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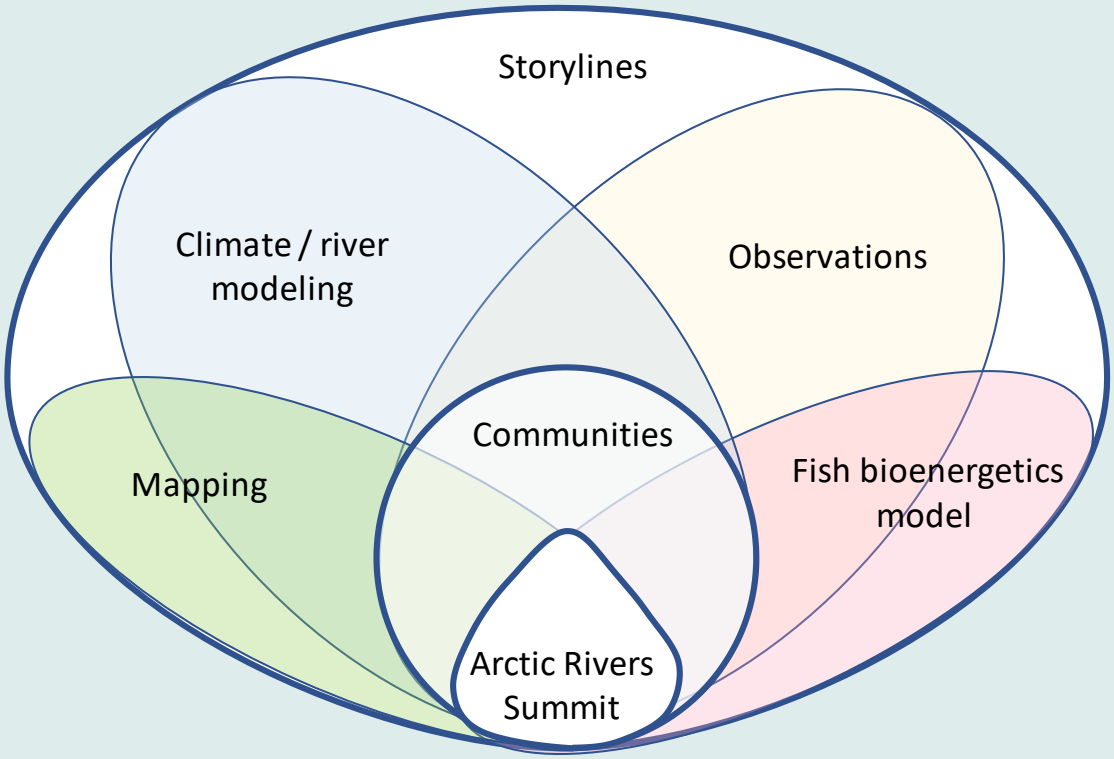
U.S. Geological Survey

GUIDING THE ARCTIC RIVERS PROJECT CLIMATE MODEL DEVELOPMENT: RESULTS FROM THE CLIMATE INFORMATION SURVEY



Cover figure represents the various convergent components of the Arctic Rivers Project.

Figure credit – Keith Musselman

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BACKGROUND

THE ARCTIC RIVERS PROJECT SEEKS TO IMPROVE OUR UNDERSTANDING OF HOW ARCTIC RIVERS, ICE TRANSPORTATION CORRIDORS, FISH, AND COMMUNITIES MIGHT BE IMPACTED BY AND HOW COMMUNITIES CAN ADAPT TO CLIMATE CHANGE. WE SEEK TO WEAVE TOGETHER INDIGENOUS KNOWLEDGE, MONITORING, AND THE MODELING OF CLIMATE, RIVERS, AND FISH. TO ACHIEVE THIS GOAL, PROJECT TEAM MEMBERS WILL BE DEVELOPING A REGIONAL CLIMATE MODEL OF OUR STUDY AREA. CLIMATE MODEL DEVELOPMENT TYPICALLY ONLY CONSIDERS WESTERN SCIENTIFIC MEASURES OF HOW WELL A MODEL PERFORMS IN A GIVEN REGION. IN AN EFFORT TO MAKE THIS CLIMATE MODEL RESPONSIVE TO THE NEEDS OF COMMUNITY MEMBERS IN OUR STUDY REGION, WE DEVELOPED A SHORT SURVEY TO UNDERSTAND THE AREAS OF GREATEST CONCERN FOR LOCAL DECISION-MAKERS RELATED TO CLIMATE CHANGE. THIS APPROACH WILL SUPPORT INCLUDING CONSIDERATIONS OF WHETHER THE MODEL DEVELOPED BY THIS PROJECT PERFORMS WELL IN INCREASING OUR UNDERSTANDING OF POTENTIAL CLIMATE IMPACTS OF GREATEST CONCERN TO COMMUNITIES IN THE PROJECT STUDY REGION.

METHODS

The climate information survey[1] was sent to 226 email addresses associated with Tribal Councils, Traditional Councils, First Nation Governments, City Councils, and Regional Indigenous Organizations using the survey software Qualtrics[2]. The complete survey can be found in the Appendix section of this report. The survey was open for six weeks and three reminders were sent to email addresses that had not completed the survey.

Survey questions were developed by a subset of the project research team (climate modelers, social scientists, tribal organization representative) based on an extensive review of literature with a focus on climate impacts on Indigenous communities in Alaska and Canada. An initial draft of questions was vetted by the project's Indigenous Advisory Council for appropriateness and cultural sensitivity and changes were made based on their recommendations. The resulting survey consisted of 14 open-ended questions (potential answers were not provided or suggested).

The first set of questions were focused on understanding each respondent's concerns related to climate impacts regarding environmental changes, subsistence resources, and extreme weather events on community health, community subsistence practices, and community safety. The next set of questions asked respondents to describe the time of year it would be most beneficial to understand potential changes in air temperature and precipitation. Finally, respondents were asked to think about the time

frame they would like to see modeled, the level of greenhouse gas emissions they would like the model to use to develop possible future scenarios, and how their community might make use of the information provided by the climate model.

Open-ended survey responses were coded for themes and placed into categories using the qualitative analysis software Nvivo[2]. Each survey question was analyzed individually. The open-ended nature of the questions allowed for respondents to list multiple categories in response to one question. These responses were categorized separately, which means that one respondent could be represented in more than one category. For example, a single respondent could answer the question: "Thinking about the safety of your community, what type of extreme weather events are you most concerned about?" by saying: "Increases in temperature in air and water". This response would be counted as a response in both the "increase in air temperature" and the "increase in water temperature" categories.

RESULTS

DEMOGRAPHICS

Twenty-three responses were received from representatives of Tribal and Traditional Councils (8), First Nation Governments (5), and Regional Indigenous Organizations (4), and City Councils (6) across our study area. Locations of survey respondents shown in figure 1.

RESPONSES

Detailed responses are shown below organized by question. The first nine questions addressed three different potential community impacts – Subsistence, Safety, and Health - with three identically worded questions. Quotes are used throughout the report with permission.

[1] Paperwork Reduction Act authorization not required due to the open-ended nature of the survey questions.
[2] Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U. S. government.

