factors, we identified the following as potentially relevant for our research context: length of time living in the Great Lakes region, proximity to water bodies, water-related values, engagement in water-related recreation, knowledge and awareness of important water-related topics, past conservation behaviors, perception of water as a product or good, and residence attributes (e.g., rural/urban neighborhood, size/type of home, and type of water service). Across the literature, the three TPB variables have shown the ability to predict household water conservation intentions, although similarly-designed work again occurred in contexts unlike the Great Lakes region and few have examined relationships between TPB variables and underlying background factors (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001). Since the interaction of these variables in water-rich contexts such as the Great Lakes region has been overlooked in the literature, little is known about the ability of the TPB to predict conservation intentions outside of water-stressed settings.

This paper describes preliminary qualitative research aimed at better understanding household water conservation intentions in the region. The objective was to provide a rich foundation for follow-up quantitative research by identifying key themes

involving residents' perspectives on regional water resources and conservation intentions. Findings will inform a quantitative survey capable of testing the predictive abilities of the TPB and quantifying relationships with additional relevant variables, potentially resulting in an enhanced conceptual model that most thoroughly explains intentions to conserve household water in the Great Lakes Region. This two-stage research will help fill the knowledge gaps identified throughout this paper and provide crucial insight for water management agencies facing recent policy developments emphasizing water conservation planning.

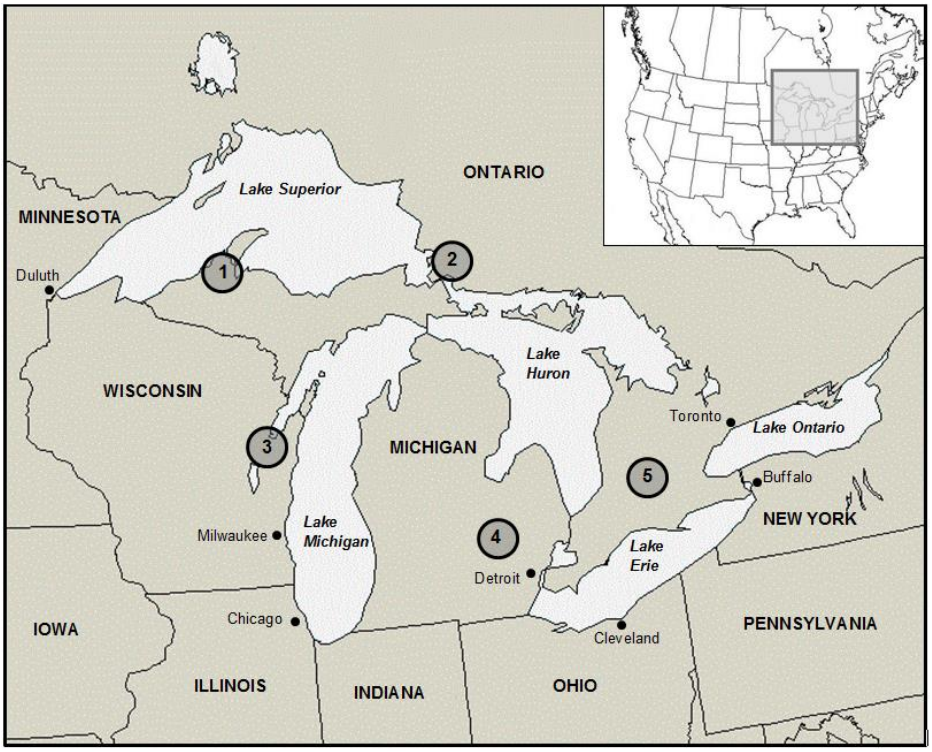

Figure 4.2: Great Lakes region study areas: (1) rural northern Michigan; (2) urban Sault Ste. Marie; (3) urban Green Bay; (4) suburban southeastern Michigan; (5) rural southern Ontario (Image: Kozich).

Research Design

We conducted semi-structured interviews with residents in five Great Lakes sub-regions to gain a richer understanding of viewpoints on water resources (Figure 4.2). These study areas were selected based on their likelihood to serve as a snapshot of the region as a whole. Communities in study areas ranged from small rural towns to large metropolitan centers and were located at varying distances from the nearest Great Lake. Through semi-structured interviews with residents, our goal was to capture the range of water-related perspectives expected to exist across the region as a whole, following Becker (1998). Appendix 4b lists all communities where we conducted interviews, including population data and approximate distance from the nearest Great Lake.

We conducted 43 interviews between May and September 2013, including at least seven interviews in each study area. To solicit interviews we randomly approached residents in public settings while only controlling for the key demographic traits of gender and life stage. At all study areas we conducted interviews on at least one weekday and one weekend day and at various times throughout each day. Outdoor interview settings included downtown sidewalk benches, university campuses, and other open gathering places. To avoid over-sampling residents in leisure settings, emphasis was also placed on locations directly near places people likely visit as part of their day-to-day routines, such as grocery stores and post offices. Indoor interviews occurred in coffee houses and eateries, shopping centers, bookstores, and libraries. We approached 48 potential interviewees, yielding 43 people who agreed to participate (response rate = 90%). As shown in Table 4.1, our group of interviewees was fairly similar to the greater

regional population across key characteristics. While this sample was not designed to be generalizable to the larger population, we are confident that our mix of interviewees included the range of perspectives present in the larger population.

Table 4.1: Demographic characteristics of interviewees compared to the general populations of Michigan, Wisconsin, and Ontario.

Variable	Interviewees	Michigan	Wisconsin	Ontario
Gender				
Male	47%	49%	50%	49%
Female	53%	51%	50%	51%
Age[1]				
Age 18-39	40%	40%	35%	34%
Age 40-59	40%	33%	39%	39%
Age 60+	21%	27%	26%	27%
Educational attainment				
Some high school	7%	8%	6%	13%
High school diploma	28%	32%	31%	28%
Some college	30%	32%	33%	30%
Bachelor degree or higher	35%	26%	27%	29%
Residence				
House	70%	72%	67%	61%
Apartment/condo	30%	23%	30%	38%
Residence setting				
Urban	70%	82%	90%	61%
Suburban	12%	11%	7%	28%
Rural	18%	7%	3%	11%
Residential water service				
Municipal water supply	74%	71%	65%	80%
Private well water supply	26%	29%	35%	20%

[1]Age proportions for states/provinces after removing percent of population below age 18 (Data sources: Statistics Canada, 2011; US Census Bureau, 2010).

Interview questions covered a wide range of topics linked to various elements of our conceptual model (see Appendix 4a for list of interview questions). Questions related to the previously-described background variables in addition to conservation-focused TPB variables (e.g., conservation behaviors already adopted, intentions to conserve in the future, and perceptions of other peoples' conservation). The semi-structured format also welcomed interviewees to share stories, elaborate on topics of particular interest or concern, and raise points not addressed by our pre-determined list of questions. Interviews averaged a half hour long. They were recorded and transcribed verbatim. All transcripts were first analyzed and coded at the item level; upon completion of item-level coding, similar codes were grouped into themes and sub-themes to identify important patterns across interviews (Babbie, 1995; LeCompte & Schensul, 1999). These patterns are reflected in the key themes described in our results.

Results

Analysis of interview transcripts resulted in the identification of the following key themes expressed by interviewees: (1) water characterizes "the way of life" in the region; (2) interviewees were more concerned about water quality than water quantity; and (3) most interviewees misunderstood environmental processes involving water. Each theme is elaborated upon in the paragraphs that follow. Percentages related to interviewee responses are included simply for reporting transparency and to indicate salience of issues across interviewees; they are not intended to be generalizable to the target population as a whole.

Water characterizes "the way of life" in the region. As we conducted interviews, we found this to be the most well-articulated theme by interviewees, who typically used many examples and stories to illustrate their views. Prevalent sub-themes involve the abundance and proximity of water, the unique ecological characteristics of the region, and the importance of serenity, recreation, and family traditions related to water. Interview questions related to this theme focused primarily on background factors of our conceptual model.

Most interviewees were long-time residents of the Great Lakes region. They typically lived close to water and were accustomed to viewing or interacting with it as part of daily life. Thirty-seven interviewees (86%) said that they live less than one mile from a significant water body and that they view it at least once a week. They described the closeness of water bodies as an essential component of their lifestyles, as illustrated by this interviewee:

> *I grew up between two lakes. I mean, water's always been an important part of my life. I can't imagine not living near water. When I think of Michigan and the Great Lakes region, I just always think of water. I took swimming lessons when I was four or five years old. When I was growing up, we fished, being that we lived right there on the lake. My dad always took me up north to the U.P. for fishing, with all the clean lakes and streams everywhere*

> *you turn. Now whenever I have a day off and have some free time, I think "where's the nearest body of water I can get to?"* (Interviewee #37)

Interviewees emphasized the abundance of water as being uniquely characteristic of the Great Lakes region. Many compared the typical scenery of the region to other parts of the country where one could drive for hours without seeing water. When asked to describe what comes to mind when they think about the Great Lakes region, 29 interviewees (67%) focused on the abundance, cleanliness, and variety, and of water features. One remarked, "It's hard to miss it; you see water everywhere you look" (Interviewee #17). Another used the example of Lake Superior to illustrate the vastness of the area's water:

> *The size of Lake Superior...that you can drive for hours, and it's still Lake Superior. My grandchildren have Lake Superior in Marquette. And then they come here to visit, and this is still Lake Superior. And they just can't believe it could be that big.* (Interviewee #42)

Interviewees used many examples to describe the aesthetic features that are characteristic of the region. Twenty-eight (65%) discussed the serenity that water provides, and specifically used the words "peace," "quiet," "space," or "relaxation" at

some point in their responses. Interviewees shared these values within stories of their daily routines, weekend recreational activities, family vacations, or long-term escapes from the bustle of city life. Many contrasted the region's water-rich serenity with other areas in which they've lived. Of these 28 interviewees, 22 also discussed sounds, smells, or textures associated with the water in addition to its visual appeal. Like several interviewees, one remarked on the unmistakable purity of the water by saying, "When you're near the water, you can always smell it in the air; it's like a very fresh feeling" (Interviewee #5).

Water-related recreation is very important to all of our interviewees, many of whom integrated comments about recreation at numerous points throughout their interviews. All 43 said they engage in water-related recreation at least once per month, and twenty-three (53%) said they do so at least once per week. Many described these activities as so central to their lifestyles that they would not choose to live in an area without abundant water. When asked to list what water-related recreational activities they engage in, most interviewees listed several. The most commonly-cited activities include water-related sightseeing (58%), visiting beaches (56%), fishing (51%), watersports (42%), and camping or picnicking near water (35%).

Many explained how water plays important roles in their daily or weekly routines beyond recreational excursions. Thirty-one interviewees (72%) described how they seek the nearness of water even if their activities do not include direct engagement with it; commonly-cited examples include using waterfront parks, trails, or seating areas as an ideal location to exercise, read, or take a relaxing break. Like the interviewee who

provided the next quote, many go out of their way to do things near water simply "because it's there":

> *I've lived in Chatham now since 1993 and I just love to come down here and bring a bottle of water or stop at Tim Horton's and get a coffee or ice-cap or something, and just sit here for an hour or so in the afternoon. I don't fish. I don't swim anymore. I'm too old – I'd just sink. But I'll come down here and sit for a couple hours just shooting the breeze. I like it.* (Interviewee #30)

Water also strongly influences interviewees' family vacations, camping trips, and other similar traditions that happen on a seasonal or annual basis. Many interviewees explained how family traditions involving water are among the most deeply-valued and memorable life experiences they have. These examples occurred through stories by 28 interviewees in response to a broad question about "anything that makes the region's water resources special." Most described memorable childhood experiences involving water and said they now carry on these same traditions with their own children. These traditions hold very special values, as indicated by a quote from this interviewee:

> *Vacation time, spending time on the Great Lakes…camping, going fishing...you know, you go and*

> *enjoy the water. I remember lots of family vacations growing up, and chances to go out with people. And it's always like, 'Yeah, we're heading up north' or 'Yeah, we're going to go out in the water here.' Between fishing, lodging, recreational places...a lot of people have cabins up north...you know, growing up I heard that phrase a lot...'going up north'...* (Interviewee #7)

Interviewees were more concerned about water quality than quantity. Interview questions related to this theme were a central focus of our research and were linked mostly to the TPB-based variables in our conceptual model. Relevant sub-themes expressed by interviewees include their perceptions of water-related problems in the region, their personal conservation motivations, and the belief that most other residents in the Great Lakes region do not take steps to conserve water.

In an open-ended question, we asked interviewees to discuss any concerns they had about the region's water resources. As shown in Table 4.2, most concerns they discussed pertained to quality, cleanliness, or safety, with few references to water supply. Most interviewees listed several specific concerns, and of the ten most frequently cited, seven can be described as pollution (Table 4.2). Twenty-five interviewees (58%) cited dumping or littering as their greatest concern, followed by sewage-related pollution (30%) and contamination from industrial activities (28%).

Table 4.2: Water-related concerns discussed by interviewees. Many listed several.

Concern	Percentage of interviewees (N)
Intentional dumping/littering	58% (25)
Sewage pollution/runoff	30% (13)
Industrial pollution	28% (12)
Effects from invasive species	23% (10)
Inadvertent nonpoint pollution	21% (9)
Excessive water withdrawals/transfers	21% (9)
Agricultural runoff	16% (7)
Reduced surface water levels	16% (7)
Pollution from power plants	7% (3)
Over-fertilizing lawns/golf courses	7% (3)

Many interviewees' water quality concerns were based on personal observations. Of the 25 interviewees who cited dumping or littering as a concern, 24 justified their concern with at least one specific example of a polluting activity they had witnessed firsthand. Many discussed concerns about contamination from wastewater treatment facilities and leaking sanitary landfills. Among the 12 interviewees who discussed industrial pollution, 10 expressed the belief that industrial discharges into water are rampant or that facilities are not adequately regulated by the government. Similarly, deep concern about agricultural runoff represents an example of an unanticipated local finding. Although only seven interviewees (16%) described this particular concern, all were from southern Ontario communities, indicating a perceived local-scale problem that warrants follow-up investigation. Some interviewees, like the one below, provided very

descriptive examples to convey their concerns about impacts from local agricultural activities:

> *Out in the country where I live, there's a pig farm across the road. And every time it rains, there's about 500 acres that just runs downhill into the ditches, into the crick, and eventually it ends up right there in that lake. I see it. And when they spread the manure on the fields, they're supposed to turn it under within 48 hours. Sometimes they do and sometimes they don't. And they can't control the rain. I've even seen the bedding from the pig farm float down through the ditches. And when they're moving the manure from one farm to another, the paved road that they used is so covered in poop that you can't drive on it. If you do, it sticks to the bottom of your car and stinks for weeks.* (Interviewee #23)

Few interviewees appeared concerned about water conservation. When asked, only eight told us that they re-use water, had installed at least one water-efficient appliance or fixture, or discontinued specific uses such as lawn watering. The remaining 35 interviewees (81%) could not provide an example of a specific conservation measure they've adopted. Twenty-nine (67%) admitted that they regularly engage in highly-

consumptive outdoor uses such as lawn watering and car washing. Many interviewees discussed their water use in vague terms, such as "We try not to waste it" or "We don't leave it running". Like the interviewee below, most appeared to believe that they are no more wasteful than others in the region:

> *Let's put it this way, I don't over-use water. I'm probably average when it comes to that. I mean, do I leave a faucet running and walk away, or leave the hose running and walk away? No. I just have these normal practices.* (Interviewee #6)

We asked interviewees if they believe other people in the region are doing anything to conserve water, and only two of 43 confidently replied "yes." Nineteen (44%) were either unsure or claimed that they do not pay attention to others' practices. Twenty-two (51%) believed that others in the region do nothing to conserve water, as the phrase "They take it for granted" was repeatedly mentioned. Twenty-one (49%) believe that water conservation would require uncomfortable lifestyle changes, with many stating that it does not seem necessary in this region since water is so abundant and inexpensive. We asked about water rights and moral obligations for residents to conserve, and responses conflicted across interviewees. Despite the admitted lack of conservation behaviors among the majority of interviewees, nearly half stated that people in the region

should conserve, while one-third expressed the belief that household water use should not be limited as long as it is paid for.

Most interviewees misunderstood key environmental processes involving water. We asked several questions linked to background factors of our conceptual model (knowledge and awareness) to gain a sense of broad links between interviewees' salient beliefs and water-impacting outcomes. Questions focused on familiarity with and understanding of current issues related to water. Specific sub-themes include watersheds and the hydrologic cycle, the importance of wetlands and groundwater, and potential impacts of climate change.

