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**Grand Traverse Bay
Watershed
Survey of Experiences
with Climate Change
and Global Warming:
A Summary**

Experiences with Climate Change in the Grand Traverse Bay Watershed

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Introduction

In late July 2014, we initiated a survey of residents in the Grand Traverse Bay Watershed as part of a larger project exploring implications of climate change in the region and opportunities for adaptation at community and watershed levels. Early scientific and policy discussions about climate change focused largely on gradual warming planet-wide, its causes, and its impacts. In recent years, however, discussions have become more nuanced and reveal a greater understanding of the many ways in which climate change will affect weather patterns generally, as well as many biotic and abiotic resources specifically. Various types of data collected in the Grand Traverse Bay (GTB) region show evidence of changes in the environment driven by shifts in climate conditions and the resulting weather patterns. Our survey asked residents what, if any, changes they have observed in a series of factors influenced by climate such as frequency and duration of rain events, ice cover on lakes, and length of growing season. We also asked a series of questions about perceptions of global warming, more generally. This report provides a summary of those survey results. Analysis of the survey data is underway to explore a number of different questions. These analyses will be described briefly at the end of this report.

What is a watershed?

The U.S. Geological Survey describes a watershed as “the area of land where all of the water that is under it or drains off of it goes into the same place”. More precisely, “A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment. Ridges and hills that separate two watersheds are called the drainage divide. The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. It all depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location. (Source: <http://water.usgs.gov/edu/watershed.html>).

Who responded to the survey?

We used both mail and the internet to conduct our survey. A sample of addresses for residents in 27 townships located in Antrim, Grand Traverse, Kalkaska and Leelanau counties, plus Traverse City, was obtained from *Marketing Systems Group – GENESYS Sampling Systems*¹. The map in figure 1 shows the

¹ There are several companies that specialize in sampling protocols for various purposes. More about the address-based sampling done by *Marketing Systems Group – GENESYS Sampling Systems* can be found at: <http://www.m-s-g.com/Web/genesys/Address-based-samples.aspx>

geographic area from which addresses were drawn. Of course, the GTB watershed boundary does not coincide with political unit boundaries. For our study area, we chose to include those townships that appeared, based on the map, to have at least 50% of their land area lying within the watershed.² A list of townships included in the study area is provided in Appendix B.