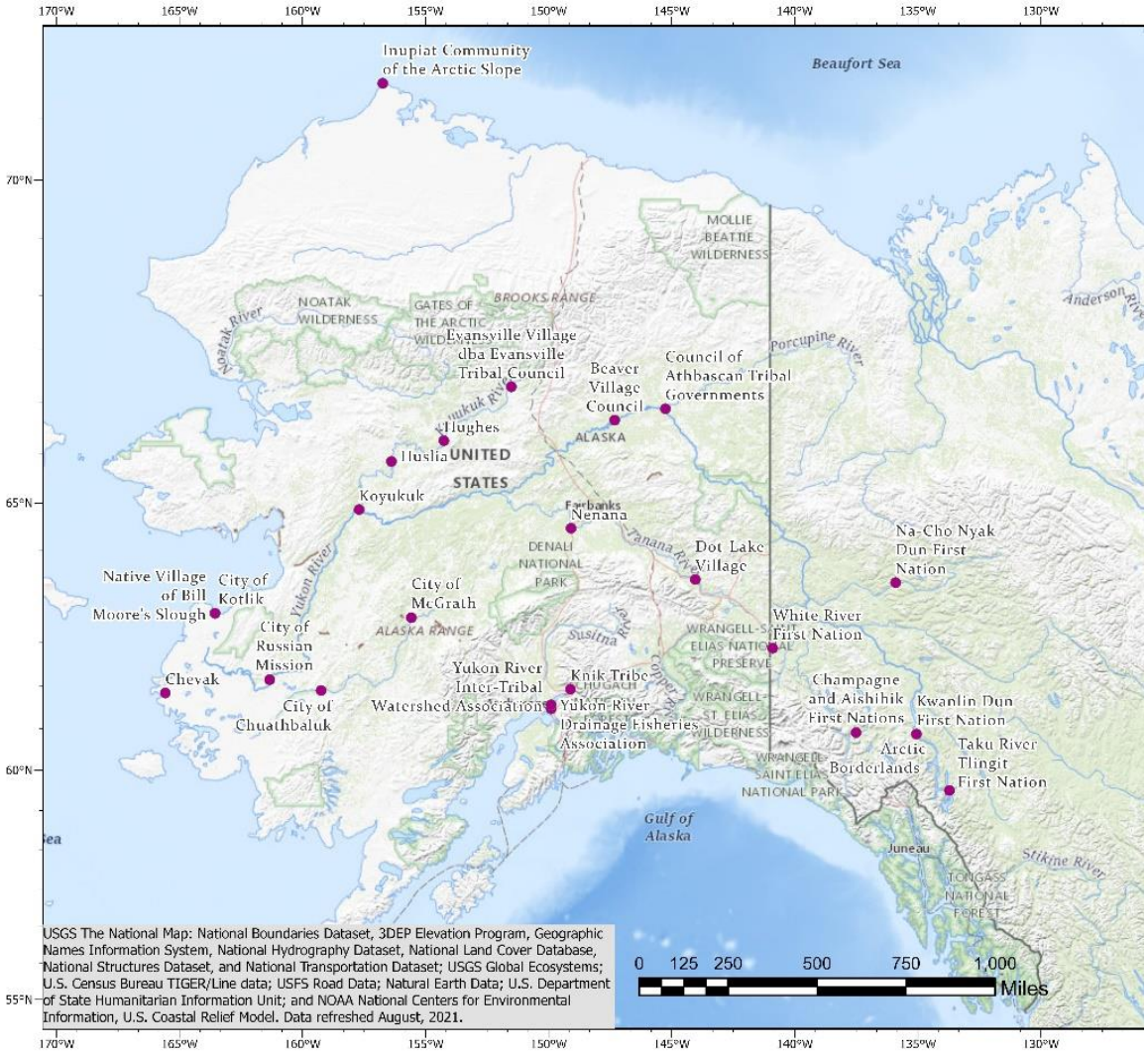

Figure 1. Location of survey respondents.

1. Thinking about the availability of subsistence resources and access to subsistence resources in your community, what specific environmental changes are you most concerned about?

SUBSISTENCE

Twenty-three (23) respondents answered this question (figure 2). The top three responses were:

1) Changing seasons and weather patterns (9) 39%

2) Salmon (6) 26%

3) Increased water temperature (5) 22%

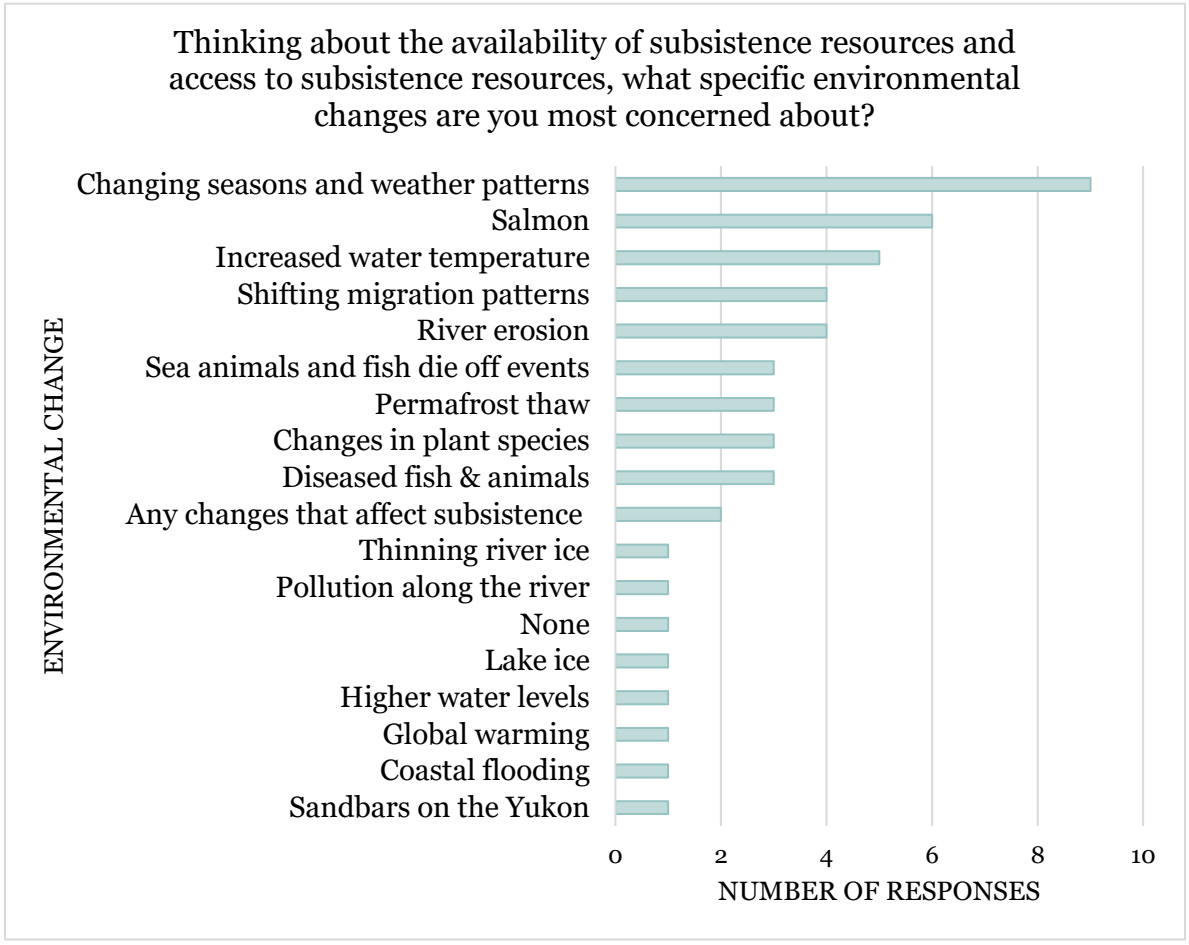

Figure 2. All response categories and number of responses for question 1.

2. Thinking about subsistence hunting, fishing, and gathering in your community, which subsistence resources are you most concerned about being impacted by climate change?

Twenty-three (23) respondents answered this question (figure 3). The top three responses were:

1. Fish (12) 52%

2. Salmon (7) 30 %,

3. Hunting and trapping (5) 22%.

However, some respondents indicated that there is a concern for all subsistence resources being impacted by climate change.