Collectively, interviewees did not indicate that they think of the Great Lakes region in terms of a single ecosystem united by inter-connected hydrological and ecological processes. When asked what comes to mind when thinking about the region in general, most focused exclusively on the Great Lakes themselves while only four discussed inland lakes or other connecting waters. Many admitted that they did not understand concepts involving watersheds or the hydrologic cycle related to questions we asked; most were unaware of the idea of watershed management and only nine could identify a local water resource management organization. Wetlands and groundwater were almost completely overlooked in interviewees' remarks. In an introductory statement before interviews began, we explained the term "water bodies" to include any landscape feature that contains water. In early questions, we asked interviewees to describe the nearest water body to their home and also asked if they had a particular water body that they enjoy visiting. No interviewees identified wetlands, and only two

interviewees mentioned wetlands at any point in interviews. Groundwater received even less attention; at no point did any interviewee specifically mention groundwater or any concerns about it, although four well-water users indirectly referenced it in discussions about the quality of their water supply.

Few interviewees indicated that they thought about possible consequences of reduced water supplies. In hypothetical terms, 15 interviewees mentioned concern for excessive out-of-basin water transfers leading to reduced surface water levels, but in follow-up questions few could accurately describe specific, potential impacts of such outcomes. Only one interviewee described impacts to fish or wildlife, and none mentioned impacts to groundwater, such as a lowered water table or reduced availability for residential use.

We asked a series of questions about climate change, focusing on its potential impacts to the region's water resources. All but one interviewee claimed to be at least somewhat familiar with the concept and 33 stated that they were concerned about it. However, few interviewees could articulate its potential impacts to water resources. For instance, while thirty-nine interviewees (91%) suspected that climate change could impact regional water resources, 15 were unable to elaborate when we asked them to. Only six interviewees linked climate change to physical or ecological disturbances in general, and only one accurately and thoroughly explained linkages between warmer temperatures and specific hydrologic processes such as increased evaporation or changes to the timing or intensity of precipitation events.

Discussion

Among the key themes we identified, the most prevalent involves the deep bonds between interviewees and the region's water resources. Interviewees were very engaged in discussions involving aspects of their lives influenced by the region's water; they provided rich descriptions of recreation, family traditions, and the importance of serenity. While the deep values interviewees associate with water represent important background factors in our conceptual model and tended to dominate interview discussions, they do not appear to translate to water conservation motivations among the residents we spoke with.

Many interviewees expressed the belief that there does not seem to be a need for conservation in the region because there is plenty of water to go around. This belief appears related to the fact that 35 of 43 interviewees admitted they have never adopted any meaningful conservation behaviors. As another background factor in our conceptual model, relationships between past conservation behaviors and future conservation intentions will be further examined in the follow-up survey. We also suspected that engagement in water-related recreation could be related to motivations to conserve water, as if people who regularly and personally interact with water would be more inclined to adopt behaviors to conserve it. That does not appear to be the case among the residents we interviewed.

Another background factor we suspected could be related to conservation intentions involves awareness and understanding of water-related issues. While our findings indicate that water conservation is not a salient issue among interviewees, a

possible explanation could be that issues related to water supply in the region are not well-communicated from scientists and water resource managers to the general public stakeholders. For instance, several interviewees who had spent time in comparably arid regions mentioned the frequency of outreach messages in those areas intended to encourage residents to cut back on water use. They remarked they had not seen or heard the same types of messages here in the Great Lakes region.

Also relating to awareness and understanding of relevant issues, we found many apparent gaps and misunderstandings in interviewees' perceptions of general concepts involving water. We asked questions to assess familiarity with concepts and current issues and found many responses short, incomplete, or ambivalent. For instance, few interviewees related climate change or excessive withdrawals to potential future supply problems, indicating the perception of an unlimited supply of water in the region. In pre-interview conversations we briefly described interview topics and encouraged participants to think broadly about the region as a whole. However, while interviewees typically spoke at length about the importance of the Great Lakes specifically, few paid similar attention to other hydrologic features or processes of the region. Interviewees had little to say about streams, wetlands, groundwater, or inland lakes, for example. While it is possible that interviewees did not fully understand the breadth of our questions, we suspect their responses were more likely a reflection of the extensive values they attach to the (admittedly unique) Great Lakes compared to the (less visible) other water resources of the area. Relationships between these variables and conservation intentions will be more fully examined in future work.

Interviewees' focus on concerns about water quality over water supply could potentially be related to the lack of conservation intentions we noted, although our methodology in this stage of the broader project does not allow for such analysis. Nonetheless, our impression before beginning the interview stage was that the below-average Great Lakes surface water levels of 1998-2013 (NOAA, 2015) had been widely reported through mainstream media outlets and we suspected that increased concern for conservation could result. The prevailing belief shared by interviewees, however, appears to be that there is plenty of water to go around and that calls for conservation are unfounded. Follow-up research should more closely investigate residents' sources of information on regional environmental issues as a potential background factor to add to the conceptual model.

The lack of conservation behaviors across interviewees also relates to a key TPB variable in our conceptual model involving perceived norms. We found beliefs about water conservation norms to be very consistent; only two of 43 interviewees believed others in the region conserve household water and none indicated that they perceive any sort of social pressure to conserve (beyond not being blatantly wasteful). Most believed that they are no more wasteful with water than the average resident. In other words, few are conserving water and few believe others are conserving either. In related studies, beliefs about water conservation norms were very strong predictors of water conservation intentions in water-stressed contexts (Clark & Finley, 2007; Trumbo & O'Keefe, 2001) and it appears that our findings agree. Our follow-up survey will assess the influence of perceived norms on conservation intentions in this region to determine if the same

patterns exist across a larger sample size. We also suspect that a person's length of time living in the Great Lakes region could be a relevant background factor directly related to perceived norms (and ultimately to conservation intentions). As most of our interviewees were long-term residents of the region, perhaps they have simply adopted lifestyles that reflect their perception of water-use norms in the area. According to interviewees, these norms would not seem to inspire conservation. The few interviewees who had spent time living in other parts of the country spoke to this notion, remarking on the noticeable differences in peoples' water use habits and expectations of others.

Several of our findings speak to the TPB variables of attitudes and perceived control related to water conservation, which others have found to be significant predictors of conservation intentions (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001). Among the 81% of interviewees who said that they have not adopted any household water conservation behaviors, most expressed the belief that conservation would require uncomfortable lifestyle adjustments such as monitoring the water use of other household members, reducing or discontinuing outdoor use, or purchasing and installing new fixtures or appliances. Whether these sorts of beliefs relate most closely to perceived control or attitudes in our context will be examined in future work to be able to compare to the findings of others. Moreover, attitudes could be influenced by beliefs about outcomes of conservation efforts, and over half of interviewees stated the belief that conservation does not seem necessary in this region due to the vast supplies of water available. We take this finding to mean that many interviewees consider conservation to

be a waste of time, money, or effort, which the TPB suggests would result in a negative attitude towards it.

The semi-structured interviews we conducted were valuable as a preliminary step in identifying potentially important ideas for future studies. Insight on the background factors and TPB variables we qualitatively examined will guide future modeling efforts and the development of a meaningful survey. We gained preliminary ideas about values and beliefs that were most salient among interviewees, and future work can quantitatively examine possible linkages between these and conservation intentions. The perspectives shared by interviewees also provide insight and richness beneficial to resource managers and policy-makers as they develop proactive water management strategies, particularly with conservation policies in the region likely to expand in the future. Our findings can also benefit outreach personnel who wish to encourage greater conservation behaviors among residents in the region.

While our findings contain policy implications and help address a knowledge gap involving perceptions of water conservation in the Great Lakes region, our work could ideally be enhanced by further studies in states we did not include due to time and scope limitations.

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Chapter 5: Using the Theory of Planned Behavior to Characterize Motivations for Household Water Conservation among Residents of the Great Lakes Region[1]

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Abstract

In the Great Lakes region of North America, increasing threats to fresh water supplies have resulted in conservation mandates signed into law in the Great Lakes Compact of 2008. While households comprise a relatively small water use sector in the region, they will likely be targeted to help meet conservation goals. Because most studies of household water conservation occur in water-stressed contexts, little is known about conservation intentions in areas that are not used to shortages. This paper builds on previous qualitative research and presents an explanatory conceptual model for water conservation motivations based on the Theory of Planned Behavior. Through a quantitative mail survey, we found attitudes and norms to be the strongest predictors of conservation intentions. Findings add to the literature and provide valuable insight to water district managers tasked with meeting conservation objectives in the region.

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Introduction

Fresh water comprises less than 3% of the total water supply on Earth, yet sustains life for countless organisms and is economically critical for human populations. The adequacy of global fresh water supplies is however threatened by the growing global human population, inequitable and unsustainable use across many societies, uneven distribution of water resources on the landscape, and contamination that renders many waters unsuitable for human use (USEPA, 2015). With finite supplies of usable fresh water, it is imperative to understand human motivations for water conservation in order to effectively inform policy-makers tasked with meeting regional water management objectives. This paper reports on the second stage of mixed-methods research that helps explain intentions for household water conservation in the Great Lakes region of the United States (Kozich et al., 2016b).

The Great Lakes basin is one of the most water-rich regions of the world. Its 23,000 km^2 of water comprises about 20% of global and over 90% of U.S. available surface fresh water supplies (GLIN, 2013; USEPA, 2013). The Great Lakes drainage area of 767,000 km^2 encompasses all or parts of eight U.S. states and two Canadian provinces that are also abundant with rivers, streams, wetlands, and inland lakes (GLIN, 2013). Fresh water provides valuable ecosystem services and is economically critical to the region's fishing, shipping, recreation, tourism, and agriculture industries in a region containing 10% of the U.S. and 30% of the Canadian population (GLIN, 2014; USEPA, 2014). The region's water also hold tremendous cultural significance to the region's Native American communities and is often said to dictate 'the way of life' for residents

who are used to viewing it and enjoying recreational activities around it (Kozich, 2016; Kozich et al., 2016a; Kozich et al., 2016b). Figure 5.2 on page 128 provides a map of the Great Lakes basin.

Despite regional water abundance, local-scale shortages are becoming increasingly common due to contamination, increasing human demands, and impacts from climate change (GLIN, 2014; Marshall & Randhir, 2008; Patz et al., 2008; Reeves, 2010). Climate predictions include warmer surface waters, more variable surface water levels, altered precipitation patterns, and more extreme weather events (Marshall & Randhir, 2008; Patz et al., 2008; USGCRP, 2009; USGCRP, 2013). These impacts, combined with increased water demand for agricultural and industrial use, could result in less water available for municipal use (Danz et al., 2007; Tang et al., 2005; USGCRP, 2009). For example, Great Lakes surface levels reached all-time lows in 2012, resulting in a wide range of economic and ecological consequences including wells running dry and the requirement that cargo vessels reduce their loads to avoid bottoming out in shipping channels (IJC, 2013; NOAA, 2013). Many sizable Great Lakes communities have faced municipal water shortages in recent years, indicating the importance of forward-looking regional water resource management strategies that include conservation (IWF, 2016).

Great Lakes households are an ideal target for water use reductions for several reasons. Conservation is a key component of the 2008 Great Lakes-St. Lawrence River Basin Water Resources Compact ("Great Lakes Compact"), an international agreement that requires regional stakeholders to work collaboratively to ensure the sustainability of

Great Lakes water resources (Council of Great Lakes Governors, 2015; Great Lakes-St. Lawrence River Basin Water Resources Compact, 2008). Under the Compact, the eight U.S. states and two Canadian provinces that bound the Great Lakes are required to develop and submit water conservation plans every five years for review (Great Lakes-St. Lawrence River Basin Water Resources Compact, 2008). The implementation of water conservation plans is likely to impact residential users who previously considered the region's water supplies unlimited, and it is currently unclear how they are likely to respond. Increased insight into their conservation motivations is therefore essential for agency personnel tasked with developing these plans.

Furthermore, serious negative economic impacts could accompany mandated water use reductions if agencies focused solely on agricultural or industrial users who may have to substantially alter their practices to comply (Wittwer, 2015). Households are often better able to adopt conservation measures such as lawn-watering restrictions or drought-tolerant landscaping requirements (Harlan et al., 2009; USEPA, 2015; Wittwer, 2015). Excessive household use, particularly outdoors, is also very visible and can result in social pressures to conserve in times of shortage, as has recently been noted in California's water crisis (Wittwer, 2015). In addition, the people making larger-scale agricultural and industrial water use decisions all reside in households. Given that previous research shows that experience with new norms can powerfully impact associated values and beliefs (Heberlein, 2012), including larger-scale water use, households are a particularly valuable research foci. Households' importance in regional water conservation planning may be disproportionately high compared to their actual

share of current water use and they may cumulatively hold the greatest potential for water savings on a regional basis (Great Lakes Regional Water Use Database, 2015).

Literature review

Researchers studying household water use find few consistent predictors when attempting to profile who conserves water and who wastes it. Demographic variables like age, gender, household income, and educational attainment appear to be inconsistent and contextual predictors across studies (Fielding et al., 2012; Hurlimann et al., 2009; Jorgensen et al., 2009; Russell & Fielding, 2010). For instance, some have found older residents more likely to conserve while others have found them to use more water if they spend more time in the home (if they are retired) or have teenagers in the household (Fielding et al., 2012; Lyman, 1992). Women often hold stronger environmental orientation than men, but they tend to use more water in the house by taking longer and more frequent showers (Domene & Sauri, 2006; Makki et al., 2011). Effects of income are similarly mixed; some studies found that higher-income households use more water, but others find that they are more likely to conserve because they can afford to install water-saving appliances or fixtures (Lam, 1999; Millock & Nauges, 2006). Some researchers have shown that high levels of educational attainment are positively associated with water conservation (Gilg & Barr, 2006; Lam, 1999, 2006), while others found the reverse (Clark & Finley, 2007; De Oliver, 1999; Gregory & DiLeo, 2003; Makki et al., 2011). Some research indicates that residents' proximity to water resources affects water-related perceptions and behaviors, but how proximity's relationship to

water conservation intentions is unknown (Brody et al., 2004; Larson & Santelmann, 2007). Across the literature, the most reliable predictors of water use appear to be home size and number of household members, both of which typically correlate with high water use (Aitken et al., 1994; Beal et al., 2011; De Oliver, 1999; Domene & Sauri, 2006; Fielding et al., 2012; Gilg & Barr, 2006; Gregory & Di Leo, 2003; Harlan et al., 2009; Jeffrey & Gearey, 2006; Makki et al., 2011; Renwick & Archibald, 1998; Renwick & Green, 2000; Richter & Stamminger, 2012; Willis et al., 2011; Zhang & Brown, 2005).

The inconsistent role of demographic variables in explaining household water use suggests that causes may run deeper and be better explained through the development of explanatory models (and corresponding policy approaches) that emphasize socio-psychological aspects of water use behaviors (Farrelly & Brown, 2011; Floress et al., 2015; Heberlein, 2012; Kennedy, 2010; Randolph & Troy, 2008; Russell & Fielding, 2010). Beliefs, norms, attitudes, and perceived ability are often examined as predictors of behaviors in frameworks such as the Theory of Planned Behavior (TPB) (Armitage & Conner, 2001; Ajzen, 1991; Fishbein & Ajzen, 2010). The TPB is likely the most widely-used model for explaining environmental behaviors, having been applied to studies of recycling, littering, industrial pollution, energy conservation, agricultural practices, and participation in landowner management programs (Armitage & Conner, 2001). The theory states that intentions to perform a behavior are determined by attitudes towards the behavior, perceived social norms surrounding the behavior, and perceived control over the performance of the behavior (Ajzen, 1991). Intentions to perform the

behavior will be high if these three factors all support the performance of it (Ajzen, 1991; Fishbein & Ajzen, 2010).

The TPB was expanded from the Theory of Reasoned Action (TRA) by adding the behavioral control variable. Unlike the TRA, the TPB is an effective explanatory model only for behaviors under actual behavioral control; if individuals have no actual control over a behavior they are unlikely to perform it no matter how strongly other factors may support it (Ajzen, 1991; Fishbein & Ajzen, 2010). For example, Corbett (2005) found the TPB unsuitable for examining reductions in automobile usage because a lack of public transportation options would leave individuals little choice (i.e., behavioral control) but to drive a car. However, in contexts where behavioral control exists, the TPB can help researchers understand a wide range of human behaviors including water use.

The TPB predicts that intentions to conserve household water will be high for individuals who perceive the ability to conserve, perceive that important others approve of conservation, and have a positive attitude towards conservation. In several studies of household water conservation, all three TPB independent variables have been shown as effective predictors of conservation intentions. Trumbo and O'Keefe (2001) examined conservation intentions in three communities experiencing varying degrees of water stress within the same watershed in the western United States. In an expanded model, they found all TPB variables significantly predicted conservation intentions, with perceived norms exerting the strongest influence overall (Trumbo & O'Keefe, 2001). Clark and Finley (2007) found attitudes to be the strongest predictor of conservation

intentions in a water-stressed region of Bulgaria, although all three TPB variables were again significant. Lam (1999, 2006) found attitudes and norms to be the strongest predictor of conservation intentions in two related studies in Taiwan. The design and overall findings of these studies were quite similar, including the fact that most study communities were experiencing some degree of water stress.