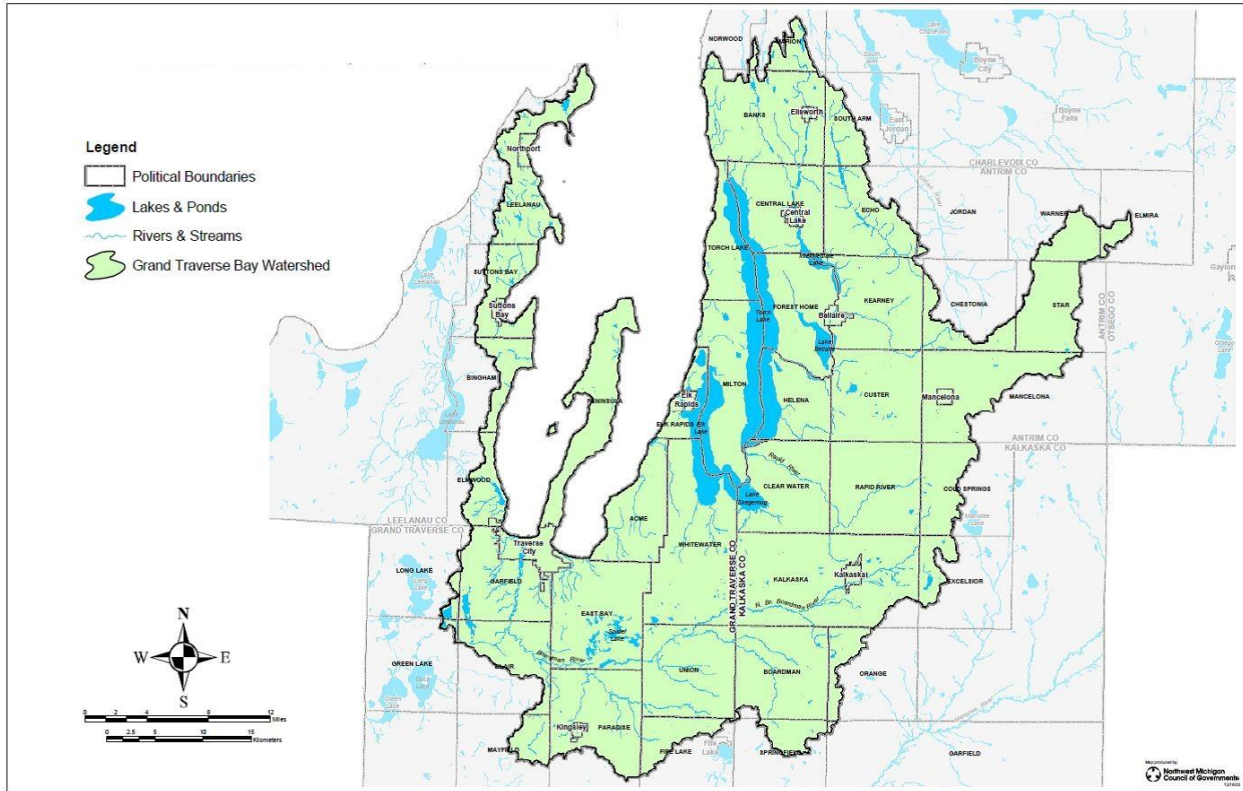


Figure 1. The Grand Traverse Bay Watershed (Source: The Watershed Center Grand Traverse Bay (2005) and Northwest Michigan Council of Governments)

We mailed letters of introduction to 1280 addresses within our study area. We did not obtain names of the residents at those addresses from *Marketing Systems Group*, so our letters were addressed to “Grand Traverse Bay Watershed Resident”. The letter of introduction described our study and informed recipients that we would be sending a questionnaire. It also provided a URL for the online version of the questionnaire, making it available to anyone who preferred responding in that way. (The online questionnaire was identical in format to the mail questionnaire.) We mailed questionnaires to 1219 addresses. (Before we did that mailing, 20 individuals had completed the survey online, while 41 letters of introduction were returned as undeliverable and so removed from the mailing list.) Based on the survey design method recommended by Dillman, Smyth and Christian (2009), we followed up with a reminder postcard one and a half weeks after the questionnaires were mailed. Then, after another two and a half weeks, we mailed the questionnaire a second time to any addresses from which we had not already received a response. Over the course of the study, 34 additional introduction letters were returned as undeliverable; these addresses were removed from the mailing list and no additional materials were mailed to them.

² Star Township in Antrim County was inadvertently left out of the sampled area.

Many respondents questioned the numerical codes found on the back of the questionnaires. These numbers served two purposes; first, they were included in the introduction letters and served as a password for anyone choosing to respond to the questionnaire online. Using the codes as passwords eliminated the risk of any one individual completing the questionnaire more than once online, because once used the codes became invalid. Secondly, we removed all of the addresses associated with codes used either online or with returned mail questionnaires, helping to ensure that we did not mail additional materials to individuals who had already responded. In some instances, items crossed in the mail such that a few individuals received additional materials before we received their responses. This process also eliminated the risk of any one person responding both online and by mail. (This did not happen, but had it occurred, we would have used the responses for whichever version we received first.) Four questionnaires were returned with the numerical codes removed. We were not able to include these in our analysis because we cannot verify that they are not duplicates of other responses.

We received responses to the online questionnaire from 64 survey participants. Of those, 60 responded to every survey question. Chi-square tests were conducted to determine whether responses to the survey were independent of whether it was answered online or using the mailed questionnaire. The results of these tests are described in Appendix A. Only education and income levels were significantly different between the online and mail respondents; those who completed the questionnaire online reported higher levels of education and higher incomes.

We received 521 questionnaires returned by mail. Of those, 20 individuals returned the questionnaire but indicated they were not interested in participating. We calculated our total response rate as 46.9 percent – 565 partially or fully completed surveys out of 1205 valid addresses.

Our questionnaire asked a series of questions designed to provide demographic information about participants. 59.5 percent of respondents indicated they live in Grand Traverse County. Of the geographic area from which addresses were obtained, the Grand Traverse County area has the largest population and so expectedly accounted for the largest number of addresses obtained. Table 1 provides the population of the study area in each county, the number of addresses obtained for each county and the number of completed surveys we received from each county.

Table 1. Population, addresses contacted, and returned questionnaires by County in study area.

County	Number of Townships in Study Area ¹	Population of study area (2010)	Number of Addresses Obtained	Number of Valid Addresses	Number of Completed Questionnaires
Antrim	11	20,735	228		121
Grand Traverse	8 + Traverse City	67,325	814		342
Kalkaska	4	9,841	100		33
Leelanau	4	12,009	138		69
Total		109,910	1280	1205	565

¹ Appendix B lists the townships from which addresses were drawn.