> *"All of them. By their definition subsistence resources are a vital component of First Nations life and changes that affect these resources through habitat loss, displacement, and changes to access will have a negative effect on First Nations."* - Champagne & Aishihik First Nations

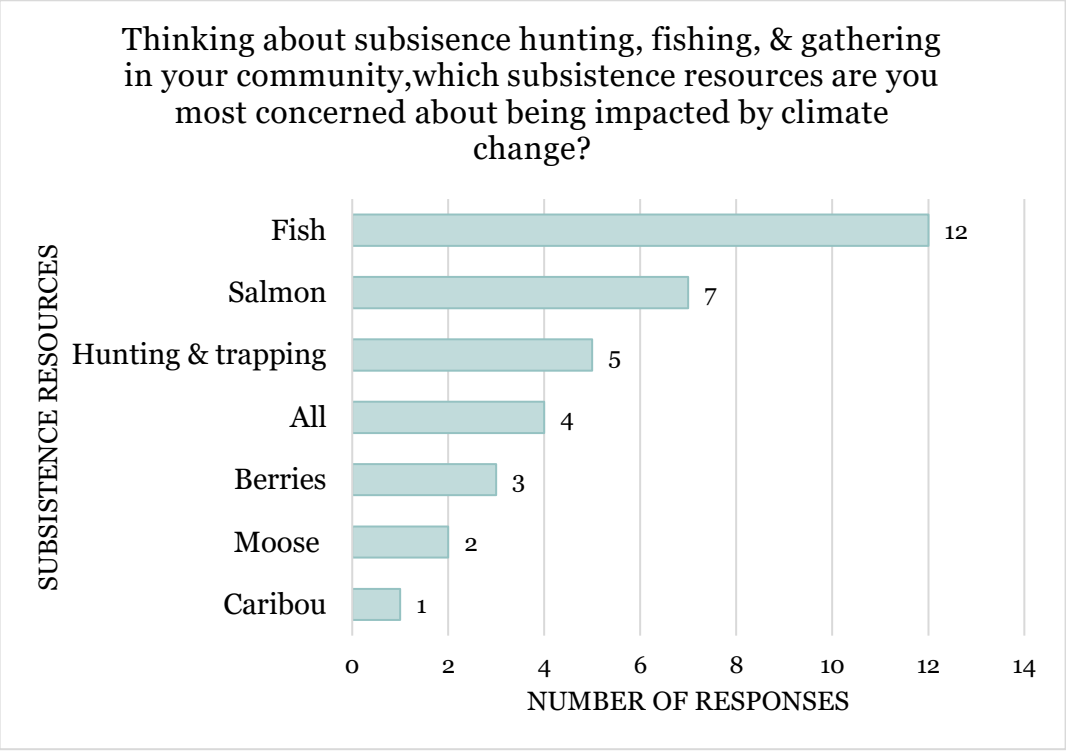

Figure 3. All response categories and number of responses for question 2.

3. Thinking about subsistence hunting, fishing, and gathering in your community, what type of extreme weather events are you most concerned about impacting the availability of subsistence resources or access to subsistence resources?

Twenty-two (22) respondents answered this question (figure 4). The top three responses were:

1. Water temperature (7) 32%

2. Hotter weather (7) 32%,

3. Change in weather conditions (5) 23%.

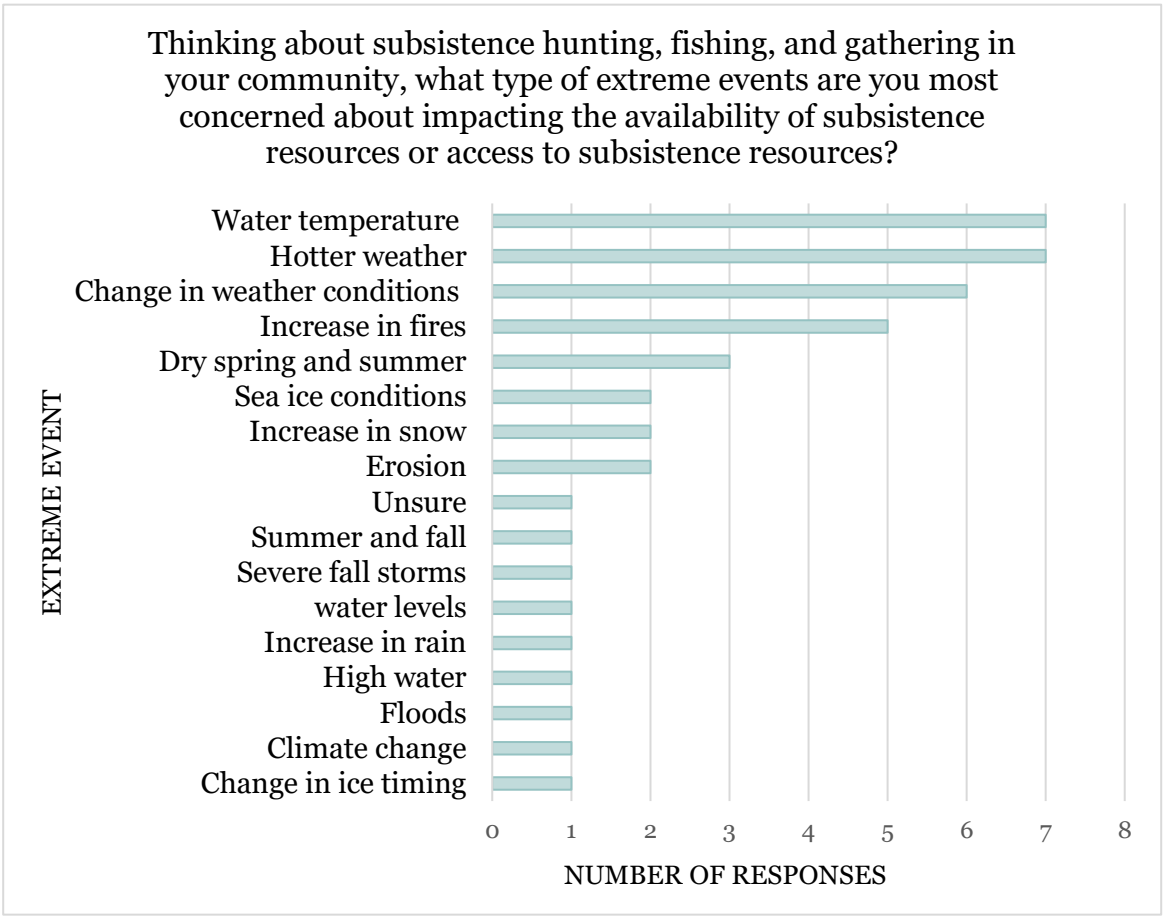

Figure 4. All response categories and number of responses for question 3.

4. Thinking about the safety of your community, what specific environmental changes are you most concerned about?

SAFETY

Twenty-two (22) respondents answered this question (figure 5). The top three responses were:

