Climate Change Perspectives and Policy Support in a Great Lakes Anishinaabe Community

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In recognition of potential negative impacts to its environment, economy, and culture, the 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 KBIC members' perspectives on climate change and their support for long-term policy actions. Through a quantitative mail survey we found that community members are acutely aware of climate change, are concerned about future generations of KBIC members, wish to prioritize traditional Anishinaabe culture in planning initiatives, and are supportive of mitigation and adaptation strategies. Our findings provide vital insight to KBIC leaders and adds to the broader literature by introducing Great Lakes Anishinaabe perspectives to discussions of climate change and environmental justice issues facing Indigenous cultures worldwide.

Key words: Climate change, Indigenous, Anishinaabe, Great Lakes

Introduction

The scientific community overwhelmingly agrees that global climate change is happening and that its negative impacts will be widespread (Intergovernmental Panel on Climate Change [IPCC], 2018; Melillo, Richmond, & Yohe, 2014; National Oceanic and Atmospheric Administration [NOAA], 2013; U.S. Environmental Protection Agency [USEPA], 2014). Environmental changes are occurring worldwide, but they are not evenly distributed; warming is most severe at high latitudes and the increase in extreme weather events varies across the globe (IPCC, 2018). Societies' ability to withstand these changes is largely based on economic resources, leaving some better-equipped than others to adapt and survive (IPCC, 2018).

Indigenous communities, who contribute relatively little to the causes of climate change, are disproportionally vulnerable to its negative impacts (IPCC, 2018; International Union for Conservation of Nature [IUCN], 2008; National Wildlife Federation [NWF], 2011; Whyte, Dockry, Baule, & Fellman, 2014). With many Indigenous communities already stressed by limited resources, the added burden of human-caused environmental changes represents one of the prominent environmental justice issues of our time (Cordalis & Suagee, 2008; Krakoff, 2008; Lynn, MacKendrick, & Donoghue, 2011; Maldonado, Shearer, Bronen, Peterson, & Lazrus, 2013; NWF, 2011; Thomas & Twyman, 2005; Tsosie, 2007; Wildcat, 2013; Whyte, 2013). Largely resulting from historical colonization and assimilation policies, many North American Indigenous communities are geographically isolated, rely heavily on natural resources and government assistance programs, have low per capita income, low educational attainment, and limited health and emergency services (Duerden, 2004; Lal, Alavalapati, & Mercer, 2011; Thomas & Twyman, 2005). These disadvantages are amplified for communities whose 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 Indigenous communities would respond to environmental changes by relocating, but legally-defined reservations and tribal lands (often associated with long-standing treaty rights) leave fewer adaptation options (Maldonado et al., 2013; Wildcat, 2013).

While economic impacts could be severe, perhaps more alarming are looming threats to entire aspects of many Indigenous cultures (Cochran et al., 2013; Cordalis & Suagee, 2008; Downing & Cuerrier, 2011; Lynn et al., 2013; Turner & Clifton, 2009; Whyte et al., 2014). Relationships between Indigenous peoples and their environments are typically very deep, with culture developing in conjunction with surroundings. Languages, traditional stories, survival strategies, and generations of accumulated knowledge are linked to the familiarity with (and sacredness of) homelands. Spiritual values and beliefs are intertwined with the natural resources of the area, such as water, geology, plant and animal species, and food sources (Lynn et al., 2013; Wildcat, 2013). While Indigenous scholars have noted the wide-ranging cultural impacts of climate change, they draw less attention than economic impacts in mainstream publications and climate change reports (IPCC, 2018; Kimmerer, 2013; LaDuke, 1999, McGregor, 2012; Whyte, 2014; Whyte et al., 2014; Wildcat, 2009).

The climate change vulnerability of Indigenous communities has only recently received attention in the U.S. scientific literature, focusing predominantly on three regions with relatively high Indigenous populations. Arctic communities are experiencing melting glaciers, reduced sea ice, thawing permafrost, and coastal erosion; impacts include diminished food sources, thawing of traditionally-frozen travel routes, and losses of homelands to the encroaching sea (Arctic Climate Impact Assessment [ACIA], 2004; Cochran et al., 2013; Cruikshank, 2001; Crump, 2008; Downing & Cuerrier, 2011; Duerden, 2004; Ford et al., 2008; National Tribal Air Association [NTA], 2009). Extreme droughts and heat waves in the already-arid U.S. Southwest are impacting traditional agriculture, reducing biodiversity, and intensifying invasions of non-native species (Cordalis & Suagee, 2008; Cozzetto et al., 2013; Finan, West, Austin, & McGuire, 2002; NTAA, 2009). In the northwest Pacific coast region, altered environmental conditions are impacting sacred salmon populations (Dittmer, 2013; Turner & Clifton, 2009).