Among our respondents, 275 were female (50.5% female, 49.5% male). The median age among respondents was 62 years. Table 2 shows the number of respondents by 10-year age category. At the

time of the 2010 Census³, median age of the population in Antrim County was 47.4 years, Grand Traverse County 41.3 years, Kalkaska County 43.0 years and Leelanau County 50.3 years.

Table 2. Age of survey respondents, N=544

Age of Respondents	Number of Respondents
19-29	28
30-39	47
40-49	60
50-59	105
60-69	144
70-79	91
80-89	63
90-99	6

Table 3 shows the level of education obtained by respondents. 60% of our respondents completed a post-secondary degree of some sort. The 2013 American Community Survey⁴ estimates for education levels indicate the median level obtained in Antrim, Leelanau and Grand Traverse Counties was some college, no degree. The median level of education in Kalkaska County was high school graduate.

Table 4 shows the income level of respondents. The 2013 American Community Survey estimates shows median income in Antrim County was \$45,362; Grand Traverse County \$51,766; Kalkaska County \$40,140 and Leelanau County \$55,018. 16.8% of respondents indicated that they receive some portion of household income from work in an agricultural, forestry or outdoor recreation/tourism business (N=554).

Table 3. Education level of survey respondents, N=545

Education Level	Number of Respondents
Some high school	7
High school graduate	79
Some college, no degree	121
Associate's degree	60
Bachelor's degree	137
Graduate or professional degree	141

³ Source: <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

⁴ Source: <http://factfinder.census.gov/faces/nav/jsf/pages/programs.xhtml?program=acs>

Table 4. Pre-tax household income of survey respondents, N=499

Income Level	Number of Respondents
Less than \$25,000	61
\$25,000 - \$34,999	57
\$35,000 - \$49,999	79
\$50,000 - \$74,999	111
\$75,000 - \$99,999	65
\$100,000 - \$149,999	69
\$150,000 - \$199,999	19
\$200,000 or more	38

We asked participants how many months per year they live in the region. Given the time period during which the survey was conducted, we suspected we might receive responses from a number of seasonal residents. While the 2010 U.S. Census indicates that 17.5 percent of housing units in the study area are for recreational, seasonal or occasional use, 20% of our respondents indicated that they do not live in the region year round. Table 5 shows the amount of time respondents live in the GTB region. We also asked respondents how long they have lived in the region (average 26.5 years), and responses ranged from 1 month to 92 years.

Table 5. Number of months per year in residence in the GTB region, N=552

Months/Year	Number of Respondents
1	6
2	4
3	11
4	11
5	3
6	27
7	6
8	6
9	9
10	4
11	17
12	448

What changes have respondents observed?

We asked respondents to describe what changes, if any, they have experienced in their region. In particular, we asked about observed changes in precipitation, water bodies in the region, and types of plant, animal and fish species. We did not ask about observed changes in temperatures; instead we asked whether changes were observed in the length of the growing season, which would indicate warmer temperatures earlier in the spring and/or later into the fall. Overall, responses to questions about snow, ice and growing season were clearly influenced by the weather experienced during the winter of 2013-14.

Precipitation

Questions about rain and snow asked whether, during their time living in the regions, respondents had noticed changes in amount of annual rain or snow, changes in the duration of rain or snow events, and changes in when precipitation occurs during the year. In Table 6, responses are summarized. Generally, more respondents observed changes in snowfall than rainfall. However, the only change indicated by a majority of respondents was in the amount of annual snowfall. Even so, just how the amount of snow changed was not universally agreed upon. Just over one-fourth of those noting change observed a decrease in the amount of snow, while 13 percent described an increase in the amount of snow. Not surprisingly, the severe winter of 2013-2014 was prominent in the minds of respondents. 71 respondents who described a decrease in the amount of snow noted that the winter of 2013-2014 was an exception. In total, 28% of those who indicated a change in snow described the heavy snows of 2013-14.

Only one-third of respondents indicated observing a change in the amount of rainfall; however, nearly 60% of those described a decrease in the amount of rain. There was little agreement among respondents about other changes in precipitation.