1. Extreme events (5) 23%
2. Erosion (5) 23%,
3. Availability of subsistence resources (3) 14%.

> *"Severe fall flooding, bank erosion."* – Bill Moore's Slough

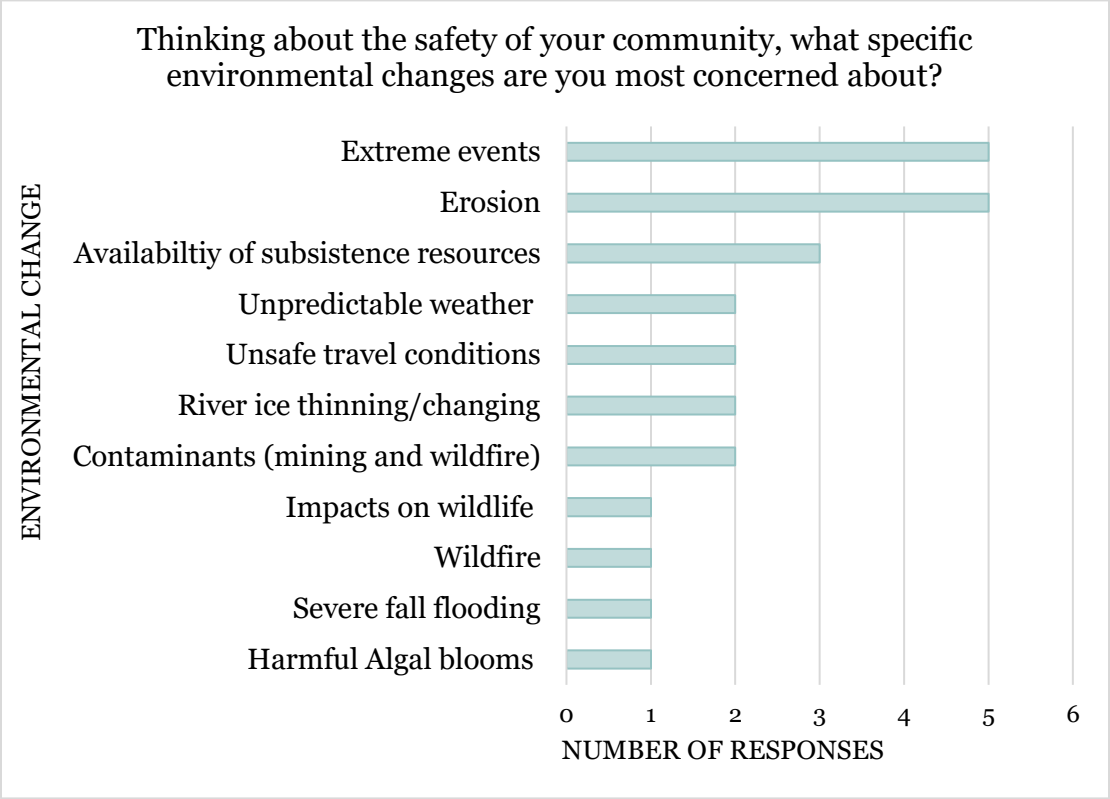

Figure 5. All response categories and number of responses for question 4.

5. Thinking about the safety of your community, which subsistence resources are you most concerned about being impacted by climate change?

SAFETY

Twenty-one (21) respondents answered this question (figure 6). The top three responses were:

1. Fish (10) 48%

2. Wildlife (7) 33%,

3. Salmon (6) 29%.

> *"Loss of habitat and changes to fish and wildlife populations, both in abundance and spatial distribution." – Champagne and Aishihik First Nations*

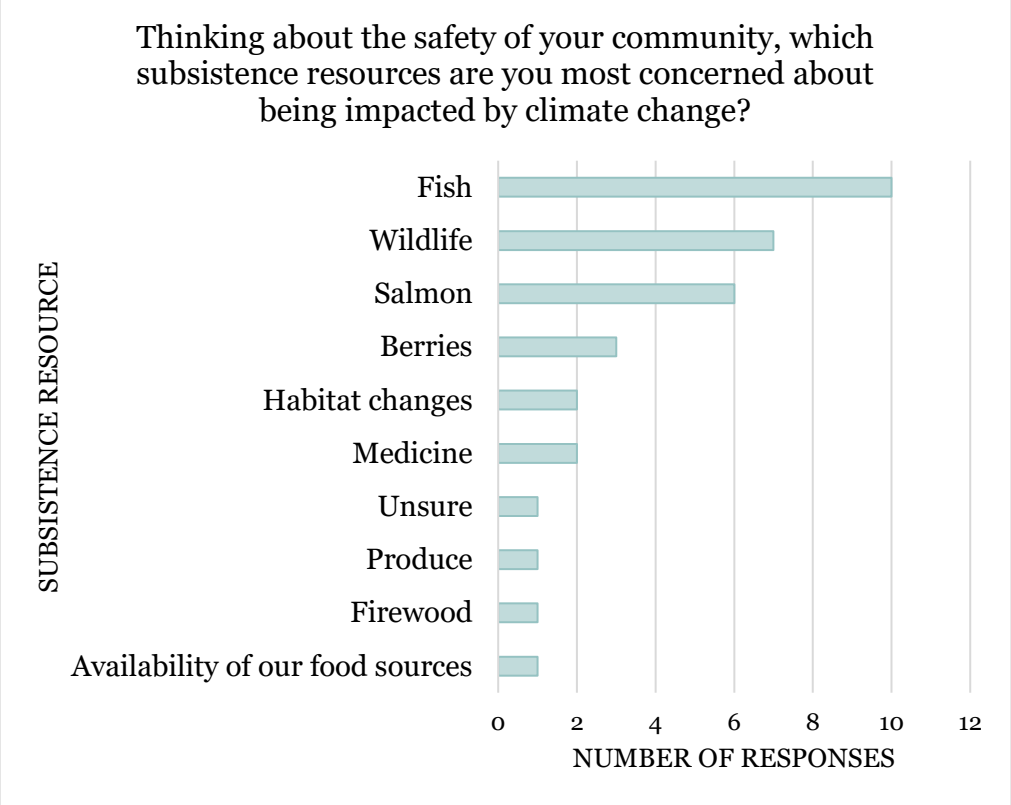

Figure 6. All response categories and number of responses for question 5.

6. Thinking about the safety of your community, what type of extreme weather events are you most concerned about?

SAFETY

Twenty-two (22) respondents answered this question (figure 7). The top three responses were:

1. Air temperature (7) 32%
2. Flooding (5) 23%,
3. Drier Summer / Wildfire (4) 18%.

> *"Increases in temperature in air and water."*
> - Yukon River Basin Indigenous Organization

