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## CLIMATE CHANGE IMPACTS, VULNERABILITIES, AND ADAPTION IN NORTHWEST ALASKA



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**Executive Summary:  
Climate Change Impacts, Vulnerabilities, and Adaptation  
in Northwest Alaska**

**Kotzebue, Alaska, NW Arctic Borough. May 24-25, 2006**

Robin Gregory<sup>1</sup>, Lee Failing,<sup>2</sup> Anthony Leiserowitz<sup>3</sup>

A two-day workshop on climate change impacts, vulnerabilities and adaptation in northwest Alaska was held in Kotzebue on May 24 & 25. The overall objective of the workshop was to help key stakeholders in northwest Alaska consider climate change impacts and vulnerabilities in the region, discuss the pros and cons of various adaptation strategies, and identify several potential near- and medium-term actions.

Workshop participants included members of the Northwest Arctic Borough (NWAB) Assembly, the city of Kotzebue, and representatives from several villages located within the Borough. Other participants included representatives from Maniilaq, NANA, the Alaska State House of Representatives, the Selawik National Wildlife Refuge, the National Park Service, Audubon Alaska, and the University of Alaska-Juneau. The workshop was organized by Anthony Leiserowitz, a geographer with Alaskan, national and international experience in public and stakeholder responses to climate change, and led by Robin Gregory and Lee Failing, decision analysts with experience helping communities to develop management plans for complex environmental and cultural problems.

As an initial workshop on climate change impacts, vulnerabilities and adaptations in the region, the participants did not make any official recommendations. The participants emphasized that any final recommendations need to incorporate the perspectives and concerns of people living in all 11 villages of the NWAB.

Observed Climate Change Impacts

The workshop participants identified many climate change impacts in the region including: more unpredictable weather, loss of sea ice, coastal erosion, greater storm surges, drying lakes and rivers, more dangerous winter travel, delayed caribou migrations, and changes in the availability of seals and other subsistence food sources.

Key Concerns

The workshop participants identified seven key concerns potentially threatened by climate change: Subsistence, Traditional Knowledge, Health and Safety, Social Disruption, Infrastructure and Services, Conservation of the Natural Environment, and Economic Development.

Important Needs

- Too many studies have simply collected information and taken it away for purposes of documentation or research. Too many of these studies have not supported the life and local

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decision making of the Inupiaq and too many of these studies were completed without sufficient participation, input and guidance from the local community.

- It is critical to include the traditional knowledge and experience of the Inupiaq to understand climate change in this region. In the past there has been too strong a reliance on conventional science to the neglect of native science.
- There is a need for better and more accessible scientific information. Some of this should be in the form of charts or graphs, for example showing changes in temperature or rainfall. Other information should be in the form of maps, for example showing changes in migration routes or the anticipated future effects of sea level rise, coastal erosion, and storm surge.
- There is a need for a better understanding of how climate change will interact with other environmental, economic, cultural and political stresses that could greatly amplify negative impacts.
- There is a need for a short-term plan that will help local communities respond to the already significant impacts of climate change. This does not mean that longer-term planning is not important; rather, it simply recognizes that climate change is already affecting the people of the NWAB and is a significant source of added stress among all the other economic, cultural and political changes that are taking place.
- There is a need for leadership from the local community to address the challenges of climate change. This response should be proactive, with an emphasis on protecting the resources that are critical to the life and culture of the Inupiaq. For this reason, a proposal will be made to the June 5 NWALT meeting that a “Climate Change Task Force” be organized to gather observations of climate change throughout the region, identify key vulnerabilities, and recommend a set of adaptation strategies. This group would be comprised of local participants, assisted by outside consultants if desired (by invitation).
- There is a need to identify and pursue funding opportunities to support projects intended to help the NWAB respond to climate change.