Throughout the literature, several attempts have been made to expand the TPB with the objective of increasing its explanatory power. For instance, researchers often propose the addition of other broad constructs as independent variables alongside the three TPB independent variables, including descriptive norms, personal habits, past behaviors, moral considerations, and environmental concerns (Aarts et al., 1998; Bamberg, 2003; Conner & Armitage, 1998; De Groot & Steg, 2007; Harland et al., 1999; Kaiser, 2006; Knussen et al., 2004; Rivis & Sheeran, 2003). However, such efforts appear to have gained limited traction in the literature, perhaps out of concern that these additional independent variables could potentially confound relationships between existing TPB independent variables or present conflicts of causal logic (Davis, 1985; Fishbein & Ajzen, 2010).

However, the addition of variables to TPB models could be appropriate and informative if included as context-specific preceding variables instead of independent variables (Armitage & Connor, 2001; Ajzen, 1991; Fishbein & Ajzen, 2010). Variables preceding attitudes, norms, and perceived control are termed 'background factors' by the TPB's authors and are typically context-specific (Fishbein & Ajzen, 2010). While the TPB is intended to be applicable to a wide range of behaviors, the inclusion of

background factors may or may not improve the usefulness of the resulting expanded model; however for specific contexts an analysis of background factors could help researchers better understand relationships between TPB variables and underlying factors that influence them (Ajzen, 1991; Fishbein & Ajzen, 2010). Our research therefore has two key objectives: (1) test the ability of the TPB to explain household water conservation intentions in the Great Lakes region, a context unlike previous studies; and (2) examine relationships between TPB variables and context-specific background factors to better explain water conservation intentions through the development of an expanded explanatory model. A key component of both objectives involves assessing the distribution of findings from previous qualitative research in the region (Kozich et al., 2016b).

The background factors on the left side of Figure 5.1 are those we determined to be potentially relevant based on previous household water conservation research in the literature and previous qualitative findings in the Great Lakes region (Kozich et al., 2016b). This initial conceptual model as shown is not intended to suggest causality between individual background factors and the three TPB independent variables; rather it was created to serve as a guide for the development of a final explanatory model after collection and analysis of data. In water-stressed contexts, linkages have been found between demographic and socio-psychological variables and water conservation intentions, but it is unknown if these linkages exist in our study area (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001; Willis et al., 2011).

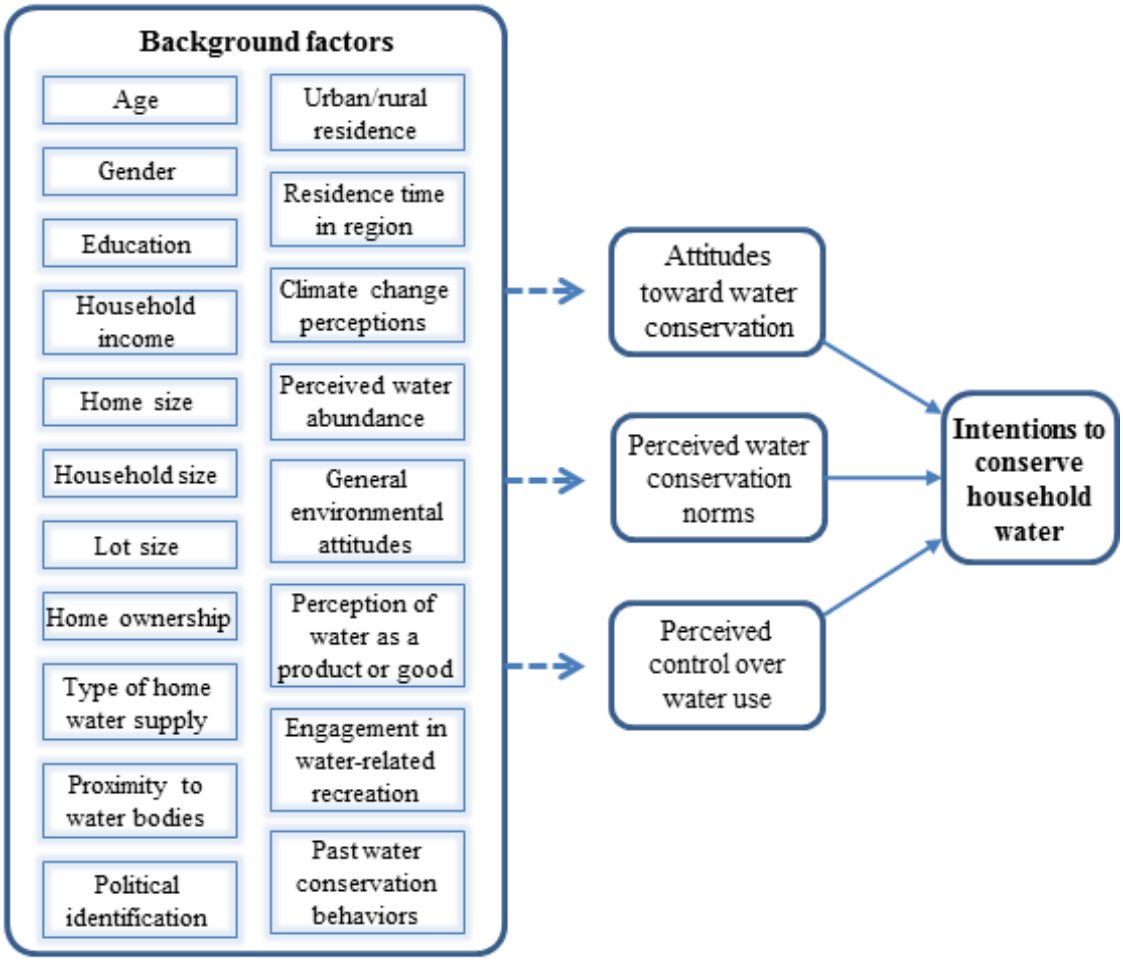

Figure 5.1: Initial conceptual model based on the Theory of Planned Behavior (image modified from Ajzen, 1991, Fishbein & Ajzen, 2010). The large box on the left contains potentially relevant background factors examined in this study.

Investigating conservation intentions in advance of potential water shortages has been cited as a necessary and beneficial precursor to the development of effective water management plans (Beal et al., 2011; Farrelly & Brown, 2011; Hurlimann et al., 2009; Jorgensen et al., 2009). Since the interaction of variables in water-rich contexts has been

understudied, little is known about the ability of any theoretical model to predict conservation intentions in the Great Lakes region, where water supply is less likely to be a salient issue for residents.

Research Design

We designed a mail-based survey questionnaire based on previous international literature and recent qualitative research from the Great Lakes basin (Kozich et al., 2016b). Survey items were linked to variables of the initial conceptual model. The TPB components were developed and incorporated into the questionnaire as recommended by the theory's author, with separate sections in the questionnaire containing multiple items linked to each TPB variable (Ajzen, 2006). Additional questionnaire sections related to background factors of the initial conceptual model. Categorical demographic data was also collected. Most survey items were measured using 5-point Likert scales, excluding those involving demographics or residence attributes. The questionnaire contained 94 items in total. Based on the literature, we formulated the following hypotheses to be tested by our survey results:

H_1: Attitudes toward water conservation are a significant predictor of water conservation intentions.

H_2: Perceived water conservation norms are a significant predictor of water conservation intentions.

H_3: Perceived control over water use is a significant predictor of water conservation intentions.

H_4: Significant differences in water conservation intentions exist between residents of rural and non-rural counties.

H_5: Variables related to affluence (e.g., income, education, home size) are significantly related to water conservation intentions.

We conducted a stratified random sample of Great Lakes residents to be mailed survey packages. Working with a limited sample size, this approach was designed to achieve relatively equal representation across urban and rural settings (e.g., avoiding oversampling of urban environments) and effectively capture the range of perspectives on water issues that exist within the region, focusing on household conservation. We used a GIS to identify all U.S. counties containing any portion of land area within the watershed, with the resulting 207 counties comprising our study area and defined as the "Great Lakes region" (Figure 5.2). By design, the study area slightly exceeds the physical boundaries of the watershed to ensure that important segments of population were not omitted through strict adherence to watershed boundaries (e.g., metropolitan Chicago and other populous areas on Lake Michigan's western coast and Lake Erie's southern coast). According to the U.S. Census Bureau, the total population for these counties in 2010 was 31,100,487 (USDA, 2013).

To stratify counties we referenced the USDA's 2013 Rural-Urban Continuum Code system, which designates all U.S. counties into one of nine categories based on degree of urbanization and proximity to metropolitan areas (USDA, 2013; see expanded explanation in Appendix 5c). For the 207 counties in the study area, we collapsed the

nine USDA county classes into three that we described as “urban” (86 counties), “semi-urban” (66 counties), and “rural” (55 counties). As expected, urban counties contained the vast majority of the population within the study area (85.4%), further emphasizing the importance of the stratified random sample method (see Appendix 5d for complete county lists and population data for each stratum).

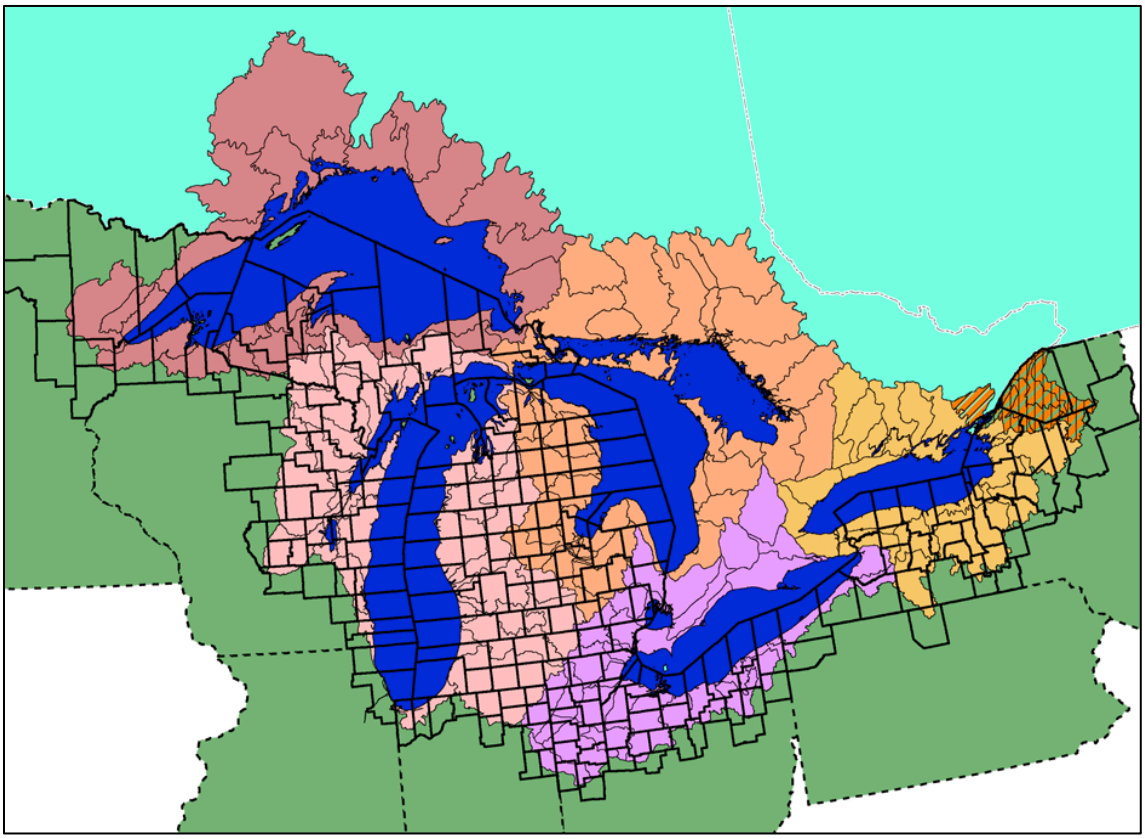

Figure 5.2: The Great Lakes basin superimposed with boundaries of U.S. counties that contain land area in the basin (image source: United States Environmental Protection Agency; http://www.epa.gov/sites/production/files/2015-09/glbasin-large.png).

Table 5.1: Demographic details of survey respondents (N=186 unless otherwise noted). Target population data from U.S. Census Bureau (2014); *Pew Research Center (2014).

Variable	Percentage of respondents	Percentage of target population
Gender		
Male	49.5	49.1
Female	51.5	51.9
Age		
18 to 30	8.1	18.5
31 to 45	24.7	25.3
46 to 60	33.9	31.1
61 and above	33.3	25.1
Household annual income (N=184)		
Less than $20,000	11.4	17.4
$20,000 to $40,000	23.9	21.3
$40,000 to $60,000	26.6	24.1
$60,000 to $80,000	18.5	17.0
More than $80,000	19.6	20.2
Educational attainment (N=183)		
Some high school	1.1	8.9
High school diploma/GED	36.1	31.4
Associate/trade degree	27.9	30.4
Bachelor Degree or higher	35.0	29.3
Political identification (N=184)		
Republican	35.9	40.0*
Democratic	29.9	43.7*
Independent/other	34.2	16.3*

We sampled equally from each of the three county classes. For each class we provided a list of counties to a direct marketing company that in turn generated separate mailing lists of randomly-selected residents. Each mailing list contained 134 names and addresses based on over 300 sources that contribute to the marketing company's

database. Every person on each list was mailed a survey questionnaire, for a total of 402 survey questionnaires mailed.

Table 5.2: Residence attributes of survey respondents (N=186 unless otherwise noted). Target population data estimated from U.S. Census Bureau (2014).

Variable	Percentage of respondents	Percentage of target population
County classification		
Urban	30.2*	85.4
Semi-urban	34.9*	11.3
Rural	34.9*	3.4
Proximity to nearest water body (N=182)		
Less than 1 mile	44.5	n/a
1 to 10 miles	48.4	n/a
More than 10 miles	7.1	n/a
Home type (N=183)		
House	85.2	79.1
Apartment	8.2	15.6
Other	6.6	5.3
Number of bedrooms (N=185)		
1 or 2 bedrooms	48.6	44.7
3 bedrooms	36.2	36.4
4 or more bedrooms	15.1	18.9
Members of household		
1	21.0	19.4
2	45.2	40.7
3	12.9	17.6
4 or more	21.1	22.3
Water supply (N=185)		
City water	56.2	68.1
Well water	43.8	31.9

*We intentionally sampled equally across these categories through a stratified random sample.

Tables 5.1 and 5.2 show descriptive statistics for survey respondents versus the region's population across key demographic and housing variables. Since respondents were fairly similar to the target population in their proportions in variable categories, we are confident their responses are representative of the regional target population. Additional analyses of survey results by response time indicate that non-response bias does not exist.

Survey questionnaires were mailed between August and October 2014 following a multiple-mailing protocol modified from Salant and Dillman (1994). The first mailing contained a cover letter describing the survey (Appendix 5a), the questionnaire (Appendix 5b), and a pre-paid return envelope. Ten days later we followed with reminder postcard to request completion of the survey and thank those who had already completed it. Twenty-one days after the initial mailing we mailed second survey packages to those who had not yet responded to the first. The fourth and final mailing occurred 60 days after the first, again with packages containing a questionnaire, a pre-paid return envelope, and a cover letter containing a final request for completion of the survey.

Thirty-four survey packages were returned incomplete due to unusable addresses or deceased recipients (coded "non-contact"), resulting in an effective sample size of 368. We received completed, usable survey questionnaires from 186 recipients, yielding a response rate of 50.5%. The stratified sampling method successfully garnered similar representation across county classes, as response rates were 52.4% for rural counties (N=65), 51.1% for semi-urban counties (N=65), and 47.9% for urban counties (N=56).

Response rates by state ranged from 46.7% (Illinois) to 71.4% (Minnesota) across the eight states included in the survey. Response rates also varied by mailing wave. Due to budgetary limitations, the first three mailings used a pre-sorted, discount mailing method and resulted in a total of 128 completed surveys (34.4% response rate). With the goal of increasing responses for the fourth and final mailing, we stamped and hand-addressed all envelopes to increase the appearance of personalization and encourage recipients to open them (Becker, 1998). We received 58 additional completed surveys from this mailing to arrive at the final response rate of 50.5%. To test for non-response bias, we compared results of early and late responders, and the only significant difference between groups was that a higher percentage of late responders were from urban counties. No other significant differences were found.