Water bodies

Table 7 summarizes responses to questions about bodies of water in the study area. We asked respondents whether they are able to see a body of water from their homes and 44.6% of the respondents answered in the affirmative. While all residents in the watershed would be expected to regularly observe and interact with the region's water, we are curious about whether observations of change may be related to proximity of homes to water. Respondents were asked whether they had noticed changes in ice cover on bodies of water, in water quality, and in the severity of algal blooms during their time living in the watershed. Almost three-quarters of respondents indicated a change in ice cover. Among those, 41% described a decrease in total ice coverage on the Grand Traverse Bay and inland lakes. The 2013-2014 winter experience was the change most noted by almost 30% of those describing change.

Changes in water quality were noticed by just over 41% of respondents. Of responses in this category, 16% noted that water is clearer, while 42% described more pollution and/or more frequent beach closings due to water quality concerns. Appendix C describes these observations in greater detail. Only 24% of respondents noticed changes in the severity of algal blooms. Among those, 55% reported more algae.

Table 6. Respondents' observed changes in precipitation

Have you observed:	No (percent of respondents)	Yes (percent of respondents)	Descriptions ¹ (percent of yes responses)
A change in the amount of annual rainfall? N=540	65.2	34.8	More rain 18.5% Less rain 57.6%
A change in when rainfall occurs during the year? N=531	80.2	19.8	Change in spring 17.1% ² Change in summer 27.6% Change in fall 14.3% Change in winter 8.6%
A change in the duration of rainfall events? N=526	75.7	24.3	Shorter events 40.6% Longer events 10.2%
A change in the amount of annual snowfall? N=538	34.0	66.0	More snow 13.2% Less snow 26.8%
A change in when snowfall occurs during the year? N=530	58.5	41.5	Begins earlier 21.8% Begins later 23.6% Ends earlier 4.1% Ends later 25.5%
A change in the duration of snowfall events? N=521	66.2	33.8	Shorter events 4.5% Longer events 14.8%

¹ Other responses are described in appendix C.

Table 7. Respondents' observed changes in characteristics of water bodies

Have you observed:	No (percent of respondents)	Yes (percent of respondents)	Descriptions ¹ (percent of yes responses)
A change in the amount of ice cover on bodies of water, including the Grand Traverse Bay? N=534	36.0	74.0	More ice 4.8% Less ice 41.3%
A change in water quality in bodies of water in the region, including the Grand Traverse Bay? N=524	59.0	41.0	Clearer 16.3% More polluted/beach closings 42.3%
A change in the severity of algal blooms? N=502	76.5	23.5	More severe 55.1% Less severe 2.5%

¹ Other responses are described in appendix C.

Plants and animals

Lastly, respondents were asked about changes that they may have observed in the growing season and in plants, animals and fish of the region during their time living there. Just over one-third of respondents indicated a change in the length of the growing season. Of those noting a change, 45% described a shorter growing season (Table 8). Approximately 25% of respondents noticed changes in plant, animal and fish species, especially noting an increase of invasive plant (59%) and fish (48%) species. Table 9 summarizes the responses that were given for these three questions.

Table 8. Respondents' observed changes in the length of the growing season

Have you observed:	No (percent of respondents)	Yes (percent of respondents)	Descriptions ¹ (percent of yes responses)
A change in the length of the growing season? N=530	65.3	34.7	Longer season 8.2% Shorter season 45.1%

¹Other responses are described in appendix C.

Table 9. Respondents' observed changes in plant, animal and fish species.

Have you observed:	No (percent of respondents)	Yes (percent of respondents)	Descriptions ¹ (percent of yes responses)
A change in the types of plant species in the region? N=511	75.3	24.7	More invasive species 58.7% Increased tree death 14.3%
A change in types of animal species in the region? N=518	72.6	27.4	More coyote 14.1% More deer 14.1% More bear 14.1% More turkeys 11.3%
A change in the types of fish species in the region? N=504	74.8	25.2	More invasive species 48% Fewer fish 32.3%

¹Other responses are described in appendix C.

How do respondents view global warming?

While our research project focuses broadly on impacts of climate change, we also used this survey to develop a sense of how residents of the GTB region perceive global warming in particular. Researchers have described a number of ways in which climate change will affect atmospheric and ecological processes on the planet. A slow warming is just one change. Despite the narrowness associated with

asking just about global warming, we chose to do so because we wished to replicate research that has been done at the national level and in several other regions.

Researchers at Yale University and George Mason University designed a survey instrument that enabled them to group respondents into six segments according to their attitudes toward global warming. (Maibach et al. 2011) These six segments are referred to as “Global Warming’s Six Americas”.