#### Key Next Steps

- A meeting on June 5 with the NWALT to direct future efforts, which might include a more comprehensive identification of climate change impacts and key vulnerabilities in the region, and development of adaptation and education strategies.
- Organization of a Climate Change Task Force to work with village residents and leaders.
- Coordination with the new Alaska State Climate Change Commission (Joule).
- Organization of a second regional workshop, after completion of village meetings / surveys, to frame the information in hand and to consider next steps.
- Maintain and strengthen coordination with state and federal management agencies and non-governmental organizations (U.S. Fish and Wildlife Service, National Park Service, Western Arctic Caribou Working Group, Alaska Department of Fish and Game) to ensure a strong voice for local participants and for the Inupiaq perspective on climate change.

**Final Report:  
Climate Change Impacts, Vulnerabilities, and Adaptation  
in Northwest Alaska  
Kotzebue, Alaska, NW Arctic Borough. May 24-25, 2006**

Robin Gregory<sup>1</sup>, Lee Failing,<sup>2</sup> Anthony Leiserowitz<sup>3</sup>

## **INTRODUCTION**

As part of a research project conducted by Dr. Anthony Leiserowitz and supported by the National Science Foundation and the Center for Research on Environmental Decisions at Columbia University, a two-day workshop on climate change impacts, vulnerabilities and adaptation was held in Kotzebue, Alaska on May 24 & 25. The overall objective of the workshop was to help key stakeholders in northwest Alaska consider climate change impacts, vulnerabilities, and opportunities in the region, discuss the pros and cons of various adaptation strategies, and identify several potential near- and medium-term actions. As only a two-day workshop, the meeting was designed to help these diverse regional stakeholders start the process of developing a coordinated response to climate change. The workshop had several inter-related goals:

- identify climate change impacts, vulnerabilities and opportunities in the region
- identify key values at risk (e.g., health and safety, subsistence, etc.)
- clarify the objectives of climate change adaptation strategies
- start to identify potential actions and their costs, benefits, and risks
- identify critical knowledge gaps and information needs
- establish next steps and develop a concrete plan for moving ahead

Workshop participants included members of the Northwest Arctic Borough (NWAB) Assembly, the city of Kotzebue, and representatives from several villages located within the Borough. Other participants included representatives from Maniilaq, NANA, the Alaska State House of Representatives, the Selawik National Wildlife Refuge, the National Park Service, Audubon Alaska, and the University of Alaska-Juneau. A full listing of participants is shown in Table 1. The workshop was organized by Anthony Leiserowitz, a geographer with Alaskan, national and international experience in public and stakeholder responses to climate change, and led by Robin Gregory and Lee Failing, decision analysts with experience helping communities to develop management plans for complex environmental and cultural problems. The workshop was held in the NW Arctic Borough Assembly room in Kotzebue (*Qikiktagrut*, or “almost an island”), located on the Baldwin peninsula, 30 miles above the Arctic Circle in northwestern Alaska.

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## **WORKSHOP ORGANIZATION**

The workshop was split into four parts across two days of presentations and discussions. The first morning was spent identifying negative impacts of climate change currently observed and experienced by native people living in northwest Alaska. Observed climate change impacts included more unpredictable weather, sea ice retreat, coastal erosion, greater storm surges, drying lakes and rivers, more dangerous winter travel, delayed caribou migrations, and changes in the availability of seals, moose, and other subsistence food sources. In this session, workshop participants also emphasized that, historically, there has been a critical lack of local participation in resource management decision-making. The morning discussions also included three short scientific presentations describing the causes, impacts and future projections of climate change at the global, arctic, Alaskan, and local scales and the impacts of climate change on both terrestrial ecology and marine mammals.

The first afternoon began with a presentation on how a structured decision-making process could help the community begin to make more effective and coordinated choices when adapting to climate change. This session was halted because many of the participants felt that it was premature to discuss responses to climate change until a more complete understanding of the ways in which climate change is currently affecting the lives of people in the region was obtained. This would require input from more than the small representative group gathered for this first workshop; instead, it was felt that public meetings to identify the range and magnitude of climate-induced changes and key vulnerabilities in each of the 11 villages of the NW Arctic Borough would be an essential step before the design of a comprehensive regional strategy.