As Table 5.3 shows, we constructed multiple-item scales to measure the TPB variables of attitudes toward conservation, perceived conservation norms, perceived control over water use, and intentions to conserve water (Ajzen, 2006; Sapsford, 2007). Additional abstract variables, including general environmental attitudes and climate change beliefs, were similarly measured through scales. Because factor and reliability analyses demonstrate high internal consistency for all scales we constructed, their use in regression models would be expected to yield more accurate results than models using only single-item variables (Sapsford, 2007).

Table 5.3: Scales constructed for TPB variables in regression models.

Variable	Items
Perceived control over water use (independent variable)	I have the ability to take shorter showers and use less water for household chores.
7 items; α =.706	Water-saving devices are too expensive or difficult for me to install in my home.*
	I don't really know how to use less water than I already do.*
	Water conservation would be difficult because I can't control the amount of water used by others in my household.*
	With small lifestyle changes, I would be able to use less water.
	I can't reduce my outdoor water usage.*
	Overall, I am confident that I could reduce the amount of water used in my household.
Perceived conservation norms	People I know don't worry about conserving water.*
(independent variable)	People in my area probably take water for granted.*
6 items; α =.791	People I know would admire me for conserving water.
	No one would really care if I took steps to use less water.*
	People I know look down upon those who waste water.
	Overall, I feel social pressures to be conservative with my water use.
Attitudes towards water conservation	If I used less water, I would feel good about helping the environment.
(independent variable)	I would not personally benefit from using less water.*
7 items; α =.807	My efforts to conserve wouldn't make much of a difference.*
	Using less water would not lower my standard of living.
	Reducing my water use would be frustrating or annoying.*
	Water-saving appliances/fixtures do not perform as well as those that use more water.*
	Overall, I would feel a positive attitude from my efforts to conserve water.
Intention to conserve water	I plan to install water-saving devices in my home in the future.
(dependent variable) 3 items; α =.857	In the future, I plan to use less water for household chores and outdoor activities.
	Overall, I plan to reduce my water usage in the future.

*responses inverted based on phrasing of statement in questionnaire.

Results

In this section we examine relationships between variables through several explanatory regression models, identify consistently significant independent variables, and describe background factors that are meaningfully related to TPB independent variables. These steps culminate in the development of an expanded conceptual model describing motivations for household water conservation in the study area.

Results from regression models

Of the 186 respondents, 72% (N=134) held a positive attitude from their water conservation efforts, 19.9% (N=37) perceived social pressures to conserve water, 80.1% (N=149) believed that they have the ability to conserve water in their home, and 52.2% (N=97) intended to conserve water in the future. Relationships between these TPB variables were examined through the construction of two linear regression models containing these variables exclusively (Figure 5.3). To be consistent with the literature, the first model operationalized single-item variables phrased as summary questions assessing each element (e.g., "Overall, I feel a positive attitude from my efforts to conserve water"). This model explained 48.3% of the variance in water conservation intentions, as shown as "simple TPB model" in Table 5.4. Attitudes were the strongest predictor of conservation intentions (.471), followed by perceived norms (.389) and perceived control over water use (.034).

As an improvement on the simple TPB model, we then created a parallel regression model operationalizing multiple-item scales (shown in Table 5.3) for all four

TPB variables. This model explained 49.4% of the variance in intentions to conserve household water, as shown in Table 5.4 as "scale-based TPB model." Confirming results from the simple TPB model, attitudes were the strongest predictor of conservation intentions (.446), followed by perceived conservation norms (.289) and perceived control over water use (.181). All three were significant predictors of conservation intentions.

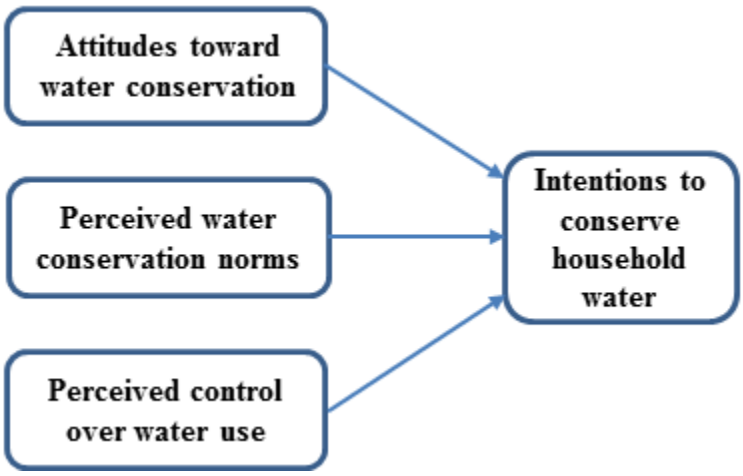

Figure 5.3: Illustration of regression models testing TPB variables only in "simple TPB model" and "scale-based TPB model" (image modified from Ajzen, 1991; Fishbein & Ajzen, 2010). N=186.

Based on the literature, we created three expanded linear regression models that included control variables in addition to the three TPB independent variables (Table 5.4). The five independent variables in Intermediate model 1 combined to explain 49.9% of variance in conservation intentions but the two non-TPB variables added were not

significant predictors. Intermediate model 2 contained 12 independent variables and explained 53.1% of variance in conservation intentions. Past conservation behaviors emerged as a significant but weak predictor in this model (.132). A fully saturated model was then created, containing 22 independent variables and explaining 51.2% of the variance in conservation intentions. Past conservation behaviors again emerged as a significant but weak predictor in this model (.154). All other control variables added to expanded models were not significant and therefore contribute little to the models' effectiveness. Multicollinearity between independent variables (e.g., education, income, home size, and home ownership) further calls into question the usefulness of all expanded models. Thus the key finding across models relates to the consistent relative influence of the three TPB variables; attitudes and perceived norms were the strongest predictors of conservation intentions in all models (Table 5.4).

Hypotheses 1, 2, and 3 were all supported in the scale-based TPB model, as all TPB independent variables were significant predictors of intentions to conserve household water. Hypotheses 4 and 5 were not supported, as county classification or any variables related to affluence were not significant predictors of conservation intentions in any model tested.

Table 5.4: Comparison of regression models. Variable values shown in unstandardized coefficients (beta in parentheses). N=186.

Variable	Simple TPB model	Scale-based TPB model	Intermediate model 1	Intermediate model 2	Saturated model
Positive water conservation attitudes	.586 (.471)*	.584 (.446)*	.473 (.364)*	.486 (.376)*	.490 (.364)*
Perceives water conservation norms	.426 (.389)*	.387 (.289)*	.336 (.252)*	.361 (.262)*	.367 (.264)*
Perceives control over water use	.042 (.034)	.277 (.181)*	.266 (.176)*	.285 (.190)*	.201 (.136)
Past water conserver			.247 (.117)	.280 (.132)*	.330 (.154)*
Pro-environmental attitudes			.092 (.075)	.055 (.045)	.027 (.022)
Female				.178 (.089)	.134 (.066)
Bachelor degree				-.210 (-.101)	-.172 (-.082)
Large home				-.129 (-.065)	-.230 (-.114)
Large household				.205 (.085)	.185 (.079)
Owns home				-.106 (-.043)	-.198 (-.067)
Rural county				-.137 (-.065)	-.093 (-.044)
Lives near water body				-.178 (-.089)	-.209 (-.103)
Concerned about climate change					.056 (.048)
Perceives abundant water					.016 (.008)
Views water as a product					.106 (.052)
Active recreationist					.016 (.008)
Older					-.050 (-.023)
High income					.107 (.052)
Large lot					.041 (.020)
City water supply					.088 (.044)
Long-term resident					.060 (.016)
Democratic political identification					.069 (.032)
Model adjusted R^2	**0.483**	**0.494**	**0.499**	**0.531**	**0.512**

* significant; $p<.05$

Relationships between background factors and TPB independent variables

Based on the literature and previous qualitative findings, we articulated hypothetical relationships between each of the three TPB independent variables (attitudes, perceived norms, and perceived control) and potentially-relevant corresponding background factors. We then created linear two linear regression models for each TPB independent variable; one shows results of saturation with all potential background factors and the other is simplified to its most parsimonious form. Each simplified model's results were compared with results from a forward stepwise regression to test for consistency. The objective of this step was to identify patterns in relationships between background factors and attitudes, perceived norms, and perceived control over water use to build towards a comprehensive path model expanding the TPB through the inclusion of significant background factors.

The saturated regression model for attitudes towards water conservation included 19 background factors and explained 47.9% of variance in attitudes (Table 5.5). Significant background factors were general environmental attitudes (.230), past water conservation behaviors (.234), climate change concerns (.323), and perceived abundance of water (-.152). The corresponding simplified model contained the same significant background factors except perceived abundance of water, and explained 45.6% of variance in attitudes (Table 5.5). A forward stepwise regression identified the same three significant background factors with a model accuracy of 45.1%.

Table 5.5: Regression models showing relationships between background factors and attitudes toward water conservation. Variable values shown in unstandardized coefficients (betas in parentheses). N=186.

Variable	Simplified model	Saturated model
Pro-environmental attitudes	.210 (.225)*	.210 (.230)*
Past water conserver	.403 (.248)*	.374 (.234)*
Concerned about climate change	.315 (.355)*	.280 (.323)*
Perceives abundant water		-.231 (-.152)*
Female		-.065 (-.043)
Long-term resident		-.193 (-.071)
Rural county		-.014 (-.009)
Active recreationist		.135 (.090)
Lives near water body		.146 (.097)
Views water as a product		.020 (.013)
City water supply		.136 (.091)
Owns home		-.026 (-.012)
Large lot		.065 (.043)
Large home		.056 (.037)
Large household		.008 (.005)
Older		.024 (.015)
Bachelor degree		.176 (.113)
High income		-.194 (-.127)
Democratic identification		.004 (.003)
Model adjusted R^2	**0.456**	**0.479**

* significant; $p<.05$

The saturated regression model for perceived water conservation norms included 12 background factors and explained 19% of variance (Table 5.5). Significant background factors were general environmental attitudes (.350), past water conservation behaviors (.176), and age (.178). The corresponding simplified model contained the same three significant background factors and explained 18% of variance (Table 5.5). A forward stepwise regression found the same results with a model accuracy of 18%.

Table 5.6: Regression models showing relationships between background factors and perceived water conservation norms. Variable values shown in unstandardized coefficients (betas in parentheses). N=186.

Variable	Simplified model	Saturated model
Pro-environmental attitudes	.239 (.262)*	.308 (.350)*
Past water conserver	.248 (.158)*	.268 (.176)*
Older	.328 (.212)*	.272 (.178)*
Concerned about climate change		-.101 (-.120)
Long-term resident		-.028 (-.011)
Rural county		-.124 (-.083)
Lives near water body		.162 (.113)
Perceives abundant water		-.084 (-.057)
City water supply		.237 (.166)
Large lot		.107 (.074)
Bachelor degree		-.067 (-.044)
High income		-.072 (-.049)
Model adjusted R^2	**0.180**	**0.190**

* significant; $p<.05$

The saturated regression model for perceived control over water use included 11 background factors and explained 12.8% of variance (Table 5.7). Significant background factors were general environmental attitudes (.210), past water conservation behaviors (.243), and length of residence time (-.198), which was negative correlated (Table 5.7). The corresponding simplified model contained the same three significant background factors and explained 12.4% of variance (Table 5.7). The forward stepwise regression for perceived control was the only one that differed from its linear regression counterpart; it found rural county residence to be a significant (but weak) predictor, while length of residence in the region was not. The forward stepwise regression model yielded an accuracy of 10.7%.

Table 5.7: Regression models showing relationships between background factors and perceived control over water use. Variable values shown in unstandardized coefficients (betas in parentheses). N=186.

Variable	Simplified model	Saturated model
Pro-environmental attitudes	.152 (.187)*	.175 (.210)*
Past water conserver	.348 (.250)*	.348 (.243)*
Long-term resident	-.423 (-.180)*	-.494 (-.198)*
Large lot		-.018 (-.014)
Large home		-.029 (-.022)
Large household		-.161 (-.104)
Older		.012 (.008)
High income		.144 (.107)
Female		-.042 (-.031)
Owns home		.052 (.026)
Rural county		-.093 (-.067)
Model adjusted R^2	**0.124**	**0.128**

* significant; $p<.05$

The consistency of results in each of the preceding models involving background factors indicates support for the development of a comprehensive explanatory model that shows relationships between all significant TPB variables and corresponding significant background factors. The resulting path model is shown in Figure 5.4 and best explains water conservation intentions among survey respondents in the Great Lakes region. It captures the parsimony of the simplified TPB model but ads richness through the inclusion of significant background factors related to each of the three TPB independent variables.

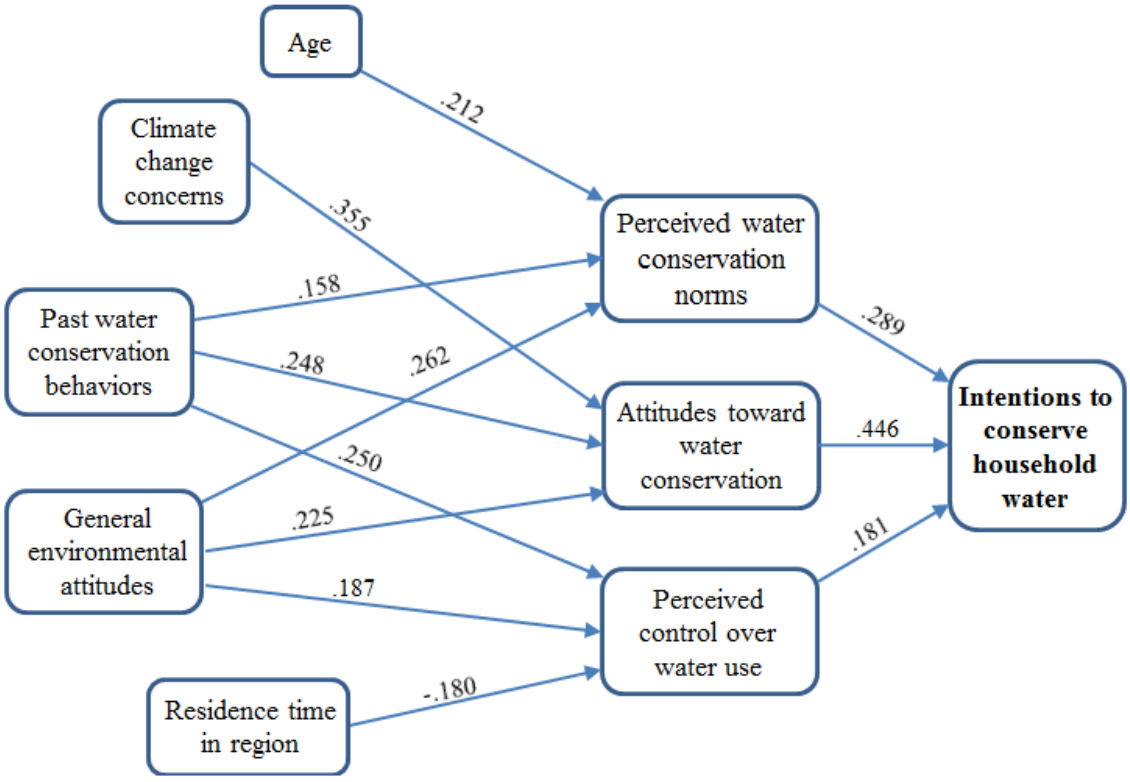

Figure 5.4: Path model explaining water conservation intentions. The model includes all significant variables and corresponding significant background factors (N=186).

Discussion

The scale based, simplified TPB model that includes significant background factors (Figure 5.4) appears to be the most parsimonious conceptual model for explaining household water conservation intentions among survey respondents of the Great Lakes region. The model explained 49.4% of variance in intentions to conserve water, and did so using only the three TPB independent variables of attitudes, perceived conservation norms, and perceived control over water use. These findings compare very favorably to

similar explanations of household water conservation intentions based on the TPB. For example, Lam's (1999) TPB-based model explained 41% of the variance in intentions to reduce water use and 24% of the variance in intentions to install water-saving devices. Lam's follow-up work (2006) found that the TPB alone explained 18% of the variance in intentions to install water-saving devices while an expanded model explained 36%. The expanded model of Trumbo and O'Keefe (2001) explained 27% of the variance in intentions to conserve water, of which the TPB variables accounted for 67%. In Clark and Finley's (2007) expanded model, TPB variables accounted for only 9.8% of the variance in intentions to conserve. As a further comparison, a 2001 meta-analysis of 185 applications of the TPB across numerous contexts found that it explained 39% of variance on average (Armitage, 2001). This indicates that the use of the TPB for our research context was suitable and very effective.