Global Warming’s Six Americas

- **Alarmed** – Individuals in this segment are very certain global warming is occurring, understand that it is human-caused and harmful, and strongly support societal action to reduce the threat. They discuss the issue more often, seek more information about it, and are more likely to act as global warming opinion leaders than the other segments.
- **Concerned** – Individuals in this segment are moderately certain that global warming is occurring, harmful and human caused; they tend to view global warming as a threat to other nations and future generations, but not as a personal threat or a threat to their community.
- **Cautious** – Individuals in this segment are likely to believe that climate change is real, but are not certain, and many are uncertain about the cause. They are less worried than the Concerned, and view global warming as a distant threat. They have given little thought to the issue and are unlikely to have strongly held opinions about what, if anything, should be done.
- **Disengaged** – Individuals in this segment have given the issue of global warming little to no thought. They have no strongly held beliefs about global warming, know little about it, and do not view it as having any personal relevance. They tend to have the lowest education and income levels of the six groups.
- **Doubtful** – Individuals in this segment are uncertain about whether global warming is occurring or not, but believe that if it is happening, it is attributable to natural causes, not human activities. They tend to be politically conservative and to hold traditional religious views.
- **Dismissive** – Individuals in this segment are very certain that global warming is not occurring. Many regard the issue as a hoax and are strongly opposed to action to reduce the threat.

Source: Leiserowitz et al. 2013

A set of 15 questions was used to determine how residents in the GTB region fit into the six segments. Respondents’ answers to these questions are summarized in Appendix D. Figure 2 shows the U.S. Six Americas results for 2012, the most recent year for which national results have been published. Figure 3 shows how, based on our survey results, residents of the GTB region fall into the Six Americas segments. In comparison to the national results, a larger proportion of the GTB population falls into the alarmed and concerned segments. At the same time, a larger proportion falls into the dismissive segment.

Figure 2. Global Warming's Six Americas, September 2012 (Source: Leiserowitz et al. 2013).

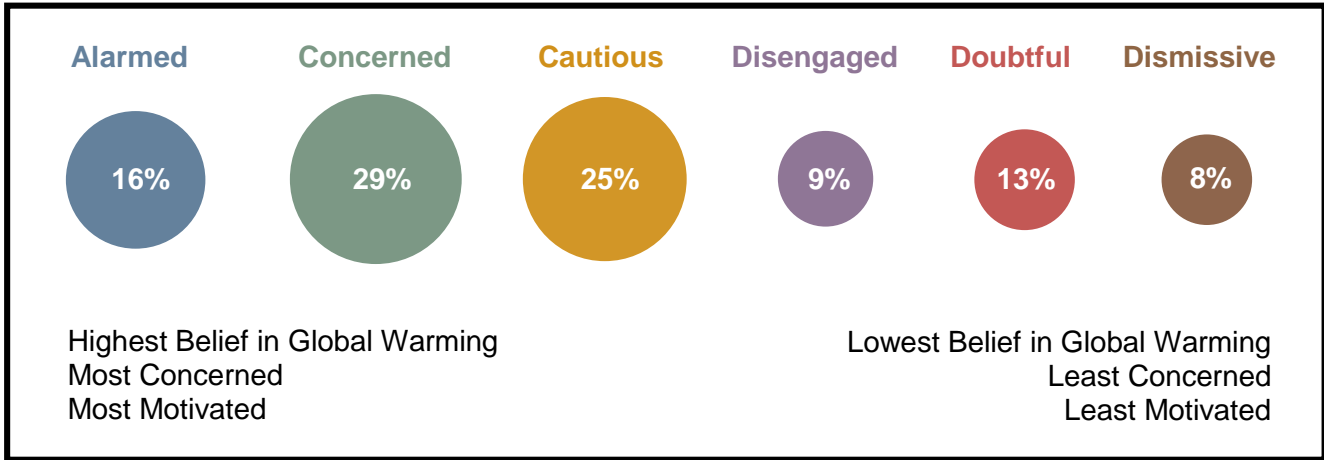
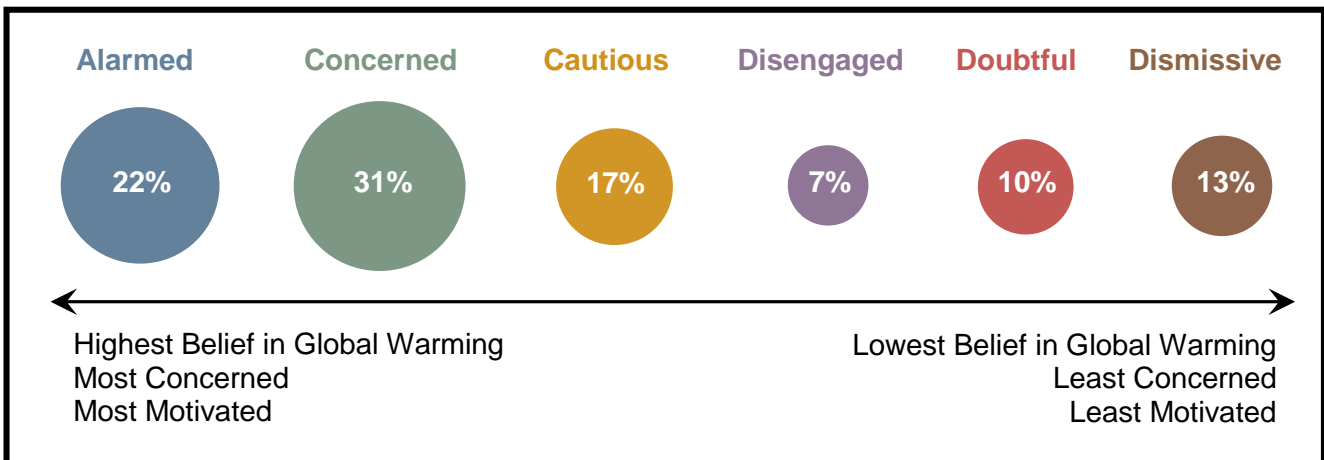