On Day 2 of the workshop, the morning session focused on an initial identification of key vulnerabilities to climate change in the region. This discussion built upon the observations and impacts identified in Day 1, was organized in terms of seven different categories of impacts, and added further examples and details within each of these impact types. These areas of key concern are summarized in Table 2. The afternoon session was spent discussing next steps, including potential future workshops, funding possibilities, and the organization of a local Climate Change Task Force. Northwest Arctic Borough Assembly President Walter Sampson offered to present the workshop results to and ask for future direction from the Northwest Arctic Leadership Team (NWALT) at their June 5 quarterly meeting.

## **WORKSHOP FINDINGS**

The Inupiaq people of northwest Alaska are already experiencing significant, adverse impacts from climate change. These impacts are diverse, pervasive, affect many aspects of life critical to the welfare, health and cultural identity of the region, and are likely to get much worse. For example, average annual temperatures across the Arctic have risen about 1.8° Fahrenheit since 1900, yet are projected to rise by an additional 7° to 12° Fahrenheit by 2100, with even larger increases in Alaska<sup>4</sup>. This future warming is anticipated to have major, large-scale, and heterogeneous impacts on the Arctic, with uncertain consequences for human societies and natural ecosystems. Adding to the concern is the fact that very little can be done at the local level to mitigate global warming, because the primary sources of greenhouse gases are both geographically diffuse and distant (the US, Canada, Europe, Russia, Japan, China, India, Brazil, etc.) and varied (e.g., coal-fired power plants, cars and trucks, deforestation, etc.).

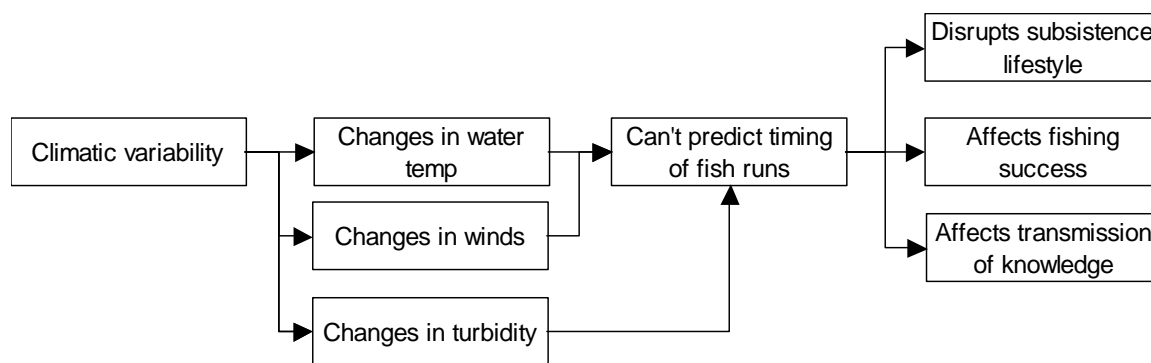
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<sup>4</sup> Arctic Climate Impact Assessment (2004) Cambridge University Press.

As a result, Inupiaq communities in northwest Alaska are faced with the necessity of adapting to a natural world that is quickly changing, generally for the worse, in that long-standing patterns of weather and ocean and animal behavior are changing as a result of global climate change. Adding to the seriousness of these impacts is the fact that climate change is not occurring in isolation. Climate change adds yet another source of social and environmental stress to an already long list, including resource development, cultural and economic changes, chemical pollution, rising fuel costs, drop-off hunting (often from distant locations), and changes in state and federal laws and regulations.

The workshop began with the identification of some of the important climate change impacts that are already being experienced by individuals, communities and key institutions across the region. Additional, and more complete, documentation of climate-related changes has previously been summarized in various reports<sup>5</sup> and papers<sup>6</sup>, including documentation of impacts on the Inupiaq way of life as the result of recent environmental change<sup>7</sup>. The listing of impacts or vulnerabilities that were identified at the workshop, shown in Table 3, is therefore partial; nonetheless, this information convincingly demonstrates the magnitude, significance and seriousness of climate change for northwest Alaska.