Across all explanatory models we constructed, attitudes and perceived conservation norms were the strongest predictors of conservation intentions, agreeing with similar research in explaining what most motivates people to conserve household water (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001). Perceived control over water use was a weak but significant predictor in our scale-based TPB model, but because this model is the one we identified as the best for explaining intentions, our first three hypotheses are all supported. The lack of significance of perceived control in expanded models suggests that it may confound with other independent variables these models included. Nonetheless the significance of all three TPB variables in our parsimonious model indicates that many of the same linkages found

in water-stressed contexts exist in our study area too (Clark & Finley, 2007; Lam, 1999, 2006; Trumbo & O'Keefe, 2001). Because little was previously known about these relationships in water-rich contexts, findings contribute valuable insight to the literature and can help inform agency personnel involved in future conservation objectives in the region. Findings also provide a valuable update to the literature, since we were unable to identify similar research conducted since that of Clark and Finley (2007).

Descriptive statistics involving norms enhance previous qualitative research in the Great Lakes region finding that few perceive water conservation as a salient issue (Kozich et al., 2016b). Regarding perceived norms of others, most survey respondents agreed with the statement, "People I know don't worry about conserving water." Respondents also indicated very low perceptions of subjective norms (social pressures to conserve), which are the focus of the norms component of the TPB. Low levels of normative pressures appear as a possible explanation to non-conservation intentions. A significant positive correlation exists (at the .01 level) between perceptions of social pressures to conserve and intentions to conserve, indicating that increased social pressures could result in increased conservation intentions. This finding could greatly assist with the development of outreach campaigns intended to increase household water conservation behaviors in the region, agreeing with previous research (Kozich et al., 2016b).

One of our research objectives was to identify and quantify significant and context-relevant background factors to more meaningfully explain household water conservation intentions in the region. Based on the literature and previous qualitative

research in the Great Lakes area, we tested 19 background factors for significance regarding their underlying influence on the three TPB independent variables. The most consistently significant of these 19 background factors, influencing all TPB independent variables, were general environmental attitudes and past conservation behaviors. Their significant relationships to all three TPB independent variables suggest their importance in a final explanatory model, which we constructed. In our research context, we agree with the TPB authors that variables such as past behaviors (or habits) and general beliefs and attitudes are best incorporated into the TPB as background factors (Ajzen, 1991; Fishbein & Ajzen, 2010), which has been challenged by some researchers (Aarts et al., 1998; De Groot and Steg, 2007; Knussen et al., 2004). Their inclusion as independent variables alongside TPB variables did not result in significant improvement to our TPB-based model; furthermore their role instead as background factors avoids causal order conflicts and possible confounding with TPB independent variables (Davis, 1985; Fishbein & Ajzen, 2010). Therefore we are confident that for our dataset the most sensible and effective explanatory model for water conservation intentions is the path model shown in Figure 7, adhering to the original design intentions of the TPB.

Typical demographic variables were of little value in explaining household water conservation intentions in our research. For example, unlike much previous research, we did not find home size or number of household members significant predictors (Aitken et al., 1994; Beal et al., 2011; De Oliver, 1999; Domene & Sauri, 2006; Fielding et al., 2012; Gilg & Barr, 2006; Gregory & Di Leo, 2003; Harlan et al., 2009; Jeffrey & Gearey, 2006; Makki et al., 2011; Renwick & Archibald, 1998; Renwick & Green, 2000; Richter

& Stamminger, 2012; Willis et al., 2011; Zhang & Brown, 2005). Additional demographic variables such as age, gender, household income, and educational attainment provided little insight either, agreeing with previous findings noting the inconsistency of these variables in predicting water use (Fielding et al., 2012; Hurlimann et al., 2009; Jorgensen et al., 2009; Russell & Fielding, 2010). Therefore our findings support the emphasis many researchers place on explanatory models for water use that focus more on socio-psychological variables and less on demographics (Farrelly & Brown, 2011; Floress et al., 2015; Heberlein, 2012; Randolph & Troy, 2008; Russell & Fielding, 2010). As an example, our final explanatory model includes only one traditional demographic variable (age), which had a weak but significant relationship only with perceived norms.

Another potential predictor that we found of little use in our explanatory model involves residents' proximity to water bodies. Based on previous research from other settings, and findings from qualitative studies in the region, we anticipated that those who live close to water would be likely to value it more and therefore conserve it more (Brody et al., 2004; Kozich et al., 2016b; Larson & Santelmann, 2007). We found this to not be the case.

Our prior qualitative research in the region found that concern for water quality appeared much higher than concern for supply, and our survey results agree (Kozich et al., 2016b). While water quality problems certainly do exist in the Great Lakes region and should not be disregarded, we suspect the visibility of vast water resources results in the ongoing impression of unlimited regional supplies, as we previously proposed

(Kozich et al., 2016b). It appears that the importance of conservation has not (yet) resonated with the general public, and that the awareness of conservation objectives such as those included in the Great Lakes compact is generally lacking. The need for effective messaging should therefore be addressed as a priority of conservation policy implementation.

Our final two hypotheses involved the predictive abilities of demographic variables such as affluence and rural/urban residence setting. We found these variables not significantly related to conservation intentions, resulting in rejection of both hypotheses and the inability to enter our findings into discussions of the conflicting roles of these variables.

Conclusion

Several objectives were met through this research. Adding to the literature, we tested the ability of the TPB to explain household water conservation intentions in the Great Lakes region and found it to be an effective framework for this context. Findings are comparable to those from similar research conducted in water-stressed contexts, indicating that many of the same linkages exist between TPB variables in explaining to intentions to conserve household water. The explanatory power of our final model also exceeds that of most TPB-based research. Filling a considerable knowledge gap, we identified relationships between TPB independent variables and underlying background factors that add to our understanding of conservation motivations. This explanatory model builds on the TPB without compromising its design objectives. Our work also

provides a valuable update to the literature, since the most recent comparable study of household water conservation based on the TPB was conducted in 2007.

There are several valuable policy implications of our research. The Great Lakes Compact was passed in 2008 with little research evident in the scientific literature involving residents' perspectives on water conservation. Our findings can aid in the development of appropriately-targeted outreach messages as regional water conservation is emphasized in accordance with goals of the Compact. For example, the significant correlation we found between perceived conservation norms and conservation intentions could be particularly valuable in efforts to change water-use behaviors.

Compared to previous research, our findings are limited by a relatively small sample size. Follow-up research would be strengthened by leveraging a larger sample size, perhaps by also including Canadian residents of the region. Although it would likely be challenging and costly, future research would also benefit from measuring actual water use compared to perceived water use to assess the strength of relationships between intentions and behavior.

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Chapter 6: Conclusion

The research presented in this dissertation demonstrates the important role of social science in addressing critical environmental problems. Worldwide, climate change impacts and reduced water availability are expected to imperil more and more communities into the future, calling for policy actions that will require changes in human behaviors. The development of effective policies requires insight on human values, beliefs, and behaviors that contribute to the problem(s) and an accurate knowledge of stakeholders' perspectives on solutions, particularly regarding their likelihood to support policy actions. Despite the best intentions, policies can be doomed to failure if any of these components are missing.

This research provides vital information for policy-making processes at a number of scales. The research described in Chapters 2 and 3, for example, was driven by a recent climate change planning initiative enacted at the local government level. While the passage of this initiative is admirable and will undoubtedly provide long-term benefits to the community, it was legislated with little fanfare and without any awareness of the perspectives of the community members it will impact. We recognized the need to collect scientifically-sound qualitative and quantitative data that will provide KBIC leaders the insight necessary to make decisions that are representative of the community's wishes. Without this sort of information, leaders would risk turning uninformed decisions into unpopular actions. Through semi-structured interviews and a quantitative mail survey, however, we are now able to present leaders with rich and detailed insight accurately describing the values, concerns, and policy preferences of the community.

For instance, we found that through personal observations and word-of-mouth information-sharing, interviewees and survey respondents were very aware of recent environmental changes in the area and largely attribute them to climate change. They were very concerned about potential cultural impacts and wish to place the highest priority on protection of sacred plants, animals, and water resources. Because of these concerns, support for climate change policies appears very high. We presented survey respondents a list of policy actions the Tribe will likely consider, and support was very high for all options (including mitigation and adaptation strategies). Interviewees and survey respondents also made it clear that they prefer decisions to include cultural values and to be made in conjunction with leaders across all relevant tribal departments. Equipped with this valuable information, Tribal leaders can now proceed confidently with specific policy actions with the ability to anticipate the community's response.

Many indigenous communities worldwide, including other Native American communities, are already bearing a disproportionate burden of climate change impacts and have limited resources to adapt. Many are developing their own climate change planning strategies in lieu of limited federal government action. With limited comparable information in circulation, their policy development will therefore benefit greatly from the availability of our research findings. Across cultures, many indigenous communities have similar strengths and challenges in responding to climate change. Our research thus provides insight that is valuable on a global scale as well as a local scale, and we will share findings through as many outlets as possible to help other indigenous communities effectively develop their own climate change strategies.

Policy actions regarding the conservation of Great Lakes water supplies are well underway. The Great Lakes Compact was signed in 2008 as an interstate and international law with the objective of sustaining the basin's water resources through state-wide conservation planning. As we began researching this topic we found little information in the scientific literature regarding stakeholders' perspectives on water conservation, specifically regarding their likelihood to support conservation requirements. Like the KBIC climate change initiative, this represents an example of important environmental legislation being passed without an adequate examination of public sentiment. Our objective from a policy standpoint was again to conduct interview and survey research to accurately gauge public perspectives on this important topic. Compared to the community-based climate change study, however, this research involved a target population of over 31 million residents across eight states and a Canadian province. The same research methodology was effective, however, and will provide valuable information to agency personnel and water district managers.

The information presented in Chapter 4 describes important links interviewees expressed between water-related values, beliefs, and behaviors. Nearly all interviewees used tremendous detail to illustrate the importance of Great Lakes water resources, but few said that they practice household water conservation or perceive others in the region to conserve either. Most expressed little concern for regional water supplies and focused instead on concerns for water quality. These findings were supported through statistical analysis of responses from the follow-up mail survey described in Chapter 5. By using a stratified random sample across all U.S. counties within the basin, we effectively

captured perspectives on a wide range of water-related topics across a very diverse population. The survey focused particularly on motivations for household water conservation, and was designed based on the widely-acknowledged Theory of Planned Behavior (TPB).

The research described in Chapter 5 represents the pinnacle of this dissertation. Besides collecting important information for policy applications, we tested the ability of an established theory from the field of psychology to explain and predict intentions to conserve household water. We then constructed a context-specific, expanded model that also articulates relationships between key TPB variables and the background factors that influence them. The result is an explanatory model that not only confirms the suitability of the TPB for our research context but can also help water management personnel more effectively create outreach messages to the desired target audience with the objective of positively influencing behaviors. Our findings therefore can be a powerful tool for policy officials at many levels.

All aspects of our research also contribute to the scientific literature by helping to fill substantial knowledge gaps. Peer-reviewed research involving indigenous communities and climate change has seemingly just begun to gain momentum in the literature, and we found very little that has been conducted in the Great Lakes region. With Native perspectives from this region previously overlooked, our work will successfully introduce new voices to broader discussions on human aspects of climate change. Likewise, most water conservation research in the literature involves contexts where water availability is already a problem. No similar research involving the TPB has

apparently been added to the literature since 2007, and all comparable studies occurred in settings very unlike the Great Lakes region. Perspectives on conservation, particularly involving the factors that influence it, were largely unknown for this area prior to our research. The ability of the TPB to explain conservation intentions outside of water-stressed contexts was similarly unknown. Our final explanatory model also exceeds the work of most similar research by incorporating an examination of background factors that relate to TPB variables. Thus, both research projects presented in this dissertation are not only proactive in a policy sense but also add novel insight to the literature that will increase our broader understanding of human-environment relationships and be valuable in the development of solutions to substantial environmental issues.

A final unifying theme in this dissertation is the parallel social science methodology we used to effectively provide insight on two very important environmental topics in two distinct research contexts. The combination of semi-structured interviews and quantitative mail surveys in both studies produced findings containing rich personal perspectives as well as detailed quantitative data suitable for statistical analysis. This two-stage approach very effectively produced thorough and defensible findings appropriate for dissertation-level research.

Each of the four chapters of this dissertation will be independently published in scientific journals and will be very valuable for scholarly and pragmatic applications at many levels.

Appendices

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Appendix 1: Keweenaw Bay Indian Community Resolution KB-016-2015 (available at http://www.kbic-nsn.gov/).

KEWEENAW BAY INDIAN COMMUNITY

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RESOLUTION
KB-016-2015

TO ESTABLISH A CLIMATE CHANGE ADAPTATION INITIATIVE

WHEREAS: the Keweenaw Bay Indian Community is a federally recognized Indian Tribe exercising inherent sovereign authority over its members and its territories, and the Keweenaw Bay Indian Community has a reservation created pursuant to the 1854 Treaty with the Chippewa, 10 Stat. 1109; and

WHEREAS: the Keweenaw Bay Indian Community is organized pursuant to the provisions of the Indian Reorganization Act of 1934, (48 Stat. 984, 25 U.S.C. §476) with a Constitution and Bylaws duly approved by the Secretary of the United States Department of the Interior on December 17, 1936; and

WHEREAS: Article VI, Section 1(a) of the Keweenaw Bay Indian Community Constitution empowers the Tribal Council to protect the health, security and general welfare of the Community; and

WHEREAS: there is overwhelming scientific evidence of climate change driven in part by the release of greenhouse gases into the atmosphere; and

WHEREAS: the effects of climate change may significantly affect the Keweenaw Bay Indian Community through changes in seasonal weather patterns, increase in extreme weather events, changes in Lake Superior ice cover and water levels, change in abundance and distribution of coastal wetlands, loss of native plant and animal species, and increase in non-native and invasive species; and

WHEREAS: the associated effects of climate change will negatively impact the local environment, fish and wildlife, natural resources, and infrastructure on which the Keweenaw Bay Indian Community relies; and

WHEREAS: through traditional knowledge, practice, experience, and relationships with nature, the Keweenaw Bay Indian Community has an important role in defending and healing the natural environment; and

WHEREAS: the Keweenaw Bay Indian Community Natural Resources Department has considered the potential and current impacts of climate change on tribal members, the environment, and natural resources and has registered these impacts as a concern; and

WHEREAS: inaction on climate change in the present may yield negative social, environmental, cultural, and economic consequences in the near future; and

WHEREAS: the Keweenaw Bay Indian Community will need to develop long-term resiliency and continuously adapt to climate change and its impacts; and

WHEREAS: a climate change adaptation initiative will create a more resilient community to be able to cope with associated climate change impacts on the tribe's social, economic, environmental, and cultural well-being; and

NOW THEREFORE BE IT RESOLVED THAT: the Keweenaw Bay Indian Community Tribal Council formally supports a Climate Change Adaptation Initiative and directs the Natural Resources Department to oversee and coordinate the initiative which shall include efforts to determine potential local effects, assessment of climate change vulnerabilities for the L'Anse Indian Reservation, integration of climate change planning into existing management plans, development of policies and strategies to address climate change, communication and coordination with other tribes and agencies, and community outreach to identify impacts and adaptation strategies and to provide education related to climate change.

AND, LET IT BE FURTHER RESOLVED THAT: the Natural Resources Department shall seek funding to support the Climate Change Initiative and strengthen the capacity of the community to adapt to evolving climate change effects.

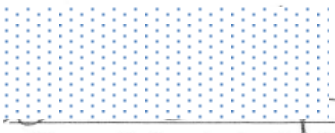
AND, LET IT BE FURTHER RESOLVED THAT: the Natural Resources Department shall report to the Keweenaw Bay Indian Community Tribal Council every quarter on the Climate Change Adaptation Initiative's progress.

CERTIFICATION

We, Warren C. Swartz, Jr., President, and Toni J. Minton, Secretary of the Keweenaw Bay Tribal Council, do hereby certify that this Resolution No. KB-016-2015 to be a true and exact copy as approved by the Tribal Council of the Keweenaw Bay Indian Community at a duly called meeting held on 4/16/15 there being a quorum present, by a vote of: 11 In Favor, 0 Opposed, and 0 Abstentions, as follows:

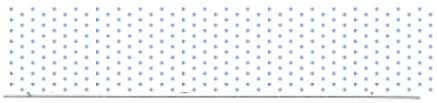
Vice President, Jennifer Misegan:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Secretary, Toni J. Minton:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Asst. Secretary, Susan J. LaFernier:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Treasurer, Doreen G. Blaker:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Robert "R.D." Curtis, Jr.:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Eddy Edwards:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Randall R. Haataja:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Michael F. LaFernier, Sr.:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Gary F. Loonsfoot, Sr.:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Don Messer, Jr.:	(AYE)	NAY	ABSTAIN	NOT PRESENT
Councilperson, Donald Shalifoe, Sr.:	(AYE)	NAY	ABSTAIN	NOT PRESENT
President, Warren C. Swartz, Jr.:	AYE	NAY	ABSTAIN	NOT PRESENT

(If Required)



17APR 2015

Warren C. Swartz, Jr., President



Toni J. Minton, Secretary

Appendix 2a: KBIC climate change interview question list.