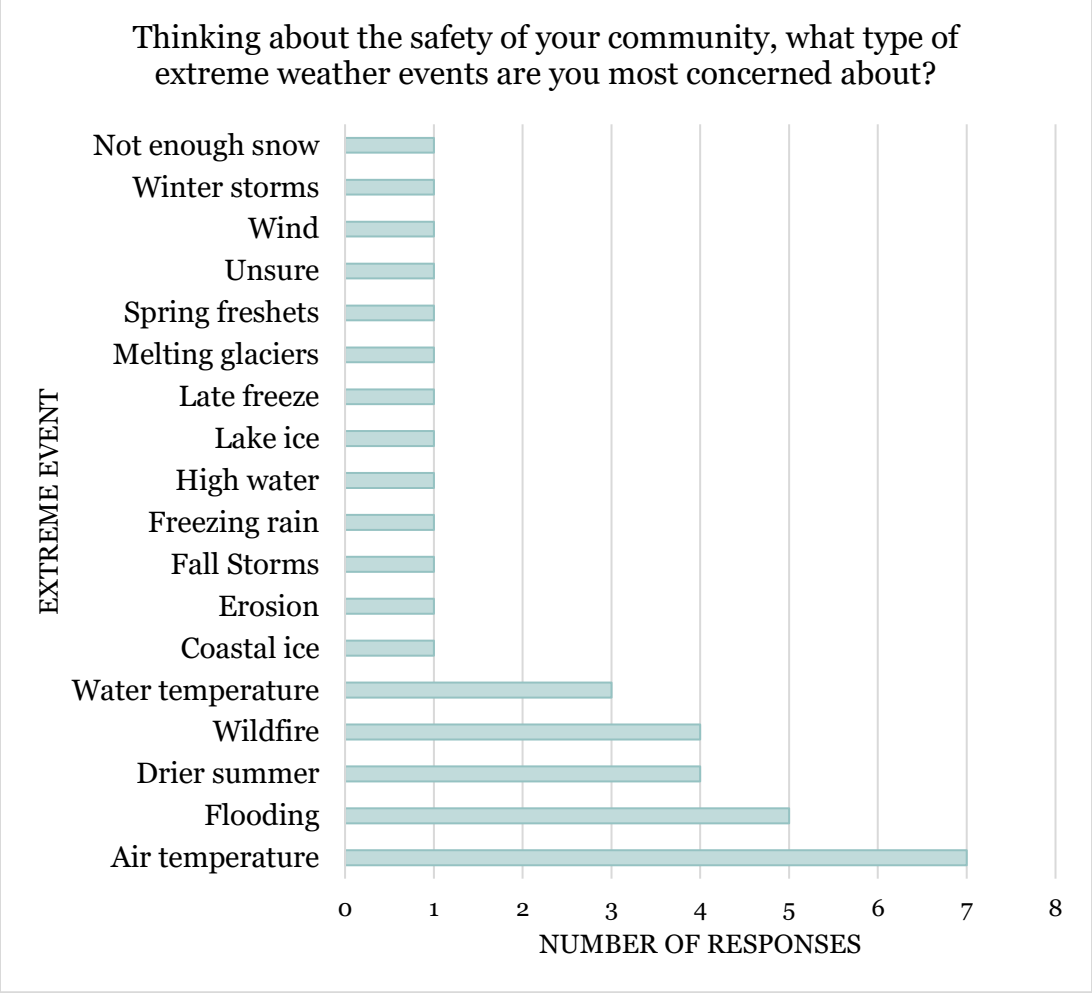

Figure 7. All response categories and number of responses for question 6.

7. Thinking about the health of your community, what specific environmental changes are you most concerned about?

Twenty-one (21) respondents answered this question (figure 8). The top two responses were:

1. Subsistence resources (6) 29%

2. Erosion (3) 14%,

All other responses were mentioned once.

> *"Not being able to harvest traditionally for our foods."* – Yukon River Fisheries Drainage Association

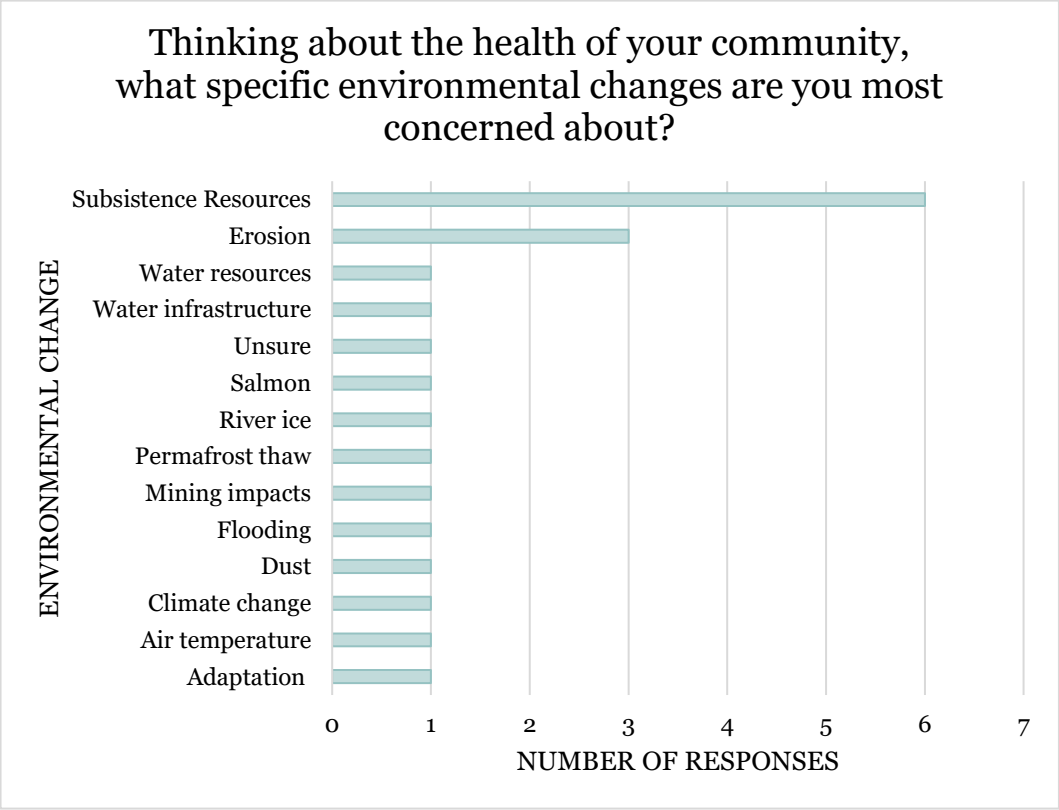

Figure 8. All response categories and number of responses for question 7.

8. Thinking about the health of your community, what subsistence resources are you most concerned about being impacted by climate change?

HEALTH

Twenty-two (22) respondents answered this question (figure 9). The top three responses were:

1. Salmon (7) 32%

2. All subsistence resources (6) 27%,

3. Fish (5) 23%.

> *"Less salmon available." – Taku River Tlingit First Nation*

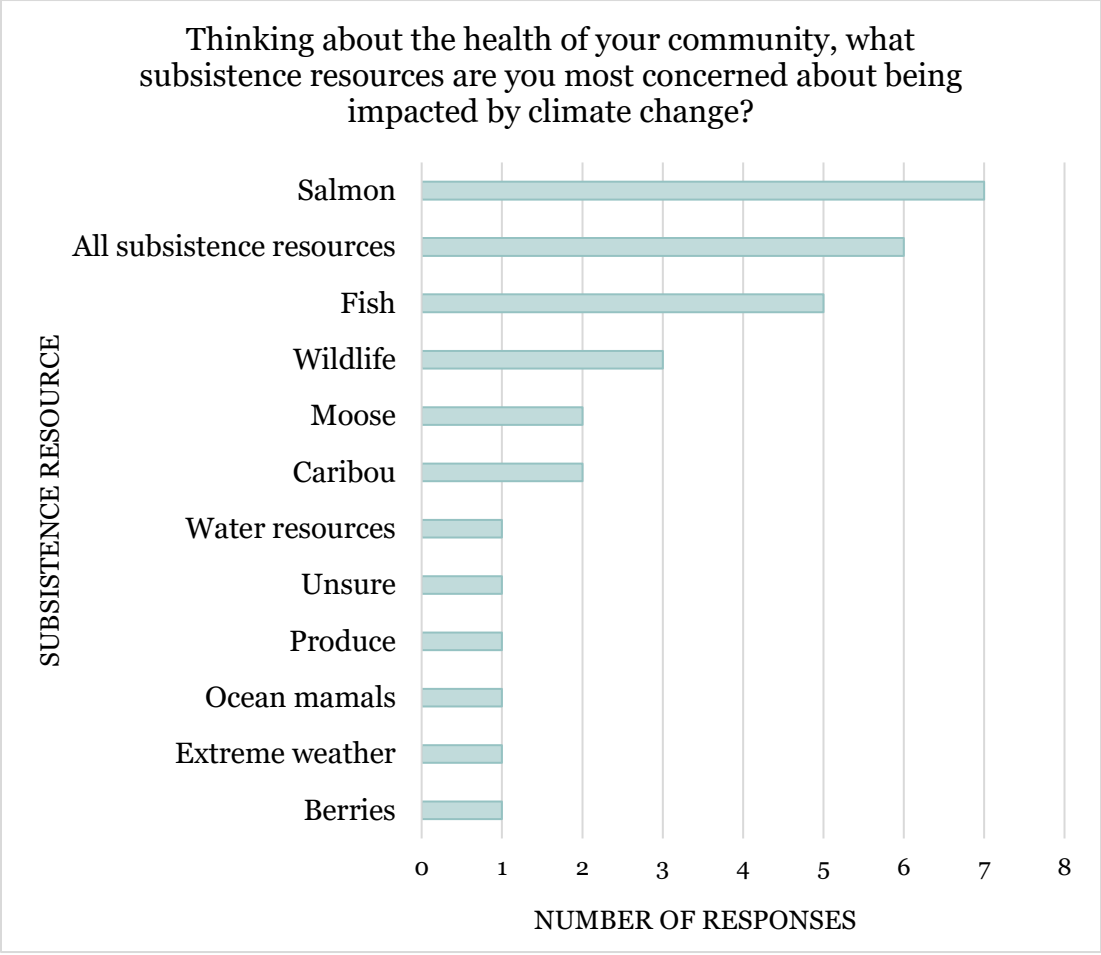

Figure 9. All response categories and number of responses for question 8.