One of the principal concerns expressed by workshop participants was the increasing danger and difficulty now experienced in carrying out traditional subsistence activities due to the variability and uncertainty in weather, wind, ice conditions, and the like. In part, this reflects both the substantial changes in climate and weather conditions and the importance placed on regular seasonal access to traditional hunting, fishing, and gathering sites. The increased variability and uncertainty of these conditions imposes significant costs, because activities that in the past occurred at a regular time are now irregular: as one participant said, fish nets that for years have been put into the river on June 20 now need to be put in the water earlier or later because it is now impossible to predict when the fish will return. This variability affects not only subsistence harvests, but also the social, cultural, and economic activities that go hand-in-hand with subsistence; a simple example, relating to changes in the timing of fish runs, is shown in the diagram presented below.



<sup>5</sup> Huntington, H. and Fox, S. The Changing Arctic: Indigenous Perspectives.

<sup>6</sup> Hinzman, L. et al. 2005. Evidence and implications of recent climate change in northern Alaska and other Arctic regions. *Climatic Change* 72: 251-298.

<sup>7</sup> Documenting Qikiktagrugmiut knowledge of environmental change. June, 2002. Native Village of Kotzebue.

Over centuries, the Inupiaq of northwestern Alaska have proven themselves to be highly adaptive, flexible, and resilient to the extreme climate conditions and variability of the Arctic. Yet the current pace of global warming is especially rapid in the Arctic and is projected to accelerate further over the next 50 to 100 years. As emphasized in the workshop, this mix of diverse impacts and high uncertainty means that cumulative impacts are difficult to predict. This adds to the case for developing flexible adaptation plans at the local level. It also adds to the urgency for other groups, agencies, and non-governmental organizations in northwest Alaska – such as the U.S. Fish and Wildlife Service, National Parks Service, Western Arctic Caribou Herd Working Group, Bureau of Land Management, and Alaska Department of Fish and Game – to develop flexible policies, strategies, and regulations that incorporate the uncertainty created by climate change and other factors. Many workshop participants expressed a low level of confidence in the current ability of management agencies to successfully manage the added stressors brought on by climate change.

Local participation in the development of a climate change adaptation plan was another primary concern. Strong support was expressed for learning more about the views of people living in all 11 villages of the NWAB. After much discussion, it was recognized that several processes are already underway that could perhaps be expanded so as to (a) encourage broad-based input as part of documenting and adapting to climate change impacts; (b) disseminate this information; and, (c) help to educate village residents about the extent and timing of anticipated changes in the local climate and environment. For example, Maniilaq is currently conducting a series of village-based environmental assessments, which could potentially be expanded to include climate change and perhaps assisted through partial resource and/or financial support from other groups such as the Subsistence Resource Commission. It was also recognized that input should also be obtained from other groups, including industry and management agencies; it was hoped that representatives of these sectors would attend at least some of the village meetings.

It was recognized that the development of a locally-based climate change adaptation plan will be an ongoing and labor-intensive effort. A variety of funding possibilities were discussed, including those shown in Table 4. Further guidance on funding direction will come after the June 5 NWALT meeting.

## **KEY VULNERABILITIES AND POSSIBLE ACTIONS**

The morning of the second day was devoted to the identification of key vulnerabilities and possible actions that might address them. This information was seen as preliminary, to be expanded and framed in light of additional interviews and workshops in all 11 villages and perhaps a second, follow-up workshop, to be held after the village interviews are completed.

The following organizes the identified vulnerabilities and possible actions around seven key concerns expressed by participants, as shown in Table 2.

### **Subsistence**

#### Key vulnerabilities

- Harder to predict availability, movement and behavior of animals
- User conflicts are aggravated by climatic variability/lack of predictability
- State management agencies are too slow to respond to changing conditions

## Possible Solutions

- Support and sustain local, traditional, experiential knowledge
- Increase capacity to more quickly share and incorporate knowledge of changing conditions
- Find ways to respond more quickly at a regulatory level – state and federal agencies need to be more responsive
- Increase local involvement in these decision-making processes. Take advantage of local on-the-ground knowledge so that local regulations fit the local area.
- Example of possible win-win option: manage timing of sport seasons to coincide with later part of the caribou migration (sport hunters want bulls who come later in the migration; moving the season later would protect the more sensitive leading edge of the migration – cows and calves – and leave them for native hunters)

## **Traditional knowledge**

### Key Vulnerabilities

- Harder to predict the availability, movement, and behavior of animals – impacts on subsistence
- Risk of losing relevant knowledge, may not be able to adapt fast enough

### Possible Solutions

- Need a plan for marrying traditional knowledge and science – i.e., a proactive plan for the body of knowledge that is to be shared and passed on.
- Take advantage of opportunities, through community involvement and work with schools, to teach traditional knowledge.
- Can't be done solely with schools, needs community involvement.