How long have you lived in the area?

What do you like about the area? What makes it special?

What kinds of things do you do outdoors?

To you, what's important about our environment? Please include anything you'd like to share about its cultural value.

From what sources do you typically hear information about the environment?

Do you have any concerns for our local environment?

Tell us about any changes you've observed in our environment during your lifetime.

Tell us what you've heard about climate change. What comes to mind when you hear people talking about it?

Do you believe climate change is already happening? Do you believe it will happen in the future?

[If yes to previous questions] What do you think is causing it?

Are you concerned about it? [If yes] Please share any concerns you may have about possible effects from climate change.

How do you think it could affect lifeways within our community?

How do you think it could affect you personally?

Do you think our community leaders should be taking action to address climate change? What should we be doing? Can you think of any solutions or strategies the KBIC leaders should consider? Would you support these types of actions?

Tell us about anything you think is important about traditional ecological knowledge. Do you think it should have a role in climate change planning?

Is there anything else you'd like to add? Do you have any questions for us?

Appendix 2b: KBIC climate change interviews invitation letter.

Keweenaw Bay Ojibwa Community College

111 Beartown Road
PO Box 519
Baraga, MI 49908

Phone: (906) 353-4639
Fax: (906) 353-8107
akozich@kbocc.org

Environmental Science Department

"Catch Your Dream through a Superior Education"

October 20, 2013

xxxxx
xxxxx
xxxxx

Dear xxxxx,

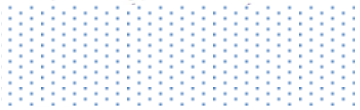
The Environmental Science Department at Keweenaw Bay Ojibwa Community College is conducting a community-based research project involving climate change. Scientists and policy-makers are increasingly certain that climate change could have serious consequences and that tribal communities are likely to be the most affected. We want to know what KBIC members think about the topic of climate change, including their beliefs, concerns, environmental changes they've noticed, and what (if anything) our leaders should be doing to plan ahead for future generations.

Our research is funded by the United States Geological Survey (USGS) and the American Indian Alaska Native Climate Change Working Group. These organizations are working with tribes across the United States to gain knowledge on how climate change could impact Native communities. We are also collaborating with the KBIC Tribal Council, Natural Resources Department, and Forestry Department, as well as with researchers from other tribes.

You are receiving this letter because your name was randomly chosen from a list of KBIC members of Baraga County. We would appreciate the opportunity to hear your opinions on a set of questions on the topic of climate change. Would you help our research by participating in an interview? We can meet at a time and place of your convenience. Interviews typically last 20-40 minutes, are strictly confidential, and do not contain questions of a sensitive nature. This type of research is very important if our leaders are to make decisions that are reflective of the community's thoughts.

If you agree, please fill out the attached response letter and mail it to us in the stamped envelope. I can be contacted by any of the means below to set up a time to meet or to answer any questions you may have. Thank you for your time and assistance.

Respectfully,



Andrew T. Kozich
Environmental Science Department Chair
akozich@kbocc.org
(906) 353-4639
(248) 245-5751 (cell)

KBOCC student research assistants:
Don Denomie Sr.
Shannon DesRochers
Peter Morin Jr.
Stephanie Cree
Marie Kovach

Appendix 2c: KBIC climate change interview informed consent form.

Keweenaw Bay Ojibwa Community College

111 Beartown Road
PO Box 519
Baraga, MI 49908

Phone: (906) 353-4639
Fax: (906) 353-8107
akozich@kbocc.org

Environmental Science Department

"Catch Your Dream through a Superior Education"

Informed Consent Form for Participation in Qualitative Academic Research

Project title: "Perceptions and Potential Ramifications of Climate Change in the Keweenaw Bay Indian Community, Michigan"

Principal Investigator: Andrew T. Kozich, Keweenaw Bay Ojibwa Community College

Project overview: This research is funded through the United States Geological Survey (USGS) and the American Indian Alaskan Native Climate Change Working Group and is being carried out by researchers and students at Keweenaw Bay Ojibwa Community College (KBOCC). The insight you share with us is extremely valuable. The objectives of this research are to:

- Assess the community's awareness and understanding of climate change concepts
- Gain insight into environmental changes over time noticed by community members
- Assess perceptions of climate change across community members
- Examine the potential role(s) of traditional knowledge in the development of climate change solutions and adaptation strategies
- Gain insight on support for climate change planning initiatives
- Produce and deliver educational materials to the community to foster awareness of climate change concepts and potential adaptation/mitigation strategies

Our research methods: We are conducting in-person interviews with willing KBIC tribal members who were randomly selected from a list provided to us by the KBIC Enrollment Office. Interviews are semi-structured, meaning that we will ask a set of pre-determined questions and allow you to elaborate on any points or particular interest or expertise. Interviews will be digitally recorded to ensure accurate reproduction of our conversation. We will also take written notes during interviews. No photographs or videos will be included.

How information will be used: Interview audio recordings will be transcribed verbatim and will be analyzed and synthesized into a final report. This report will contain key research findings and will be made publicly available to the KBIC and project funders. Our findings will also be submitted for publication in a relevant science journal presented and at science conferences that call attention to climate change issues in Native communities.

Confidentiality: Interviews are 100% confidential. Interview transcriptions will not contain your name. Only KBOCC research personnel have access to interview recordings and transcriptions. Materials we share in printed or oral presentations may include direct quotes from interview conversations, but we will never attach names to anything said during interviews. By signing below, you agree to participate in an interview and acknowledgement the methods and objectives described above. Thank you again for your valuable assistance and willingness to share your knowledge in a way that benefits the community.

Signature:_____ Date:_____

Appendix 2d: KBIC climate change interview demographic data form.

KBOCC Climate Study Interviewee Data

Gender: □ Male
□ Female

Age: □ 18-30
□ 31-45
□ 46-60
□ 61 and over

Are you an elder? □ Yes □ No

Level of education: □ Some high school
□ High school diploma or GED
□ Some college
□ Associate or vocational degree
□ Bachelor degree
□ Master degree or higher

Annual income: □ Below 10,000
□ $10,000 to $20,000
□ $20,000 to $30,000
□ $30,000 to $40,000
□ $40,000 to $50,000
□ $50,000 to $75,000
□ $75,000 to $100,000
□ $100,000 or higher

Political orientation: □ Republican/conservative
□ Democrat/liberal
□ Independent/other

Town of residence:_____

Occupation:_____

Appendix 3a: KBIC climate change survey cover letter.

Keweenaw Bay Ojibwa Community College
Environmental Science Department

770 Main St.
L'Anse, MI 49946

Phone: (906) 524-8303
Fax: (906) 353-8107

July 24, 2015

Dear KBIC Tribal Member:

The KBIC Tribal Council recently passed a resolution to study climate change (or "global warming") and assess possible impacts to our community. Because scientists consider climate change a serious threat, the Council wishes to develop long-term plans to best prepare the community for possible environmental changes. The KBIC Natural Resources Department, Forestry Department, and KBOCC Environmental Science Department are working with the Council to help develop long-term strategies.

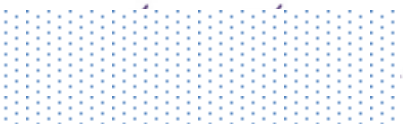
This mailing contains a survey to assess community perspectives related to climate change. Collecting this kind of information is a crucial step in the Tribe's planning process. Your insight is very valuable and your responses will help shape decisions regarding the KBIC's climate change planning.

To make sure that your opinions are counted, **we need to receive your completed survey by August 10, 2015.** Don't miss out on the opportunity to have your voice heard by our leaders.

This survey is anonymous, and you don't need to be an expert on the subject of climate change. We just need to know your opinions on a range of questions so we can provide the most accurate information to the Council. When you complete the survey, simply put it in the pre-stamped envelope and drop it in the mail.

Thank you for participating in this important community survey. If you have any questions, feel free to contact me at the phone number or email listed below.

Kindest regards,



Andrew T. Kozich
Environmental Science Department Chair
Keweenaw Bay Ojibwa Community College
(906) 524-8303
andrew.kozich@kbocc.edu

Appendix 3b: KBIC climate change survey questionnaire.

Keweenaw Bay Indian Community
Climate Change Survey

Administered by

Keweenaw Bay Ojibwa Community College
Environmental Science Department

In conjunction with

KBIC Natural Resources Department and KBIC Forestry Department

KBIC Climate Change Survey

Thank you for responding to this important community survey. It will probably take 15 minutes to complete. Please read each question carefully and select the response that best describes your views. When finished, simply place the completed survey in the pre-stamped return envelope and drop it in the mail. **To make sure your responses are included in our final report, it is important that we receive your completed survey within two weeks.**

Below are answers to frequently-asked questions regarding this survey:

> ***Why did I receive this survey?*** Your name was randomly-selected from a list of KBIC members. Just as in election polls, we need responses from a pre-determined percentage of people to ensure that our findings are representative of the community. This is why it is critical that we receive your completed survey.
>
> ***Do I need to know a lot about climate change?*** No, you do not need to be an expert to provide valuable insight. Most questions involve your opinions and beliefs, and are not a test of your scientific knowledge.
>
> ***Who is paying for this survey?*** This survey was funded by the organizations shown at the bottom of this page, which support climate change research and planning across Native American communities.
>
> ***How will the information be used?*** Findings will be shared with our leaders and policy-makers (such as our Tribal Council) as part of the community planning process. We will also share findings at local community events and educational forums. We will prepare a summary for appropriate scientific publications and events, to bring the KBIC "to the table" on national and regional discussions about climate change.
>
> ***Will my name be associated with the information I provide?*** No, the information you provide is strictly anonymous. Your name appears nowhere on the survey. Answers from respondents will be combined to describe important patterns among our community members.

To help you provide the most accurate responses, please know that scientists use the term "climate change" to describe **long-term changes in temperature and precipitation patters for a given area.**

Thank you for your participation in this important survey. If you have questions or comments, you can contact me directly by any of the means listed below.

Andrew Kozich
Keweenaw Bay Ojibwa Community College
Environmental Science Department
(906) 524-8303 office
(248) 245-5751 cell
andrew.kozich@kbocc.edu

Let's begin! These questions are about your experiences living in the community.

1. How many years (total) have you lived in the Baraga County area?

   ☐ 5 or less ☐ 11 to 20
   ☐ 6 to 10 ☐ More than 20

2. Which of the following outdoor activities do you participate in? Check all that apply.

   ☐ Fishing/ice fishing ☐ Hiking/walking/bicycling
   ☐ Swimming/going to beach ☐ Sight-seeing/wildlife viewing
   ☐ Boating/canoeing ☐ Harvesting wild rice
   ☐ Maple syrup production ☐ Gathering berries/plants/medicine
   ☐ Hunting ☐ Attending summer powwows
   ☐ Snowmobiling/ORV use ☐ Gardening/landscaping
   ☐ Camping/picnicking ☐ Other:_____

3. Which of the following locally-harvested foods do you eat? Check all that apply.

   ☐ Fish ☐ Maple syrup
   ☐ Wild game ☐ Wild rice
   ☐ Berries ☐ Leeks/mushrooms
   ☐ Other:_____

4. On average, how many hours a week do you spend outdoors in the spring?

   ☐ Less than 5 ☐ 5 to 10 ☐ 10 to 20 ☐ More than 20

5. On average, how many hours a week do you spend outdoors in the summer?

   ☐ Less than 5 ☐ 5 to 10 ☐ 10 to 20 ☐ More than 20

6. On average, how many hours a week do you spend outdoors in the fall?

   ☐ Less than 5 ☐ 5 to 10 ☐ 10 to 20 ☐ More than 20

7. On average, how many hours a week do you spend outdoors in the winter?

   ☐ Less than 5 ☐ 5 to 10 ☐ 10 to 20 ☐ More than 20

These questions ask about your housing, comfort, and health.

8. Do you live in any form of Tribal housing?

   ☐ Yes ☐ No

9. Do you have air conditioning (or central air) in your home?

   ☐ Yes ☐ No

10. Which statement best describes the weatherization and comfort level of your home during summer weather conditions?

    ☐ Everything seems fine and it keeps me comfortable.
    ☐ It's OK, but I could be more comfortable.
    ☐ It's a real problem. It's too hot, or is difficult/expensive to keep cool.

11. Which statement best describes the weatherization and comfort level of your home during winter weather conditions?

    ☐ Everything seems fine and it keeps me comfortable.
    ☐ It's OK, but I could be more comfortable.
    ☐ It's a real problem. It's cold/drafty/expensive to heat.

12. Do any of the following problems occur in your home? Check all that apply.

    ☐ Mold ☐ Humidity too high
    ☐ Insects/pests ☐ Too much dust

13. When indoors, do you or anyone in your household experience any of the following symptoms? Check all that apply.

    ☐ Nausea ☐ Dizziness
    ☐ Headaches ☐ Skin problems
    ☐ Fatigue ☐ Respiratory problems/coughing

14. When outdoors, do you or anyone in your household experience any of the following symptoms? Check all that apply.

    ☐ Heat exhaustion ☐ Allergies/respiratory problems
    ☐ Bad reactions from insect bites ☐ Skin/eye problems from sun

15. Overall, which of the following statements best describes your tolerance for the summer weather conditions in our area (when you're outdoors)?

- ☐ No problems at all. I'm used to it and I stay comfortable.
- ☐ It can get a little uncomfortable but I manage.
- ☐ It's a real problem. I don't do well in the summer heat.

16. Overall, which of the following statements best describes your tolerance for the winter weather conditions in our area (when you're outdoors)?

- ☐ No problems at all. I'm used to it and I stay comfortable.
- ☐ It can get a little uncomfortable but I manage.
- ☐ It's a real problem. I don't do well in the winter cold.

In this section, please circle the number that best reflects your level of agreement with each of the following statements.

	Statement	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
17	We need to maintain our cultural identity.	1	2	3	4	5
18	Cultural opportunities are important.	1	2	3	4	5
19	Ojibwa culture is intertwined with our environment.	1	2	3	4	5
20	Protection of our environment should be a top priority for the community.	1	2	3	4	5
21	As an Ojibwa community, we have the ability to adapt to changing environmental conditions.	1	2	3	4	5
22	Water is sacred to me.	1	2	3	4	5
23	We need to ensure a healthy environment for future generations.	1	2	3	4	5

Doing great! You're about 1/3 of the way done.

This section specifically involves the concept of climate change. Please read each statement carefully and circle the number that best reflects your level of agreement.

	Statement	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
24	I am familiar with the concept of climate change.	1	2	3	4	5
25	Climate change is already happening.	1	2	3	4	5
26	Climate change will happen (or continue happening) in the future.	1	2	3	4	5
27	I have observed changes in local weather patterns during my lifetime.	1	2	3	4	5
28	Worldwide, extreme weather events (floods, droughts, fires, storms, etc.) are happening more often than in the past.	1	2	3	4	5
29	Climate change is influenced by human activities.	1	2	3	4	5
30	Climate change is a natural process.	1	2	3	4	5
31	Burning fossil fuels (oil, gas, coal) is making the atmosphere warmer.	1	2	3	4	5
32	Worries about climate change are exaggerated.	1	2	3	4	5
33	Scientists understand what is happening with the climate.	1	2	3	4	5
34	Politicians understand what is happening with the climate.	1	2	3	4	5
35	Government leaders are doing enough to address climate change.	1	2	3	4	5
36	Scientists should advise leaders on what to do about climate change.	1	2	3	4	5
37	If the climate is changing, there will be more drawbacks than benefits.	1	2	3	4	5
38	Climate change could negatively affect our Ojibwa culture.	1	2	3	4	5
39	Climate change could negatively affect our KBIC economy.	1	2	3	4	5

40. From what sources do you typically receive information on climate change? Check all that apply.

- ☐ Television
- ☐ Radio
- ☐ Internet
- ☐ Newspapers/magazines
- ☐ Scientific publications
- ☐ Word of mouth, in general
- ☐ Local educators/scientists/leaders
- ☐ Other:_____

In this section, please circle the best number to indicate your level of concern for possible negative impacts from climate change in our community.