Climate Change and Great Lakes Indigenous Communities

In the Great Lakes region, altered air and water temperatures, hydrological patterns, seasonal events, and weather patterns have been widely noted (IPCC, 2018; Melillo et al., 2014; Pryor et al.,

2014; Schramm & Loehman, 2010). Ensuing impacts to forest, wetland, and aquatic communities are expected to include altered structure and species composition and invasions of non-native species (Pryor et al., 2014; Schramm & Loehman, 2010). While potential outcomes of climate change have drawn attention in mainstream scholarly literature, few studies have examined impacts to the region's Indigenous communities that rely on stable environmental conditions for the continuation of familiar lifeways. Instead, several inter-tribal initiatives have recently collaborated to produce rich reports intended to draw attention to cultural impacts and aid tribes in climate change planning (e.g., Inter-Tribal Council of Michigan, 2016; Tribal Adaptation Menu Team 2019; White et al., 2014).

Literature involving Anishinaabe[1] communities indicates concern about climate change and environmental changes, particularly involving water resources (Cave et al., 2011; Kozich, 2016; Kozich, 2018; Plummer et al., 2009). Water is particularly sacred to the Anishinaabe, as themes involving water are prevalent in creation and migration stories and many other enduring cultural traditions (Benton-Banai, 1988; Densmore, 1979; Kozich, 2018; Kozich, Halvorsen, & Mayer, 2018). Abundant wetland ecosystems provide critical habitat for manoomin (wild rice), a sacred plant that provides valuable nutrition. Additional sacred plant species, including giizhik (northern white cedar; *Thuja occidentalis*), rely on wetland habitats for their survival. Populations of manoomin and giizhik have already decreased in many areas, and further losses are feared as a result of altered hydrologic patterns (Schramm & Loehman, 2010). Significant cold-water fish species such as mookijiwanibi-namegos (brook trout; *Salvelinus fontinalis*) and ogaa (walleye; *Sander vitreus*) are at risk of habitat loss due to warming waters and invasion of non-native species (Michigan Department of Natural Resources [MDNR], 2015; NTAA, 2009; Nuhfer, Zorn, & Willis, 2015). Commercial and sustenance fishing that supports many Anishinaabe communities could be severely impacted.

Forest ecosystems include plant species used for traditional Anishinaabe medicines, foods, and utility items. For instance, wiigwaasaatig (paper birch; *Betula papyrifera*) is used for canoe-making, sap collection, and medicine. Baapaaggimaak (black ash; *Fraxinus nigra*) is highly regarded for making baskets and other goods. Ininaatig (sugar maple; *Acer saccharum*) is used for medicine, lodge poles, and supports the revered sugar-making tradition. These tree species are likely to be stressed by changing hydrological patterns, warmer temperatures, and the migration of competitive species (and invasive insects) from the south (Dickmann & Leefers, 2003; Pryor et al., 2014; Schramm & Loehman, 2010). 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, affecting traditional hunting and trapping activities (Kozich & Kozich, 2015; Schramm & Loehman, 2010; Voggesser, Lynn, Daigle, Lake, & Ranco, 2013).

Generations of traditional ecological knowledge (TEK) could enhance understandings 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; Whyte et al., 2014; 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, often in collaboration with other regional tribes (Inter-Tribal Council of Michigan, 2016; Tribal Adaptation Menu Team 2019; White et al., 2014). Scholarly literature on Great Lakes Indigenous climate change perspectives, largely based on interviews, symposia, or

[1] Often translated to mean "original people", Anishinaabe includes many culturally-related Indigenous peoples of the Great Lakes region such as Ojibwa, Potawatomi, and Odawa.

working group meetings, indicates awareness of environmental changes and concern about ramifications (Cave et al., 2011; Ford, et al., 2008; Kozich, 2016; Plummer et al., 2009; Smith, Liu, Safi, & Chief, 2014; Turner & Clifton, 2009).