## **Health and safety**

### Key Vulnerabilities

Individual safety – from unreliable ice conditions

Community safety – from coastal erosion, flooding and storm surge

- Kivalina
- Kotzebue
- Deering
- Selawik
- Noatak
- Others?

### Possible Solutions

Improve individual safety:

- Improve public education, especially of young people (changing climate, potential for dangerous, unpredictable conditions)
- Improve public warning system (current dangerous conditions such as unstable ice, etc.)



### Improve community safety

- Protect and prevent damage from storm surges and flooding (sea walls, dikes, other)
- Improve emergency response (warning systems, escape routes, planning for necessary provisions)
- Relocation of critical infrastructure, facilities or entire villages if necessary
- Network with local groups (e.g., search and rescue)

### **Social disruption**

#### Key vulnerabilities

- Changes in the timing of subsistence activities
- Increased conflicts between native and non-native users of resources
- Decreased use of bartering and other traditional means of exchange
- Increased conflict due to northern extension of animals (beavers)

#### Possible Solutions

- Improved information to document changes in timing of activities
- New restrictions placed on use of local wildlife by outsiders

### **Infrastructure and services**

#### Key Vulnerabilities:

- Rupture of water and sewer lines leading to health risks
- Leaching at dump sites leading to environmental damage and health risks
- Possible opportunity: Bring new technology development initiatives into the communities to build capacity and increase local involvement.

#### Possible Solutions

- Develop new technologies, designs and standards more appropriate for the Arctic. Consider developing new programs / curricula at universities (over the long term).
- Increase local involvement in planning and design. Should happen at the local level and include technology choices, system design and siting decisions.
- Improve monitoring, surveillance and prevention. Identify key problem areas and identify actions to prevent damage.
- Improve emergency response plans, including training (for short term).

(Note: these all require funding!)

## **Conservation of natural environment**

### Key Vulnerabilities

- List specific resources thought to be particularly at risk – caribou, sheefish, walrus, seals?

### Possible Solutions

- Protect critical habitat and corridors
- Preserve options

## **Economic Development**

- Maximize local benefits
- Minimize local impacts/costs

## **SUMMARY**

As an initial workshop on climate change impacts, vulnerabilities and adaptations, the participants did not make any official recommendations. The participants emphasized that any final recommendations need to incorporate the perspectives and concerns of people living in all 11 villages of the NWAB. Nevertheless, several strong themes emerged during the workshop discussions.

- Too many studies have simply collected information and taken it away for purposes of documentation or research. Too many of these studies have not supported the life and local decision making of the Inupiaq and too many of these studies were completed without sufficient participation, input and guidance from the local community.
- It is critical to include the traditional knowledge and experience of the Inupiaq to understand climate change in this region. In the past there has been too strong a reliance on conventional science to the neglect of native science.
- There is a need for better and more accessible scientific information. Some of this should be in the form of charts or graphs, for example showing changes in temperature or rainfall. Other information should be in the form of maps, for example showing changes in migration routes or the anticipated future effects of sea level rise, coastal erosion, and storm surge.
- There is a need for a better understanding of how climate change will interact with other environmental, economic, cultural and political stresses that could greatly amplify negative impacts. For example, the primary calving grounds for the Western Arctic caribou herd are currently located on lands with large deposits of natural gas, coal, and other minerals. Resource development in combination with climate change could potentially impact the health of the herd and subsistence values. Whereas changes in the weather directly lead to changes in rivers, lakes, sea ice, or vegetation that can negatively (or, in some cases, positively) affect the life of people, animals and plants, changes in resource development can also influence the capacity of the environment or social systems to adapt to climate change and this, in turn, can affect people and animals.