9. Thinking about the health of your community, what type of extreme weather events are you most concerned about?

HEALTH

Twenty (20) respondents answered this question (figure 10). The top three responses were:

1. Wildfire (3) 15%

2. Flooding (3) 15%,

3. Air temperature changes (3) 15%.

> *"Flood, fire, changes to habitat" – Champagne and Aishihik First Nations*

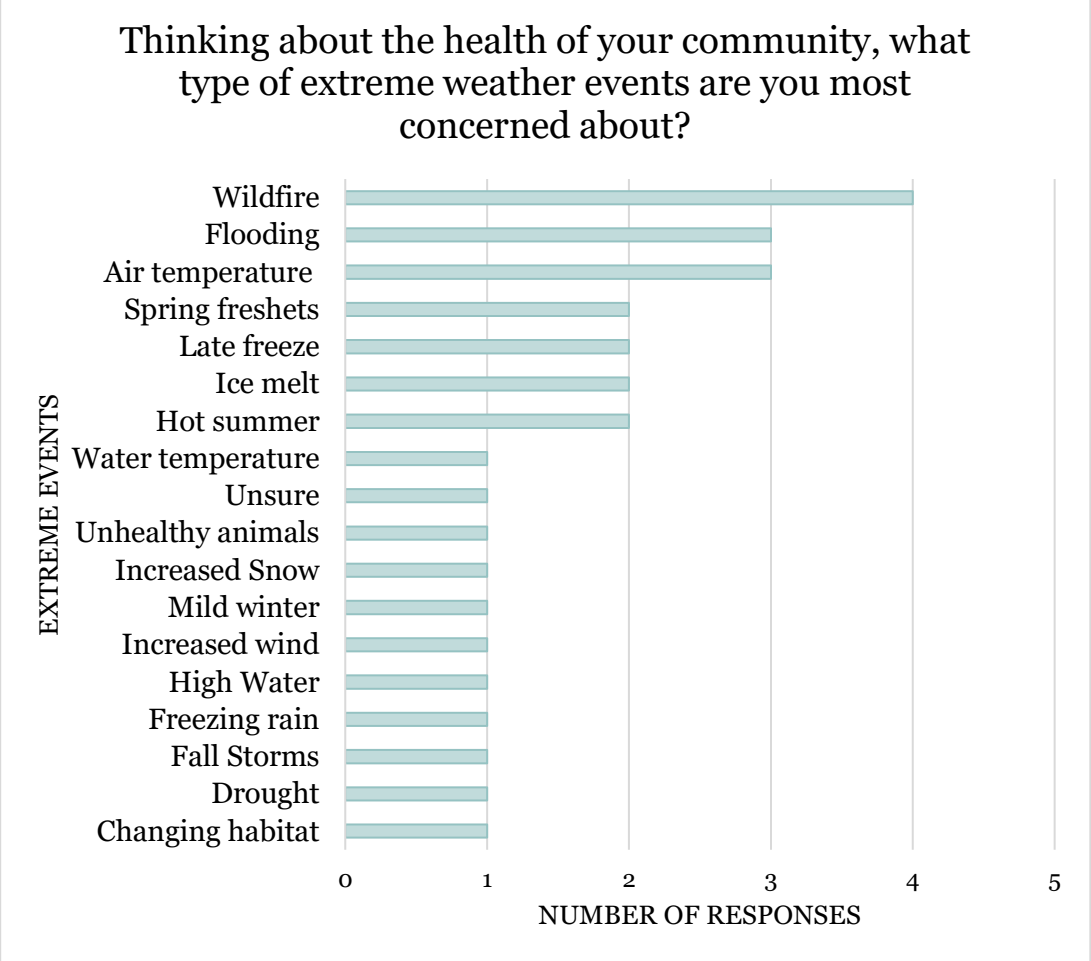

Figure 10. All response categories and number of responses for question 9.

10. Please tell us what time of year you feel is most important for understanding warming air temperatures and why.

Twenty-one (21) respondents answered this question (figure 11). Some respondents answered with concerns other than warming air temperature and thus those responses are not included here. Forty-three percent (43%) (9 responses each) listed summer and winter as the time of year most important for understanding warming air temperatures by 43% (9) of respondents each. Thirty-eight percent (38%) (8 responses) listed fall as the most important season for understanding warming air temperatures and 33% (7 responses) listed and spring as the most important season for understanding warming air temperatures. Reasons given for these responses included the impacts that warmer winters have on the ability to move around on the landscape as well as the impacts of warmer waters on salmon.

> *"Winter, because warmer winters have significant impacts on how people can move on the landscape and harvest."* – Taku River Tlingit First Nation

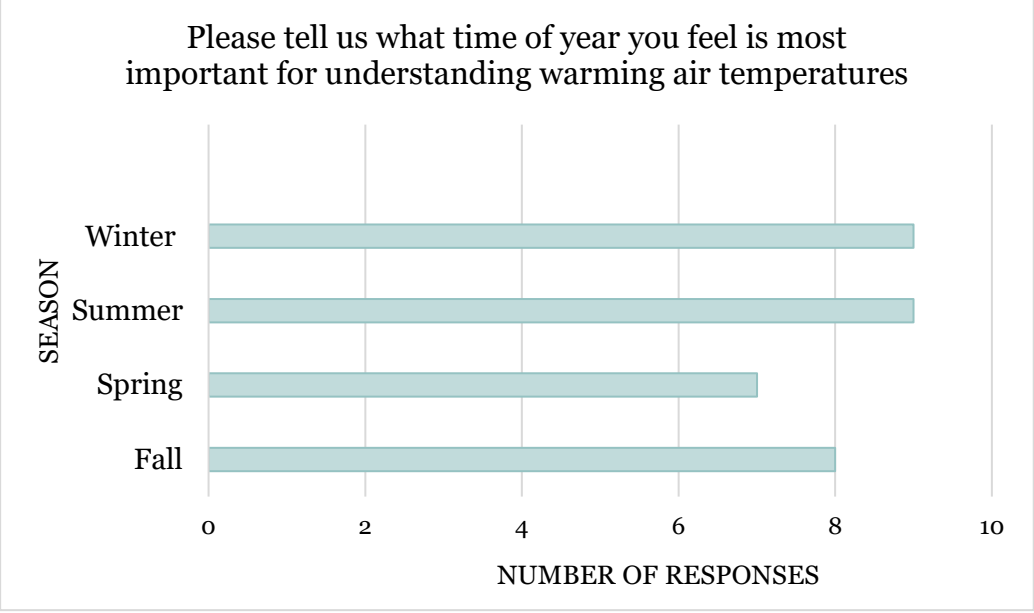

Figure 11. All response categories and number of responses for question 10.

11. Please tell us what time of year you feel is most important for understanding changes in precipitation (rain or snow) patterns and why.

Twenty-one (21) respondents answered this question (figure 12). Winter was listed as the most important time of year to understand changes in precipitation (rain or snow) by the most respondents at 43% (9). Summer was the next highest followed by Fall and then Spring. However, five respondents felt that all seasons were equally important.