Case Study: Keweenaw Bay Indian Community

The remainder of this paper describes climate change through the lens of the Keweenaw Bay Indian Community of northern Michigan (Figure 1). The Tribe[2] is federally recognized and a signatory to two treaties 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 other usual privileges of occupancy within more than 10 million acres of ceded land and water territory (7 Stat., 591:1842). The *1854 Treaty with the Chippewa* established the L'Anse Indian Reservation, containing approximately 59,000 acres of land (10 Stat., 1109:1854), primarily located in Baraga County at the base of Michigan's Keweenaw Peninsula. Legislation in 1934 created the Tribe's governing structure, including the council that is elected by Tribal members and tasked with the community's governance.

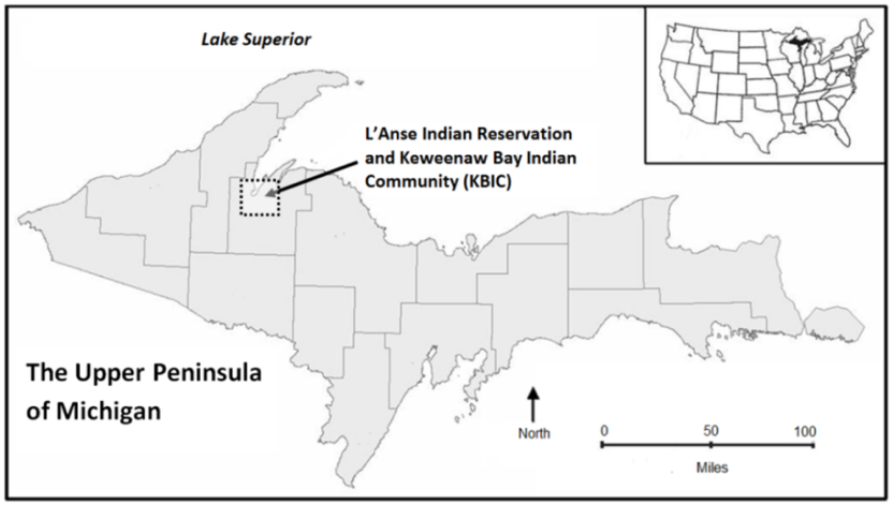

Figure 1. The L'Anse Indian Reservation in Michigan's Upper Penisula (Image: Kozich).

Resolution KB-016-2015, "To Establish a Climate Change Adaptation Initiative", was unanimously passed by Tribal Council in 2015. With this action the Tribe joined many others nationwide in recognizing that climate change poses substantial environmental, economic, cultural, and human health threats and that the development of mitigation and 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 to advise Tribal Council on policy formulation. The resolution inherently addresses 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 also reflects the traditional "seventh generation" principle, in which decisions are made based on the knowledge of previous seven generations and with the utmost consideration of seven future generations (Gagnon, 2016).

[2] To align with community norms, Tribe, Tribal, and Tribal Council are capitalized in this article when referencing KIBC and are not capitalized when referencing other tribal nations or tribes in general.

The purpose of this study was to conduct quantitative survey research to provide insight to the Tribal Council as part of its climate change planning process, with a research team composed of Tribal college faculty and students, Tribal natural resource personnel, and university partners. An additional goal was to offer college students opportunities to enrich their educational experiences by contributing to the scholarly research process, earning internship credits and salaries, and making valuable contributions to their community. Building on previous qualitative findings (Kozich, 2016), our research objectives were to: 1) examine the community's awareness and understanding of climate change science; 2) synthesize opinions on potential ecological, economic, cultural, and human health impacts; and 3) assess support for various long-term planning strategies. Our rationale was that understanding community views is critical to policy formulation, and policy measures are likely to be effective only if supported by those they impact. Thus, the project was designed to simultaneously serve the community and enhance the scholarly literature involving Indigenous perspectives on climate change.

Methods

This research was led by full-time faculty and student assistants from the Keweenaw Bay Ojibwa Community College (KBOCC) Environmental Science department. Faculty previously conducted parallel interview-based research and gained community support for continued work. These steps ensured that we were trusted to continue interacting with the community and representing them in a good way as we conducted this work. A survey questionnaire and protocols were developed with insight from Michigan Technological University and Tribal Natural Resource Department partners. Students assisted with survey mailing, data entry, analysis, and public outreach.