Figure 3. Global Warming's Six Americas in the Grand Traverse Bay Watershed, Summer 2014).



How will the survey data be used?

Two research questions will be addressed using the results of this survey.

1. How do GTB region residents' observations of changes compare to experts' measurements of similar variables?

We will use our survey data and data from historical records to assess how survey respondents' observations of change compare to the official record. The willingness of communities to make changes required for adaptation to new climatic conditions may be affected by the extent to which its residents believe they will be affected by climate change. Public uncertainties exist even in locations where measured changes in biotic and abiotic systems validate predictions of climate change impacts. Our survey questions focused on changes for which historical record has begun to show climate-related changes. Residents in these areas may not observe the changes or may not connect them to climate change. Regardless of the data collected by experts, those living in and experiencing conditions in a particular location may make decisions based on their own experiences (or subjective memories of experiences) rather than objective historical records.

2. Do GTB regions residents' observations of climate-related changes influence their views on global warming?

We hypothesize that individuals' responses to the Six Americas questions will be related to whether or not they have observed climate-related changes in the Grand Traverse Bay region. Specifically, if citizens have not observed any significant climate-related changes in their area they may be less concerned about global warming – although other factors, such as media attention, certainly play a role in individuals' perspectives. Both residents' experiences with climate-related changes and degree of concern about global warming may provide insights into public support for adaptation and mitigation strategies that could be undertaken in the region.

A third research question influenced the survey design. In one half of the questionnaires, the set of questions about views on global warming was asked first and the questions about changes experienced were asked second. In the other half of the questionnaires, the set of questions on changes experienced were asked first, and the questions about views on global warming were asked second. In both versions of the questionnaire, the last section included questions about age, gender, education and income. This design was used in order to determine whether the sequence in which questions were asked would affect responses. We speculated that asking about observed changes before asking about views on global warming could affect responses to the global warming questions because thinking about changes observed could cause respondents to be sensitive to global warming as a possible cause of some changes. On the other hand, asking questions about global warming first could potentially alienate individuals who have strong views about the topic, resulting in less attention to later questions.

We used chi-square tests to determine whether responses to questions about observed changes and questions in the Six Americas instruments section were independent of question order. The chi-square test results are reported in Appendix E. On only one question were responses not independent of question order. Those who responded to the questionnaire with questions about observed changes first and the Six Americas questions second were more likely to report observing changes in when rainfall occurs during the year. However, we do not consider this a substantive result.

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Appendix A

This table shows results of chi-square tests for independence of survey format and six characteristics of respondents. Only level of education and income level were not independent of survey format.

Respondent Characteristics	Chi-square (Degrees of freedom)	Explanation
Respondent's Six Americas segment	2.95 (5)	Score independent of survey format
Respondent's county of residence	3.61 (3)	County of residence independent of survey format
Age of respondent	6.26 (7)	Age independent of survey format
Gender of respondent	1.68 (1)	Gender independent of survey format
Respondent's level of education	11.88 (5)*	Education levels of online respondents were higher than those responding to the paper survey.
Respondent's income level	35.67 (7)*	Income levels of online respondents were higher than those responding to the paper survey.