	Negative impacts related to...	Not concerned ←				→ Very concerned
41	Outdoor air quality	1	2	3	4	5
42	Indoor air quality	1	2	3	4	5
43	Water quality	1	2	3	4	5
44	Lake levels	1	2	3	4	5
45	Fisheries	1	2	3	4	5
46	Wetlands	1	2	3	4	5
47	Rivers and streams	1	2	3	4	5
48	Groundwater	1	2	3	4	5
49	Hunting/game species	1	2	3	4	5
50	Sacred animal species	1	2	3	4	5
51	Sacred/medicinal plant species	1	2	3	4	5
52	Forests	1	2	3	4	5
53	Traditional food sources	1	2	3	4	5
54	Invasive/non-native species	1	2	3	4	5
55	Human health	1	2	3	4	5
56	Extreme weather events	1	2	3	4	5
57	Community infrastructure (roads, shorelines, municipal water systems, energy, etc.)	1	2	3	4	5
58	Heating/cooling costs	1	2	3	4	5
59	Transportation costs	1	2	3	4	5
60	Tourism-dependent businesses	1	2	3	4	5
61	KBIC economy, in general	1	2	3	4	5
62	Outdoor recreation	1	2	3	4	5
63	Cultural opportunities	1	2	3	4	5
64	Future KBIC generations	1	2	3	4	5

Below are actions the KBIC may consider to address climate change. Please circle the number that best reflects your level of support for each action. Please read each question carefully.

	Action	Strongly oppose	Somewhat oppose	No opinion	Somewhat support	Strongly support
65	Focus on ways to **adapt** to climate change	1	2	3	4	5
66	Focus on ways to **reduce human influence** on climate change	1	2	3	4	5
67	Create initiatives for environmentally-friendly energy sources (wind, solar, etc.)	1	2	3	4	5
68	Increase locally-grown food sources	1	2	3	4	5
69	Increase the availability of public transportation	1	2	3	4	5
70	Invest in home efficiency improvements for community members	1	2	3	4	5
71	Offer incentives for reductions in energy use	1	2	3	4	5
72	Manage forests to prepare for environmental changes	1	2	3	4	5
73	Manage fisheries to prepare for environmental changes	1	2	3	4	5
74	Prioritize the survival of important plant and animal species	1	2	3	4	5
75	Prepare for possible human health impacts	1	2	3	4	5
76	Create advisory group of specialists in KBIC departments to advise Council	1	2	3	4	5
77	Develop community outreach programs to increase awareness and understanding of climate change	1	2	3	4	5
78	Ensure traditional knowledge has a key role in planning	1	2	3	4	5
79	Take as many steps as needed to address climate change in long-term planning	1	2	3	4	5
80	Take no actions at this time	1	2	3	4	5

This is the last section! These questions involve demographic information that helps us describe statistics across survey respondents. Remember that your answers are anonymous.

81. Which best describes your home?

- ☐ House
- ☐ Apartment
- ☐ Other (please describe):_____

82. How many bedrooms do you have in your home?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4 or more

83. How many bathrooms are in your home? Please count any "half-baths" as bathrooms.

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4 or more

84. How many people live in your household (including yourself)?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6 or more

85. What is your age?

- ☐ 18-29
- ☐ 30-39
- ☐ 40-49
- ☐ 50-59
- ☐ 60-69
- ☐ 70 or older

86. Are you an elder?

- ☐ Yes
- ☐ No

87. What is your level of education?

- ☐ Some high school
- ☐ High school diploma/GED
- ☐ Associate/trade degree
- ☐ Bachelor degree
- ☐ Master degree or higher

88. What is your household's approximate annual income?

- ☐ Less than $20,000
- ☐ $20,000 to $40,000
- ☐ $40,000 to $60,000
- ☐ $60,000 to $80,000
- ☐ $80,000 to $100,000
- ☐ More than $100,000

89. How would you describe your political identification?

- ☐ Republican/conservative
- ☐ Democrat/liberal
- ☐ Independent
- ☐ Other:_____

Thank you for your participation in this community survey! Please place it in the pre-stamped envelope and drop it in the mail. You may use the lines on the back to add comments. If you have questions and would like us to respond, please provide contact information.

Questions or comments:

Keweenaw Bay Ojibwa Community College
Environmental Science Department
770 N. Main St.
L'Anse, MI 49946
(906) 524-8303

ACCREDITED
Higher Learning Commission
North Central Association

Formed out of American Indian identity, the mission of Keweenaw Bay Ojibwa Community College is to provide post-secondary education rich in Ojibwa culture, tradition and beliefs that support life-long learning.

Appendix 4a: Great Lakes water resources interview question list.

How long have you lived in the Great Lakes area? Are there things you like about the area?

What comes to mind when you think about the Great Lakes?

How close do you live to any water body? Tell me about it. How big is it? How close? How often do you see it?

Do you enjoy spending time around water? What do you like to do? How often?

Do you have any favorite water that you like to visit? What do you like about it? Is there anything that makes it special? Do you have any concerns about it?

Have you heard of the word "watershed"? **(If yes)** What does it mean? Are you aware of any watershed protection groups in your area?

What is your neighborhood like? Rural, urban, or suburban? Do you live in a house or apartment?

Are you on city water or a well? What do you think about your water, like the rates, quality of water, and so forth?

Do you use water for things like watering the lawn, washing cars, and so forth?

Do you do anything in particular to try to conserve or protect water?

Do you think other people are doing anything to conserve or protect water?

What's important about the Great Lakes? To you, what makes them valuable?

What kinds of things can people do that affect the Great Lakes?

Do you believe people have the right to consume as much water as they want, as long as they pay for it? Do you think of Great Lakes water as being unlimited?

Do you have any concerns about the Great Lakes? Have you heard of anything being done to protect them? Do you think the government does enough, or too much? Do you eat Great Lakes fish?

Are you familiar with climate change? What do you think causes it?

Are you concerned about it?

Do you think climate change could affect the Great Lakes?

What solutions do you think there could be?

How many people live in your household? How many square feet is your home? How many bedrooms/bathrooms?

What is your level of education? What do you do for a living?

Do you consider yourself an environmentalist? Do you belong to any environmental or conservation organizations?

Appendix 4b: This appendix contains Great Lakes water resources interview location details. Table 4b-1 shows the five Great Lakes sub-regions where research interviews were conducted in 2013. The municipalities listed were the nearest to the actual interview locations. In some instances (e.g., metropolitan Flint and metropolitan Green Bay), interviews occurred in various suburban communities; for simplicity only the name of the large urban center is listed.

Table 4b-1: Water resources interview locations.

Interview location	Population (2010)	Distance to Great Lake
Rural northern Michigan (9 interviews)		
Houghton/Hancock	11,644	15 km
L'Anse/Baraga	3,392	<1 km
Rural southern Ontario (13 interviews)		
Woodstock	37,765	60 km
Chatham	44,074	20 km
Tilbury	4,809	6 km
Urban Sault Ste. Marie (7 interviews)		
Sault Ste. Marie, Ontario	79,800	5 km
Sault Ste. Marie, Michigan	14,144	5 km
Suburban southeastern Michigan (7 interviews)		
Metropolitan Flint	425,790	85 km
Waterford	73,150	65 km
Urban Green Bay (7 interviews)		
Metropolitan Green Bay	306,241	5 km

Appendix 5a: Great Lakes water resource survey cover letter.

Michigan Technological University

School of Forest Resources and Environmental Science
Noblet, Hesterberg, and Horner Halls
1400 Townsend Drive
Houghton, Michigan 49931-1295
906/487-2454 1-800-WOODS-MI
Fax 906/487-2915
www.forest.mtu.edu

August 5, 2014

xxxx
xxxx
xxxx

Dear xx:

I am a graduate student at Michigan Technological University conducting a survey on Great Lakes water resources as part of my dissertation research. Your name was randomly selected from public records, and I am writing to ask for your assistance with this project.

Considering that we live in such a water-rich region, you may be surprised at how little researchers know about public opinion on our water. Policy-makers rely on an accurate reading of public opinion to make decisions that can affect us all, so your participation is very important for this type of research.

You can make sure your voice is heard by taking 10-20 minutes to complete this survey. You'll see that the questions are not difficult to answer – you don't need to be an expert on the subject – and all information you share is strictly anonymous. We are mostly curious about your views on topics such as water recreation, household water use, and any concerns you may have about water quality, supply, or price.

Kindest regards,

Andrew T. Kozich
Michigan Technological University
School of Forest Resources and Environmental Science

Appendix 5b: Great Lakes water resource survey questionnaire.

Great Lakes Water Resources Survey

Andrew T. Kozich
Michigan Technological University

Great Lakes Water Resources Survey

Thank you for taking the time to complete and return this survey. Water is an important topic in the Great Lakes region, and we believe you will find our questions easy to answer.

To help us accurately understand your opinions about Great Lakes water resources it is important that we receive your response. This will also help me complete my graduate research work.

This survey will take 10-20 minutes to complete. Please read each question carefully and select the response that best describes your views. When you are finished, simply place the completed survey in the pre-stamped return envelope and drop it in the mail.

Below are answers to frequently-asked questions regarding this survey:

Who should fill out this survey? Residents of the Great Lakes region should complete the survey. You don't need to be an expert on the subject; we just want to know your thoughts and concerns.

Who is paying for this survey? The complete list of our project funders is shown at the bottom of this page. This research is not funded by private individuals, corporations, or political organizations.

How will the information be used? The answers we collect will be used for academic research purposes only. We will share our findings with other scientists and policy-makers through public presentations and scientific publications.

Will my name be associated with the information I provide? No, the information you provide in this survey is strictly anonymous. Answers will be combined to describe important patterns for Great Lakes residents.

Again, thank you very much for your participation. If you have any questions or comments, you can contact me directly at (248) 245-5751 or by email at atkozich@mtu.edu.

Andrew Kozich
Michigan Technological University
School of Forest Resources and Environmental Science

National Science Foundation
AMERICAN INDIAN COLLEGE FUND
Center for Water and Society, Michigan Technological University
Forest Resources & Environmental Science, MichiganTech
ecosystem Science Center

Let's begin! For questions 1-9, please place an "X" in the appropriate box to tell us about your experiences living in the Great Lakes region.

1. How long have you lived in the Great Lakes area?

   ☐ Less than 1 year
   ☐ 1 to 5 years
   ☐ 5 to 10 years
   ☐ 10 to 20 years
   ☐ More than 20 years

2. Please identify which of the following water-related recreational activities you participate in (check all that apply):

   ☐ Fishing/ice fishing
   ☐ Swimming/going to beach
   ☐ Boating/canoeing
   ☐ Other watersports
   ☐ Camping/picnicking
   ☐ Hiking/walking
   ☐ Sight-seeing/wildlife viewing
   ☐ Waterfowl hunting
   ☐ Gardening/landscaping
   ☐ Other:_____

3. How often do you engage in water-related recreation in the spring, summer, and fall?

   ☐ Daily
   ☐ Weekly
   ☐ Monthly
   ☐ Less than once a month

4. How often do you engage in water-related recreation in the winter?

   ☐ Daily
   ☐ Weekly
   ☐ Monthly
   ☐ Less than once a month

5. How close do you live to the nearest Great Lake?

   ☐ I live on a Great Lake waterfront
   ☐ Less than 1 mile
   ☐ 1 to 10 miles
   ☐ 10 to 50 miles
   ☐ More than 50 miles
   ☐ I don't know

6. How close do you live to any water body?

   ☐ I live on a waterfront
   ☐ Less than 1 mile
   ☐ 1 to 5 miles
   ☐ 5 to 10 miles
   ☐ More than 10 miles
   ☐ I don't know

7. Approximately how often do you see this water body?

☐ Daily ☐ Monthly
☐ Weekly ☐ Less than once a month

8. How would you describe this water body?

☐ A Great Lake ☐ A river
☐ An inland lake or pond ☐ A stream
☐ A wetland

9. How often do you eat fish caught in the Great Lakes region?

☐ Daily ☐ Monthly
☐ Weekly ☐ Less than once a month

On a scale of 1 to 5, please rate your level of concern for each of the following water-related issues in the Great Lakes region. For each topic, circle the number that best describes your level of concern.

	Topic	Not concerned ⟷ Very concerned				
10	Dumping/littering	1	2	3	4	5
11	Industrial/agricultural pollution	1	2	3	4	5
12	Reduced water levels/supply	1	2	3	4	5
13	Contaminated runoff/sewage	1	2	3	4	5
14	Invasive species	1	2	3	4	5
15	Groundwater contamination	1	2	3	4	5
16	Wetland destruction	1	2	3	4	5
17	Diversions of water out of the Great Lakes	1	2	3	4	5

On a scale of 1 to 5, please rate the importance <u>to you</u> of each of the following water sources in the Great Lakes area:

	Water source	Not important ⟷				Very important
18	The Great Lakes	1	2	3	4	5
19	Large inland lakes	1	2	3	4	5
20	Small lakes and ponds	1	2	3	4	5
21	Wetlands	1	2	3	4	5
22	Groundwater	1	2	3	4	5
23	Large rivers	1	2	3	4	5
24	Small streams	1	2	3	4	5
25	Seasonal or intermittent water bodies	1	2	3	4	5
26	Springs and headwaters	1	2	3	4	5

Please share your opinions on the following water-related topics:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
27	In the Great Lakes region, there is plenty of water to go around.	1	2	3	4	5
28	Worldwide, problems related to water resources are increasing.	1	2	3	4	5
29	There are few reasons to be concerned about water quality in the Great Lakes region.	1	2	3	4	5
30	We need more policies and laws to protect water.	1	2	3	4	5
31	Water is a basic human right.	1	2	3	4	5
32	Everyone should be charged according to how much water they use.	1	2	3	4	5
33	Water should be considered a "product" or "good", like anything else that we pay for.	1	2	3	4	5

These questions pertain to water use and <u>other people</u>:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
34	People I know don't worry about conserving water.	1	2	3	4	5
35	The amount of water I use is about the same as what other people in the area use.	1	2	3	4	5
36	People in my area probably take water for granted.	1	2	3	4	5
37	People I know would admire me for conserving water.	1	2	3	4	5
38	I would conserve water if I knew other people were conserving too.	1	2	3	4	5
39	No one would really care if I took steps to use less water.	1	2	3	4	5
40	People I know look down upon those who waste water.	1	2	3	4	5
41	Overall, I feel social pressures to be conservative with my water use.	1	2	3	4	5

These questions help us understand your views on water conservation:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
42	If I used less water, I would feel good about helping the environment.	1	2	3	4	5
43	I would not personally benefit from using less water.	1	2	3	4	5
44	My efforts to conserve water wouldn't make much of a difference.	1	2	3	4	5
45	Using less water would not lower my standard of living.	1	2	3	4	5
46	Reducing my water use would be frustrating or annoying.	1	2	3	4	5
47	Water-saving appliances and fixtures do not perform as well as those that use more water.	1	2	3	4	5
48	Overall, I would feel a positive attitude from my efforts to conserve water.	1	2	3	4	5

These questions relate to your ability to conserve water:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
49	I have the ability to take shorter showers and use less water for household chores.	1	2	3	4	5
50	Water-saving devices are too expensive or difficult for me to install in my home.	1	2	3	4	5
51	I don't really know how to use less water than I already do.	1	2	3	4	5
52	Water conservation would be difficult because I can't control the amount of water used by others in my household.	1	2	3	4	5
53	With small lifestyle changes, I would be able to use less water.	1	2	3	4	5
54	I can't reduce my outdoor water usage.	1	2	3	4	5
55	Overall, I am confident that I could reduce the amount of water used in my household.	1	2	3	4	5

Please answer the following questions about your water usage:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
56	I already take many steps to conserve water.	1	2	3	4	5
57	I'm too busy to think about water conservation.	1	2	3	4	5
58	I don't plan to conserve water because there's plenty to go around in my area.	1	2	3	4	5
59	I plan to install water-saving devices in my home in the future.	1	2	3	4	5
60	In the future, I plan to use less water for basic household chores and outdoor activities.	1	2	3	4	5
61	I don't plan to conserve water because it's a service that I pay my fair share for.	1	2	3	4	5
62	I'll plan to reduce my water use if it gets too expensive.	1	2	3	4	5
63	Overall, I intend to reduce my water usage in the future.	1	2	3	4	5

These questions pertain to water resources and climate change:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
64	I am familiar with the concept of climate change.	1	2	3	4	5
65	Climate change concerns me.	1	2	3	4	5
66	Climate change is already happening.	1	2	3	4	5
67	Scientists do not fully understand what's happening with the climate.	1	2	3	4	5
68	Worries about climate change are exaggerated.	1	2	3	4	5
69	Climate change is part of natural cycles of the earth.	1	2	3	4	5
70	Climate change is caused by human activities.	1	2	3	4	5
71	Climate change could affect water resources of the Great Lakes area.	1	2	3	4	5

These questions relate to your general environmental opinions and beliefs:

	Question	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
72	The earth is like a spaceship with very limited room and resources.	1	2	3	4	5
73	Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
74	The balance of nature is very delicate and easily upset.	1	2	3	4	5
75	Human ingenuity will insure that we do NOT make the earth unlivable.	1	2	3	4	5
76	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	1	2	3	4	5
77	The earth has plenty of natural resources if we just learn how to develop them.	1	2	3	4	5
78	If things continue on their present course, we will soon experience a major ecological catastrophe.	1	2	3	4	5

Almost done! This section asks about your home and your neighborhood. Your answers will help us understand how you use water.