In July 2016, we acquired a mailing list from the Tribal Enrollment Office containing names and addresses of all adult enrolled members residing in Baraga County. These 897 members served as our target population. We conducted a systematic random sample to select members to be mailed survey questionnaires (excluding 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 between July and September 2016, following established multiple-mailing protocols (Becker, 1998; Dillman, 1978). Survey packages for each mailing contained a cover letter, a questionnaire, and an addressed, pre-stamped return envelope. The only stimulus altered between the three mailings was the wording of the enclosed 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.

The 189 completed surveys yielded a response rate of 52.4%. Data were entered and analyzed using IBM's SPSS statistical software. Key demographic traits of respondents were fairly reflective of the target population (Table 1), including average age (44.8 versus 45.8), with 39.7% above age 55 (target population: 36.1%). Assigned gender distribution was 47.6% male and 52.4% female (target population: 48.5% male; 51.5% female). 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. Regarding political identification, 83

respondents (46.7%) 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 1

Demographic details of survey respondents (N=189 unless otherwise noted)

Category	Respondents (N)	% of respondents
Assigned 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's degree or higher	22	11.7%
Political identification (N=178)		
Republican	23	12.9%
Democratic	83	46.7%
Independent	67	37.6%

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).

Table 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

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 similar across demographic variables to those who completed the mailed questionnaire (Table 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. We then compared support for climate change planning based on survey response time, but no significant differences were found. 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 findings are reliable and representative of the community as a whole.

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 within the following sections.

Lifeways are Intertwined with the Environment, and Environmental Concern is High

The first section of the questionnaire contained broad questions intended to gauge respondents' general environmental values. We asked about participation in 13 specific outdoor activities to infer personal and cultural environmental connections. Ten of the 13 questions 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 or more hours outdoors weekly. These findings indicate that outdoor activities are highly valued and that respondents are likely to personally observe environmental changes based on their degree of environmental engagement.

In another section 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 four for 20 of the 24 attributes listed. Table 3 lists respondents' concern for a sub-set of these attributes.

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.

Table 3

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*

Climate Change is Happening and is Major Problem

Respondents appear very aware of the existence and potential impacts of climate change. Ninety percent stated belief that climate change is happening, 92% reported personally observing changes in local weather patterns in their lifetime, and only 20% believe worries about climate change are exaggerated. Respondents were also generally clear on the causes of climate change with 80% reporting that it is human-induced and 60% identifying fossil fuel combustion as the leading cause. Trust in climate science was high, with 62% believing scientists understand the problem and 75% agreeing scientists should advise leaders on addressing it. However, trust in government efforts to combat climate change was low, with fewer than 18% believing politicians understand climate change and 9% agreeing that governments are doing enough to address it.

Based on previous findings among interviewees, the survey contained items asking respondents to indicate their level of concern for several non-ecological potential climate change impacts. Topics included human health, community infrastructure, heating/cooling costs, transportation costs, tourism-dependent businesses, and the Tribe's economy in general. 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 4).

Table 4
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, as air quality can decrease as ambient temperature increases. Over half of respondents (54%) reported that they live in homes without air conditioning or central air; under warming conditions these residents would be susceptible to increased problems related to mold, insects, humidity, and other threats that could compromise their health and comfort. Many reported already experiencing these problems. When asked to describe current conditions inside their homes, 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, because many community members appear ill-equipped to adapt to climate change without substantial investments in housing improvements (as has already been noted through home inspections by Tribal departments). This is another example of environmental justice issues facing Indigenous communities; compared to affluent households, many residents could be at risk from heat-related issues because they lack the resources to adapt through home improvements.

Cultural Values Should be Incorporated in Planning

Across numerous survey items, respondents consistently expressed concern for climate change disrupting links between traditional culture and the environment. In response to separate questions, over 95% of respondents agreed that Anishinaabe cultural opportunities are important to maintain, cultural identity needs to be maintained in the community, and that culture is intertwined with the environment. Concern specifically for future generations of community members, a traditionally-sacred value, was well-expressed. Over 96% agreed that the Tribe needs to ensure a healthy environment for future generations, and 87% of respondents ranked concern for future generations in light of climate change as either 4 or a 5 on the 5-point scale.