*p<.05

Appendix B

Addresses for the survey were drawn randomly from the list of townships below. These townships were estimated to have at least one half of their land area within the Grand Traverse Bay watershed. Star Township in Antrim County was inadvertently excluded.

Antrim

- Banks Township
- Central Lake Township
- Custer Township
- Echo Township
- Elk Rapids Township
- Forest Home Township
- Helena Township
- Kearney Township
- Mancelona Township
- Milton Township
- Torch Lake Township

Grand Traverse

- Acme Township
- Blair Township
- East Bay Township
- Garfield Charter Township
- Peninsula Township
- Paradise Township
- Union Township
- Whitewater Township

Kalkaska

- Boardman Township
- Clearwater Township
- Kalkaska Township
- Rapid River Township

Leelanau

- Bingham Township
- Elmwood Charter Township
- Leelanau Township
- Suttons Bay Township

Appendix C:

Below is the full categorization of responses for each survey question that asked about changes observed with the number of responses for each. Numbers will not sum to the total number of yes responses for some questions because some responses could be placed into more than one category and because some respondents did not describe observed changes.

Observed change in amount of annual rainfall (N=188)

<u>More</u> - 16	<u>Anchored on 2013-14</u> - 17
<u>Less</u> - 68	<u>Drier conditions</u> - 9
<u>Normal variability</u> - 21	<u>Change in water levels</u> - 10
<u>Increased variability</u> - 6	<u>Change in intensity</u> - 23

Observed change in when rainfall occurs during the year (N=105)

<u>More in summer</u> - 14	<u>More in spring</u> - 8
<u>Less in summer</u> - 15	<u>Less in spring</u> - 10
<u>More in fall</u> - 12	<u>Normal variation</u> - 11
<u>Less in fall</u> - 3	<u>Anchored on 2013-14</u> - 13
<u>More in winter</u> - 9	<u>Frequency</u> - 3

Observed change in duration of rainfall events (N= 128)

<u>Shorter</u> - 52	<u>Normal variation</u> - 4
<u>Longer</u> - 13	<u>Anchor on 2013-14</u> - 3

Observed change in amount of annual snowfall (N=355)

<u>Less</u> - 95	<u>Anchored on 2013-14</u> - 99
<u>More</u> - 47	<u>Normal variation</u> - 69

Observed change in when snowfall occurs during the year (N=220)

<u>Begins earlier</u> - 48	<u>Normal variation</u> - 14
<u>Begins later</u> - 52	<u>Anchored on 2013-14</u> - 39
<u>Ends earlier</u> - 9	<u>Change in predictability</u> - 5
<u>Ends later</u> - 56	

Observed change in duration of snowfall events (N=176)

Longer - 26

Shorter - 8

Intensity/frequency - 24

Anchored on 2013-14 - 28

Normal variation - 12

Observed change in amount of ice cover on bodies of water (N=395)

More - 19

Less - 163

Frozen longer - 5

Frozen shorter - 2

Anchored on 2013-14 - 113

Normal variation - 19

Observed changes in water quality (N=215)

Beach closings - 60

Cleaner - 35

More polluted - 31

More algae - 31

Clearer - 5

Higher water levels - 6

Lower water levels - 12

Observed changes in the severity of algal blooms (N=118)

More - 65

Less - 3

Anchored on 2013-14 - 10

Observed change in length of growing season (N=184)

Longer - 15

Shorter - 83

Late frost - 5

Early frost - 1

Normal variation - 12

Anchored on 2013-14 - 18

Observed changes in plant species (N=126)

More invasives - 74

Poison Ivy observations - 3

Increased tree death - 18

Other changes in plant community - 20

Observed changes in animal species (N=142)

More bear - 20

More turkey - 16

Coyote observations - 20

Deer observations - 20

Wolf observations - 8

Rabbit observations - 7

Fox observations - 7

Bald eagle observations - 8

Bird community observations - 12

Cougar observations - 4

Amphibian/reptile observations - 7

Insect community observations - 3

Animals closer to civilization - 4

Observed changes in fish species (N=127)

More invasives - 61

Fewer fish - 41

Change in diversity - 3

Concern with Asian carp - 5

Salmon observations - 10

Appendix D

The following tables summarize responses to the 15 questions used in the Six Americas instrument.