79. How would you describe your neighborhood?

- ☐ Urban
- ☐ Rural
- ☐ Suburban
- ☐ Small town

80. What type of water supply do you have in your home?

- ☐ City water
- ☐ Well water

81. Do you own or rent your home?

- ☐ Own
- ☐ Rent
- ☐ Other/live with relatives

82. Which best describes your home?

- ☐ House
- ☐ Apartment
- ☐ Other (please describe):_____

83. If you live in a house, what is the approximate size of your lot? *If you do not live in a house, please proceed to question 85.*

- ☐ It is a "typical city lot"
- ☐ 5 to 10 acres
- ☐ Large lot, but less than 1 acre
- ☐ 10 to 40 acres
- ☐ 1 to 5 acres
- ☐ Larger than 40 acres

84. Do you live on a farm?

- ☐ Yes
- ☐ No

85. How many rooms in your home are currently used as bedrooms?

- ☐ None/studio-style home
- ☐ 3
- ☐ 1
- ☐ 4
- ☐ 2
- ☐ 5 or more

86. How many bathrooms are in your home?

- ☐ 1
- ☐ 1.5
- ☐ 2
- ☐ 2.5
- ☐ 3 or more

87. How many people live in your household (including yourself)?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6 or more

88. Do you live within the Great Lakes watershed?

- ☐ Yes
- ☐ No
- ☐ Not sure

Finally, please answer a few demographic questions about yourself. Your responses, combined with those of others, provide basic statistical information that is important to our research. Please recall that all information you supply is anonymous.

89. What is your age?

- ☐ 18-30
- ☐ 31-45
- ☐ 46-60
- ☐ 61 or older

90. What is your ethnicity?

- ☐ Caucasian/white
- ☐ African American
- ☐ Hispanic/Latino
- ☐ Asian American
- ☐ Native American
- ☐ Arabic/Middle-Eastern
- ☐ Other (please describe):_____

91. What is your level of education?

- ☐ Some high school
- ☐ High school diploma/GED
- ☐ Associate/trade degree
- ☐ Bachelor degree
- ☐ Master degree or higher

92. What is your household's approximate annual income?

- ☐ Less than $20,000
- ☐ $20,000 to $40,000
- ☐ $40,000 to $60,000
- ☐ $60,000 to $80,000
- ☐ $80,000 to $100,000
- ☐ More than $100,000

93. How would you describe your political identification?

- ☐ Republican/conservative
- ☐ Democrat/liberal
- ☐ Independent
- ☐ Other:_____

94. Do you belong to any environmental/conservation organizations?

- ☐ Yes
- ☐ No

Thank you very much for your participation in our research survey. Please place the completed survey in the envelope provided and drop it in the mail. You may use the lines below to add any comments on this survey. If you have questions and would like us to respond, please provide contact information.

Appendix 5c: Details on the U.S. Department of Agriculture Economic Research Service's *Rural-Urban Continuum Code* system (all text and imagery pasted from the USDA website: http://www.ers.usda.gov/data-products/rural-urban-continuum-codes/documentation.aspx). This county classification formed the basis of our stratified random sample across the Great Lakes region.

Documentation

ERS' 2013 Rural-Urban Continuum Codes form a classification scheme that distinguishes metropolitan (metro) counties by the population size of their metro area, and nonmetropolitan (nonmetro) counties by degree of urbanization and adjacency to a metro area or areas. This documentation is organized in the following sections:

Background

ERS Rural-Urban Continuum Codes distinguish metropolitan (metro) counties by the population size of their metro area, and nonmetropolitan (nonmetro) counties by degree of urbanization and adjacency to metro areas. The Office of Management and Budget's 2013 metro and nonmetro categories have been subdivided into three metro and six nonmetro groupings, resulting in a nine-part county classification. The codes provide researchers working with county data a more detailed residential classification, beyond a simple metro-nonmetro dichotomy, for the analysis of trends related to degree of rurality and metro proximity.

Scope

The 2013 Rural-Urban Continuum Code scheme classifies all counties in the United States, including 1,167 metro counties and 1,976 nonmetro counties. Also included are 69 metro municipios and 9 nonmetro municipios in Puerto Rico. Several nonmetro independent cities in Virginia have been combined with their counties of origin (see the data file for details).

The Rural-Urban Continuum Codes were created in 1975 by David L. Brown, Fred K. Hines, and John M. Zimmer, then of the Economic Research Service, for their report, Social and Economic Characteristics of the Population in Metro and Nonmetro Counties: 1970. The codes were updated after the 1980, 1990, and 2000 censuses, with a somewhat more restrictive procedure for determining metro adjacency. The versions based on the 1970, 1980, 1990, and 2000 Censuses are found in the file listing of this data product.

Methodology

To create the 2013 Rural-Urban Continuum Codes, all U.S. counties and county equivalents were first grouped according to their official metro-nonmetro status, defined by the Office of Management and Budget (OMB) as of February, 2013. OMB determined

current metropolitan status by applying population and worker commuting criteria to the results of the 2010 Census and the 2006-2010 American Community Survey (ACS). A detailed description of metro area criteria is available in this OMB bulletin.

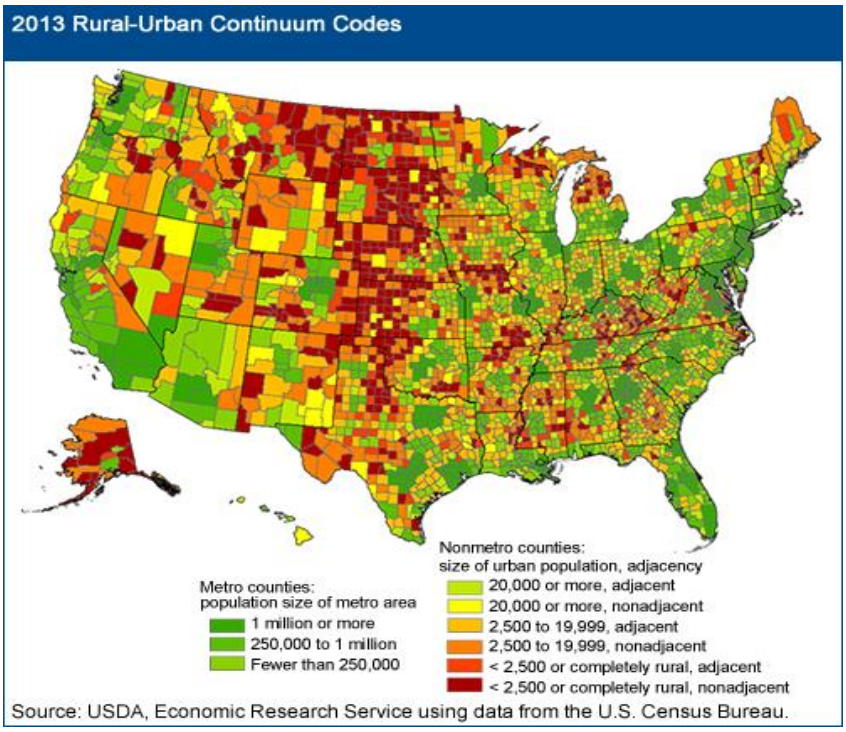


Figure 5c-1: USDA county classifications (image source: http://www.ers.usda.gov).

For the Continuum Codes, metro counties are divided into three categories according to the total population size of the metro area of which they are part: 1 million people or more, 250,000 to 1 million people, and below 250,000. Nonmetro counties are classified along two dimensions. First, they are divided into three urban-size categories (an urban population of 19,999 or more, 2,500 to 20,000, and less than 2,500) based on the total urban population in the county. (A description of urban-rural categories and their relationship to the metro-nonmetro delineation is available on the page What is Rural?) Second, nonmetro counties in the three urban-size categories are sub-divided by whether or not the county is adjacent to one or more metro areas. A nonmetro county is defined as adjacent if it physically adjoins one or more metro areas, and has at least 2% of its employed labor force commuting to central metro counties. Nonmetro counties that do not meet these criteria are classed as nonadjacent.

In concept, the 2013 version of the Rural-Urban Continuum Codes is comparable with that of earlier decades. However, in 2000, OMB made major changes in its metro-area delineation procedures, and the Census Bureau changed the way in which rural and urban are measured. Therefore, the 2013 and 2003 Rural-Urban Continuum Codes are not fully comparable to those of earlier years. OMB's changes added some additional metro areas

by no longer requiring that a metro area must have at least 100,000 population if its urbanized area includes no place of at least 50,000 people. More importantly, simplifying the worker commuting criteria that determine outlying metro counties had the effect of adding numerous new outlying counties to metro areas while deleting a smaller number that were previously defined as metro.

No major changes were made in either the metro-nonmetro or urban-rural criteria between 2000 and 2010. However, the decennial census long form was eliminated in 2010 and OMB used 5-year average commuting flow data from the 2006-2010 American Community Survey (ACS) rather than a point in time estimate to delineate metropolitan and micropolitan areas. The 2006-2010 ACS commuting flow data was also used to compute adjacency for the Rural-Urban Continuum Codes.

Table 5c-1: Re-coding of the USDA's classification used for our stratified sample of Great Lakes counties.

USDA County description	**USDA Code**	**Our classification**
Counties in metro areas of 1 million population or more	1	*Urban*
Counties in metro areas of 250,000 to 1 million population	2	*Urban*
Counties in metro areas of fewer than 250,000 population	3	*Urban*
Urban population of 20,000 or more, adjacent to a metro area	4	*Semi-urban*
Urban population of 20,000 or more, not adjacent to a metro area	5	*Semi-urban*
Urban population of 2,500 to 19,999, adjacent to a metro area	6	*Semi-urban*
Urban population of 2,500 to 19,999, not adjacent to a metro area	7	*Rural*
Completely rural or less than 2,500 urban population, adjacent to a metro area	8	*Rural*
Completely rural or less than 2,500 urban population, not adjacent to a metro area	9	*Rural*

Appendix 5d: Great Lakes water resources survey county lists and population data.

Table 5d-1: Rural counties in study area.

State	County	2010 population
IN	Steuben	34,185
MI	Alcona	10,942
MI	Alger	9,601
MI	Alpena	29,598
MI	Antrim	23,580
MI	Arenac	15,899
MI	Baraga	8,860
MI	Benzie	17,525
MI	Charlevoix	25,949
MI	Cheboygan	26,152
MI	Chippewa	38,520
MI	Crawford	14,074
MI	Dickinson	26,168
MI	Emmet	32,694
MI	Gogebic	16,427
MI	Huron	33,118
MI	Iosco	25,887
MI	Iron	11,817
MI	Kalkaska	17,153
MI	Keweenaw	2,156
MI	Lake	11,539
MI	Leelanau	21,708
MI	Luce	6,631
MI	Mackinac	11,113
MI	Manistee	24,733
MI	Mason	28,705
MI	Menominee	24,029
MI	Missaukee	14,849
MI	Montmorency	9,765
MI	Ogemaw	21,699
MI	Ontonagon	6,780
MI	Osceola	23,528
MI	Oscoda	8,640
MI	Otsego	24,164
MI	Presque Isle	13,376
MI	Roscommon	24,449
MI	Schoolcraft	8,485
MI	Wexford	32,735
MN	Aitkin	16,202
MN	Cook	5,176
NY	Allegany	48,946
NY	Hamilton	4,836
OH	Mercer	40,814
OH	Wyandot	22,615
PA	Potter	17,457
WI	Adams	20,875
WI	Ashland	16,157
WI	Bayfield	15,014
WI	Florence	4,423
WI	Forest	9,304
WI	Iron	5,916
WI	Marquette	15,404
WI	Menominee	4,232
WI	Oneida	35,998
WI	Vilas	21,430

Total rural counties: 55
Total population: 1,042,032
Percent of region-wide target population: 3.4%

Table 5d-2: Semi-urban counties in study area.

State	County	2010 population
IN	Adams	34,387
IN	DeKalb	42,223
IN	Kosciusko	77,358
IN	LaGrange	37,128
IN	Noble	47,536
MI	Allegan	111,408
MI	Branch	45,248
MI	Clare	30,926
MI	Delta	37,069
MI	Gladwin	25,692
MI	Grand Traverse	86,986
MI	Gratiot	42,476
MI	Hillsdale	46,688
MI	Houghton	36,628
MI	Ionia	63,905
MI	Isabella	70,311
MI	Lenawee	99,892
MI	Marquette	67,077
MI	Mecosta	42,798
MI	Newaygo	48,460
MI	Oceana	26,570
MI	St. Joseph	61,295
MI	Sanilac	43,114
MI	Shiawassee	70,648
MI	Tuscola	55,729
MN	Itasca	45,058
MN	Lake	10,866
MN	Pine	29,750
NY	Cattaraugus	80,317
NY	Cayuga	80,026
NY	Chautauqua	134,905
NY	Cortland	49,336
NY	Genesee	60,079
NY	Lewis	27,087
NY	Schuyler	18,343
NY	Seneca	35,251
NY	Steuben	98,990
NY	Wyoming	42,155
OH	Ashland	53,139
OH	Ashtabula	101,497
OH	Auglaize	45,949
OH	Crawford	43,784
OH	Defiance	39,037
OH	Erie	77,079
OH	Hancock	74,782
OH	Hardin	32,058
OH	Henry	28,215
OH	Huron	59,626
OH	Marion	66,501
OH	Ottawa	41,428
OH	Paulding	19,614
OH	Putnam	34,499
OH	Sandusky	60,944
OH	Seneca	56,745
OH	Shelby	49,423
OH	Van Wert	28,744
OH	Williams	37,642
PA	Crawford	88,765
WI	Dodge	88,759
WI	Door	27,785
WI	Langlade	19,977
WI	Manitowoc	81,442
WI	Marinette	41,749
WI	Portage	70,019
WI	Shawano	41,949
WI	Waushara	24,496

Total semi-urban counties: 66
Total population: 3,499,362
Percent of region-wide target population: 11.3%

Table 5d-3: Urban counties in study area.

State	County	2010 population
IL	Cook	5,194,675
IL	Lake	703,462
IN	Allen	355,329
IN	Elkhart	197,559
IN	Lake	496,005
IN	LaPorte	111,467
IN	Porter	164,343
IN	St. Joseph	266,931
IN	Wells	27,636
MI	Barry	59,173
MI	Bay	107,771
MI	Berrien	156,813
MI	Calhoun	136,146
MI	Cass	52,293
MI	Clinton	75,382
MI	Eaton	107,759
MI	Genesee	425,790
MI	Ingham	280,895
MI	Jackson	160,248
MI	Kalamazoo	250,331
MI	Kent	602,622
MI	Lapeer	88,319
MI	Livingston	180,967
MI	Macomb	840,978
MI	Midland	83,629
MI	Monroe	152,021
MI	Montcalm	63,342
MI	Muskegon	172,188
MI	Oakland	1,202,362
MI	Ottawa	263,801
MI	Saginaw	200,169
MI	St. Clair	163,040
MI	Van Buren	76,258
MI	Washtenaw	344,791
MI	Wayne	1,820,584
MN	Carlton	35,386
MN	St. Louis	200,226
NY	Chemung	88,830
NY	Erie	919,040
NY	Herkimer	64,519
NY	Jefferson	116,229
NY	Livingston	65,393
NY	Madison	73,442
NY	Monroe	744,344
NY	Niagara	216,469
NY	Oneida	234,878
NY	Onondaga	467,026
NY	Ontario	107,931
NY	Orleans	42,883
NY	Oswego	122,109
NY	Tioga	51,125
NY	Tompkins	101,564
NY	Wayne	93,772
NY	Yates	25,348
OH	Allen	106,331
OH	Cuyahoga	1,280,122
OH	Fulton	42,698
OH	Geauga	93,389
OH	Lake	230,041
OH	Lorain	301,356
OH	Lucas	441,815
OH	Medina	172,332
OH	Portage	161,419
OH	Richland	124,475
OH	Stark	375,586
OH	Summit	541,781
OH	Trumbull	210,312
OH	Wood	125,488
PA	Erie	280,566
WI	Brown	248,007
WI	Calumet	48,971
WI	Columbia	56,833
WI	Douglas	44,159
WI	Fond du Lac	101,633
WI	Green	36,842
WI	Kenosha	166,426
WI	Kewaunee	20,574
WI	Marathon	134,063
WI	Milwaukee	947,735
WI	Oconto	37,660
WI	Outagamie	176,695
WI	Ozaukee	86,395
WI	Racine	195,408
WI	Sheboygan	115,507
WI	Washington	131,887
WI	Winnebago	166,994

Total urban counties: 86
Total population: 26,559,093
Percent of region-wide target population: 85.4%