> *"All seasons are affected with this warming of the Earth going on." – Chevak Traditional Council*

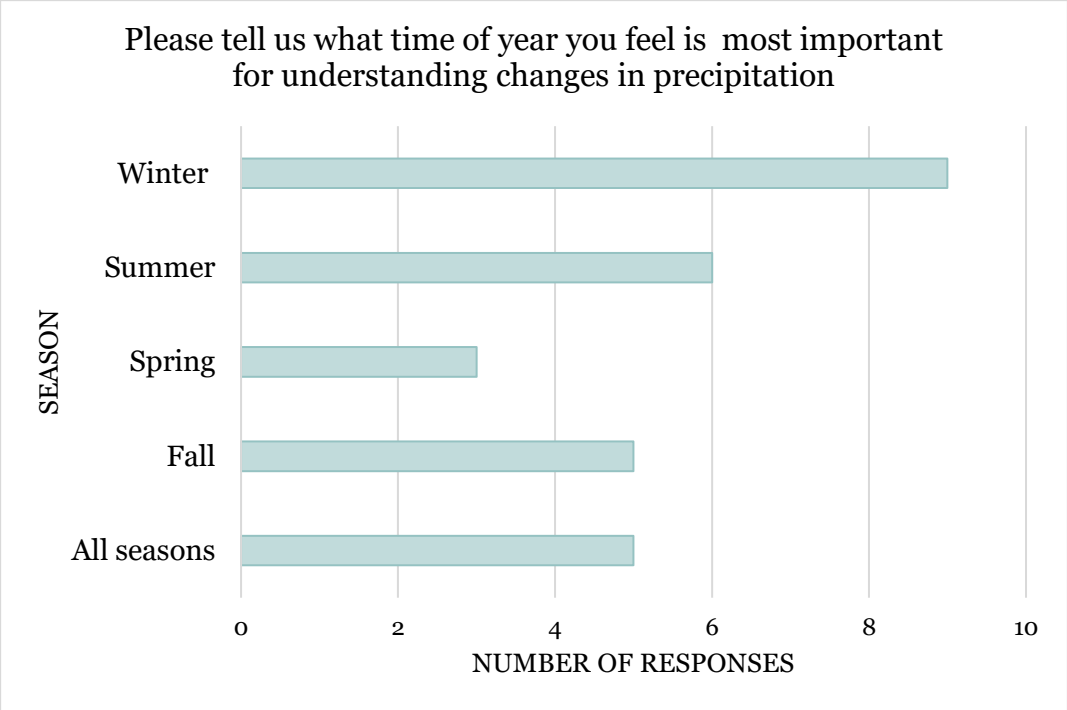

Figure 12. All response categories and number of responses for question 11.

12. The climate information produced by this project will be freely available for communities to use as they see fit. How might your community use this climate information?

Nineteen (19) respondents answered this question (figure 13). The top three responses were:

1. Community learning (9) 47%

2. Better understanding of what to expect in the future (3) 17%

3. Mitigation (3) 17%

Community learning encompasses things like providing education to the broader community about the consequences of not taking action on climate change, spreading the word about how the climate is changing, how to help slow climate change, and how the land and animals are affected by climate change.

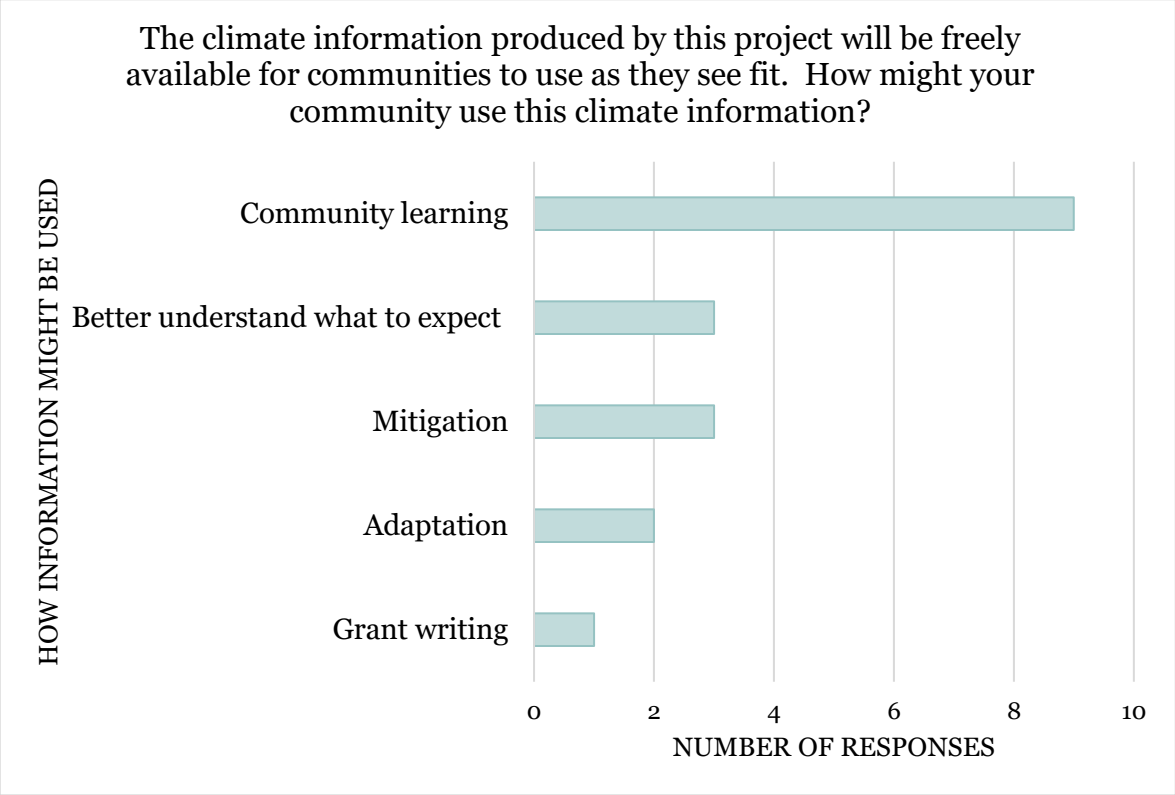

Figure 13. All response categories and number of responses for question 12.

13. Thinking about planning for climate change impacts for your community what time frame would you prefer to see modeled?

Eighteen (18) respondents answered this question. The answer with the highest number of responses was near term (9 responses, 50%), somewhere between 10 and 20 years into the future. Some respondents understood this question as asking how quickly the model should be developed and indicated a sense of urgency that the model be developed as quickly as possible.

> *"The earlier the better, so there needs to be a priority made on this." – Inupiat community of the Arctic Slope.*