1. Do you think that global warming is happening?

Responses	Number of respondents
Yes and I'm extremely sure	140
Yes and I'm very sure	115
Yes and I'm somewhat sure	112
Yes but I'm not at all sure	39
I don't know	39
No but I'm not at all sure	9
No and I'm somewhat sure	26
No and I'm very sure	37
No and I'm extremely sure	30

2. Assuming global warming is happening, do you think it is

Responses	Number of respondents
Caused mostly by human activities	312
Caused mostly by natural changes	128
Other	36
None of the above because global warming isn't happening	53

3. How worried are you about global warming?

Responses	Number of respondents
Very worried	122
Somewhat worried	208
Not very worried	135
Not at all worried	91

4. How much do you think global warming will harm you personally?

Responses	Number of respondents
A great deal	71
A moderate amount	158
Only a little	115
Not at all	129
Don't know	82

5. When do you think global warming will start to harm people in the United States?

Responses	Number of respondents
They are being harmed now	214
In 10 years	58
In 25 years	67
In 50 years	44
In 100 years	35
Never	110

6. How much do you think global warming will harm future generations of people?

Responses	Number of respondents
A great deal	243
A moderate amount	111
Only a little	34
Not at all	74
Don't know	89

7. How much had you thought about global warming before today?

Responses	Number of respondents
A lot	179
Some	211
A little	117
Not at all	45

8. How important is the issue of global warming to you personally?

Responses	Number of respondents
Extremely important	43
Very important	127
Somewhat important	196
Not too important	95
Not at all important	86

9. How much do you agree or disagree with the following statement: "I could easily change my mind about global warming"?

Responses	Number of respondents
Strongly agree	213
Somewhat agree	153
Somewhat disagree	161
Strongly disagree	18

10. How many of your friends share your views on global warming?

Responses	Number of respondents
All	25
Most	204
Some	163
A few	114
None	25

11. Which of the following statements come closest to your view?

Responses	Number of respondents
Humans can reduce global warming, and we are going to do so successfully.	20
Humans could reduce global warming, but it's unclear at this point whether we will do what's needed.	294
Humans could reduce global warming, but people aren't willing to change their behavior so we're not going to.	95
Humans can't reduce global warming, even if it is happening.	82
Global warming isn't happening.	45

12. Do you think citizens themselves should be doing more or less to address global warming?

Responses	Number of respondents
Much more	111
More	266
Currently doing the right amount	76
Less	39
Much less	33

13. Over the past twelve months, how many times have you punished companies that are opposing steps to reduce global warming by NOT buying their products?

Responses	Number of respondents
Many times (6+)	39
Several times (4-5)	35
A few times (2-3)	64
Once	5
Never	275
Don't know	131

14. Do you think global warming should be a low, medium, high, or very high priority for the President and Congress?

Responses	Number of respondents
Very high	107
High	151
Medium	137
Low	146

15. People disagree whether the United States should reduce greenhouse gas emissions on its own, or make reductions only if other countries do too. Which of the following statements comes closest to your own point of view?

The United States should reduce its greenhouse emissions...

Responses	Number of respondents
Regardless of what other countries do	385
Only if other industrialized countries (such as England, Germany, and Japan) reduce their emissions	6
Only if other industrialized countries and developing countries (such as China, India and Brazil) reduce their emissions	51
The U.S. should not reduce its emissions	34
Don't know	63

Appendix E

This table shows results of chi-square tests for independence of question order and response to questions about global warming and about changes observed in the region. Only the observation of change in when rainfall occurs was not independent of question order. However, we do not consider this a substantive result.

Survey questions	Chi-square (Degrees of freedom)	Explanation
Respondents' Six Americas segment	6.04 (5)	Segment independent of question order
A change in the amount of rain	0.18(1)	Yes response independent of question order
A change in when rainfall occurs	3.04 (1)*	Respondents who received the questionnaire which asked first about observed changes were significantly more likely to report observing no change in when rainfall occurs during the year.
A change in the duration of rainfall events	0.52 (1)	Yes response independent of question order
A change in the amount of snow	0.78 (1)	Yes response independent of question order
A change in when snowfall occurs	0.10 (1)	Yes response independent of question order
A change in the duration of snowfall events	1.17 (1)	Yes response independent of question order
A change in ice cover patterns	1.80 (1)	Yes response independent of question order
A change in the growing season	0.08 (1)	Yes response independent of question order
A change in water quality	0.13 (1)	Yes response independent of question order
A change in algal blooms	0.00 (1)	Yes response independent of question order
A change in the plant species	0.24 (1)	Yes response independent of question order
A change in the animal species	0.33 (1)	Yes response independent of question order
A change in the fish species	0.02 (1)	Yes response independent of question order

*p<.05