Respondents articulated tremendous support for incorporating Anishinaabe culture in long-term climate change planning (Table 5). We asked respondents to rate their level of support for various policy measures the Tribe could potentially adopt. Over 90% supported prioritizing the survival of sacred plant and animal species in planning and managing forests and fisheries specifically to prepare impacts of climate change. Over 82% strongly supported the creation of a group of Tribal

specialists to advise the Tribal Council in planning. Over 88% supported ensuring that traditional Anishinaabe knowledge has a key role in climate change planning.

Table 5

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*

Support for Long-Term planning is Very High for Adaptation and Mitigation Measures

We asked two summary questions about Tribal leaders taking 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." 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. Respondents appear clear in their support for leadership action.

Respondents expressed strong support for a range of potential mitigation and adaptation strategies. We first asked respondents to rank their level of support through general statements such as "focus on ways to reduce human influence on climate change" and "focus on ways to adapt to climate change." Following each of these broad statements, a sub-set of additional items asked respondents to rate their support for specific actions, such as adopting alternative energy sources, and preparing for human health impacts. As Table 5 shows, respondents articulated strong support across all potential policy emphases, including adaptation and mitigation strategies. Respondents' support for the specific examples listed agreed with their support for the Tribe taking "as many steps as needed to address climate change."

Discussion

Our findings agree with previous work finding Indigenous 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 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 studies concluding that Indigenous peoples tend to have a fuller awareness of the human causes of climate change compared to the U.S. public as a whole (Smith et al., 2014; Vaidyanathan, 2015). However, while 80% of our 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 to build support for some mitigation strategies the Tribe may choose to adopt.

Our second objective was to gain insight on perceptions of how climate change could potentially impact lifeways. Respondents expressed substantial concern for a wide range of negative impacts. Their high engagement in outdoor activities, including recreational and traditional cultural activities and sustenance harvesting, demonstrates that links between culture and the environment remain strong. Respondents identified potential threats to water resources, sacred plant and animal species, and traditional activities such as fishing and gathering. They also made astute links between climate change and numerous other facets of daily life that could be described as non-ecological and non-cultural, including human health, community infrastructure, tourism, and the Tribal economy in general. The potential impacts identified by respondents largely mirror those that scientists anticipate occurring in the region in the future (Melillo et al., 2014; Pryor et al., 2014; Schramm & Loehman, 2010). Interviewees in previous research in the community identified a similar range of potential impacts, but a higher proportion of survey respondents expressed concern for these impacts (Kozich, 2016).

Our final objective, perhaps relating most critically to future policy initiatives, was to assess support for long-term climate change adaptation and mitigation strategies in the community. Previous interview research found substantial interest in mitigation strategies, such as the development of wind and solar energy sources, with few mentions of adaptation strategies beyond the management of forests and fisheries in anticipation of environmental changes (Kozich, 2016). Survey respondents, by comparison, expressed strong support for adaptation strategies. Perhaps the focus on mitigation strategies by previous interviewees resulted from the fact that interview questions did not provide 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 adaptation actions to consider, perhaps enlightening respondents on the variety of possible actions that would better-prepare the community for a changing climate. Regardless, Tribal leadership will benefit from knowing that all potential policy measures posed in the survey garnered strong 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, and the development of community outreach programs to increase climate change awareness. Findings support the notion that traditional knowledge should play 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. Many specialists will need to be involved. 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 will largely be supported by those they affect.

Conclusion

The ability of KBIC leaders to take action on climate change reflects an assertion of sovereignty through self-management on critical issues. Although climate change is a global phenomenon, many jurisdictions are taking policy steps on their own in light of limited federal government action. The Tribe 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, community members provided statements suggesting that Indigenous 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 at numerous scales. Building on previous qualitative research, survey findings provide robust quantitative data to confidently advise the Tribal Council on matters involving long-term climate change planning. Nationally, other Indigenous communities can benefit from Tribal perspectives as they consider adopting their own climate change strategies. As Great Lakes Indigenous communities are largely underrepresented in the scientific literature on climate change, our findings address a knowledge gap that follow-up work in other regional tribes can continue to fill to enhance recent inter-tribal efforts (Inter-Tribal Council of Michigan, 2016; Tribal Adaptation Menu Team 2019; White et al, 2014). Action on climate change requires international effort, but community-level actions, such as those being considered by the KBIC can serve as an example to create culturally-relevant and tribally specific policies for many Indigenous communities.

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