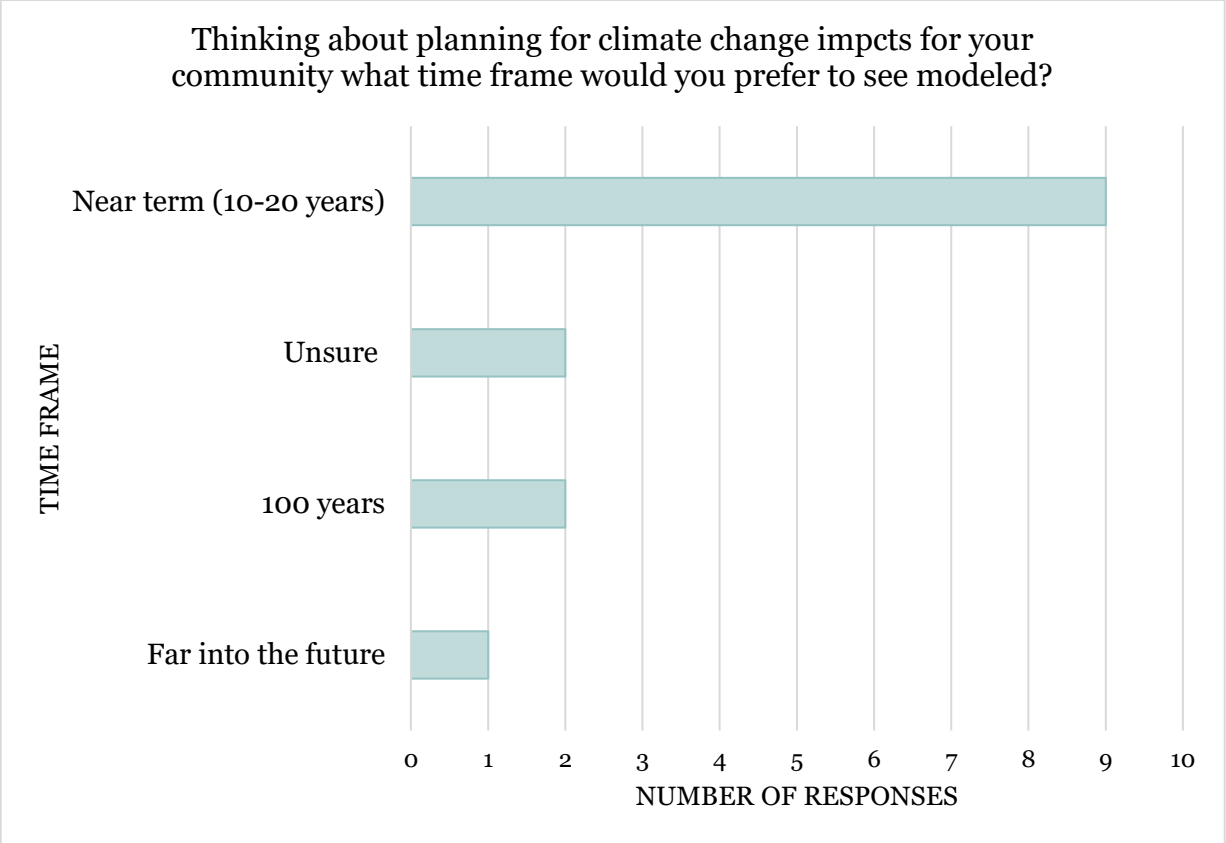

Figure 14. All response categories and number of responses for question 13.

SUMMARY

Survey participant responses indicate widespread concern regarding increased water temperatures in rivers across our study area and potential impacts on fish including salmon (figure 15). Increased water temperatures were cited by respondents as a top concern as an environmental change and extreme event impacting subsistence resources (survey question 1 and 3). Salmon and other fish were cited as the subsistence resources of most concern of being impacted by climate change in response to four survey questions spanning the categories of subsistence, health, and safety (survey questions 1,2,5, and 8). Several extreme events, including erosion, flooding, and wildfire were given by respondents as concerns. There is also widespread concern about changes in seasonality and weather patterns across the study area amongst survey respondents. Warming air temperature and potential changes in precipitation are important during all times of year, though more respondents indicated that winter precipitation is more important due to winter travel. In terms of model information, most survey respondents would like to see the near term modeled as opposed to the far term and will use the information from the model for community learning and awareness. Finally, although the survey asked respondents the type of future emissions scenarios they would prefer to see modeled, this question was unclear and the majority of respondents provided answers related to their views on society's potential future for human generated greenhouse gas emissions; thus results from that question are not presented here.

Figure 15. Word cloud highlighting 500 most used words across all responses.

The results in this report are from a small number of respondents across a large geographic area, of 226 surveys sent out only 23 where completed and returned, for a response rate of 10%. Due to the small sample size these results cannot be considered representative of all governing bodies (Tribal/Traditional Councils, City Councils, Regional Indigenous Organizations, and First Nations) in our study region but do represent the views of the survey respondents. The results presented here are similar to impacts of greatest concern described by Indigenous communities in the scientific literature.

These survey results will be used by the Arctic River Project's modeling team to make key decisions in the development of a regional climate model. These decisions include which global climate models to use, the time frame to model, and which emissions scenario to use. Further guidance from the Arctic River's Project – Indigenous Advisory Council will be sought as the model is developed.

Appendix 1: Survey

Arctic Rivers Project - Climate Modeling Survey

Thank you for participating in this survey! This survey is being administered by the University of Colorado, Boulder and the U.S. Geological Survey as part of the Arctic Rivers Project. We estimate that the survey will only take 10 minutes to complete. To move through the survey, click on the "next" and "back" buttons at the bottom of the survey. Your participation in this survey is voluntary and you may withdraw at any time by not completing the survey. If you have any questions about this survey, or to withdraw your responses after submitting the survey, please contact Nicole Herman-Mercer at nhmercer@usgs.gov

Introductory Text:
The weather conditions that occur in an area over a long period of time are called climate. Climate change refers to major shifts in the Earth's climate system, including changes in land and ocean temperatures, rain and snowfall patterns, and the atmosphere. The Arctic Rivers Project will build a model of the climate of the state of Alaska and part of Canada. Models are a representation of something. For example, a toy car is a model of a real car. Climate models are representations of actual climate based on mathematical equations. The climate information produced by the Arctic Rivers Project will be made freely available to your community or organization. Many decisions are made when creating a model to estimate future climate conditions. Your responses to this survey will help us make decisions.

The following three questions will repeat for the topics of subsistence, health, and safety in your community. For the first three questions please think about **subsistence hunting, fishing, and gathering in your community**.

Thinking about the availability of **subsistence resources and access to subsistence resources** in your community, what specific environmental changes are you most concerned about?

Thinking about **subsistence hunting, fishing, and gathering in your community**, which subsistence resources are you most concerned about being impacted by climate change?

Thinking about **subsistence hunting, fishing, and gathering** in your community, what type of extreme weather events are you most concerned about impacting the availability of subsistence resources or access to subsistence resources?

The following three questions are the same, but this time think about the **safety of your community** when answering.

Thinking about the **safety of your community**, what specific environmental changes are you most concerned about?

Thinking about the safety of your community, which subsistence resources are you most concerned about being impacted by climate change?

Thinking about the **safety of your community**, what type of extreme weather events are you most concerned about?

This is the last set of identical questions. This time please think about the **health of your community** when answering.

Thinking about the **health of your community**, what specific environmental changes are you most concerned about?

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Thinking about the **health of your community**, what subsistence resources are you most concerned about being impacted by climate change?

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Thinking about the **health of your community**, what type of extreme weather events are you most concerned about?

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There is evidence that temperatures are warming across the Arctic and that precipitation (rain and snow) patterns are changing. Thinking about your answers to the previous questions and the subsistence resources, environmental changes, and extreme weather events you are most concerned about impacting your community, please tell us what time or year or seasons are most important for understanding warming temperatures and changing precipitation (rain and snow) patterns.

Try to focus on **one or two of your biggest concerns** when answering these questions.

Please tell us what time of year you feel is most important for understanding warming air temperatures and why.

_____

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_____

Please tell us what time of year you feel is most important for understanding changes in precipitation (rain or snow) patterns and why.

_____

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_____

Recent changes in climate (climate change) are caused by rising levels of greenhouse gases in the atmosphere that trap heat and make the planet warmer. This is called the greenhouse effect. Human activities are responsible for almost all of the increases in greenhouse gases in the atmosphere over the last 150 years. The largest source of greenhouse gas emissions from human activities in the United States and Canada is from burning fossil fuels for electricity, heat, and transportation. It is important to keep in mind that even though the impacts of climate change happen at the local level, climate change is a global problem and greenhouse gases are

created by countries around the world.

This final set of questions are about the kind of climate information that would be best for your community.

The climate information produced by this project will be freely available for communities to use as they see fit. How might your community use this climate information?

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Greenhouse gases produced by human activity (emissions) may stay the same in the future, decrease, or increase with different impacts to climate change. Not knowing how human activity may change in the future, in your opinion, what level of emissions should the project focus on and why?

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_____

Thinking about planning for climate change impacts for your community what time frame would you prefer to see modeled?

_____

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_____

Thank you for taking the time to complete this survey! Please provide your contact information so that we may share the results of this survey with you in late summer 2021. You will also be added to our listserv so that we can provide you with project updates.

Name _____

email address _____

Name of community or organization _____