- There is a need for a short-term plan that will help local communities respond to the already significant impacts of climate change. This does not mean that longer-term planning is not important; rather, it simply recognizes that climate change is already affecting the people of the NWAB and is a significant source of added stress among all the other economic, cultural and political changes that are taking place.
- There is a need for leadership from the local community to address the challenges of climate change. This response should be proactive, with an emphasis on protecting the resources that are critical to the life and culture of the Inupiaq. For this reason, a proposal will be made to the June 5 NWALT meeting that a “Climate Change Task Force” be organized to gather observations of climate change throughout the region, identify key vulnerabilities, and recommend a set of adaptation strategies. This group would be comprised of local participants, assisted by outside consultants if desired (by invitation).
- There is a need to identify and pursue funding opportunities to support projects intended to help the NWAB respond to climate change.

Based on the workshop discussions, key next steps will likely include:

- A meeting on June 5 with the NWALT to direct future efforts, which might include a more comprehensive identification of climate change impacts and key vulnerabilities in the region, and development of adaptation and education strategies.
- Organization of a Climate Change Task Force to work with village residents and leaders.
- Coordination with the new Alaska State Climate Change Commission (Joule).
- Organization of a second regional workshop, after completion of village meetings / surveys, to frame the information in hand and to consider next steps.
- Maintain and strengthen coordination with state and federal management agencies and non-governmental organizations (U.S. Fish and Wildlife Service, National Park Service, Western Arctic Caribou Working Group, Alaska Department of Fish and Game) to ensure a strong voice for local participants and for the Inupiaq perspective on climate change.

**Table 1: Northwest Alaska climate change workshop participants**

Name	Organization	Telephone	E-mail
Annabelle Alvite	NWAB	907-442-2500	aalvite@nwabor.org
Hazel Apok	Maniilaq	907-442-7673	hapok@maniilaq.org
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Tom Bolen	NWAB	907-442-8543	tbolen@nwabor.org
Reggie Cleveland	NWAB	907-437-2168	
Verne Cleveland Sr.	NWAB	907-636-2261	
Sophie Ferguson	NWAB	907-442-3156	
Willie Goodwin	NWAB/Kotzebue Elder		wgoodwinjr@yahoo.com
George Helfrich	US National Park Service	907-442-8301	George_Helfrich@nps.gov
Brendan Kelly	Univ. Alaska SE	907-796-6531	brendan.kelly@uas.alaska.edu
Reggie Joule	Alaska House of Representatives	907-465-4833	Representative_Reggie_Joule@legis.state.ak.us
Linda Joule	Kotzebue	907-442-3467	
Eugene Monroe	NWAB	907-485-2209	
Ron Moto	NWAB	907-363-2327	
Clyde Ramoth Sr.	Selawik	907-484-2118 907-484-2225	clyde_ramoth@fws.gov
Herman Reich Sr.	Kotzebue		reich@kotzebue.org
Carl Remley	Maniilaq	907-442-7225	
Walter Sampson	NANA, NWAB, NWALT	907-442-3321	walter.sampson@nana.com
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Robin Gregory	Decision Research	250-539-5701	rgregory@interchange.ubc.ca
Anthony Leiserowitz	Decision Research	541-485-2400	ecotone@uoregon.edu

**Table 2: Key areas of concern and vulnerability due to climate change**

Type of concern	Key elements
<b>Subsistence activities</b> (includes hunting caribou and moose, gathering greens and roots and berries and edible plants, herbal medicines, fishing, hunting marine mammals, hunting ducks and geese, harvesting whales)	Protect resources: fishing, hunting, gathering Abundance, distribution and timing of resources Access to resources: ice, rivers, ocean, tundra
<b>Traditional knowledge</b>	Ability to deal with variability: in weather: snow, ice, wind, rain in migrations: caribou, salmon, fish Support use of traditional knowledge (native science)
<b>Health and safety</b>	Individual: prevent injuries, sickness, and deaths predictability of ice safety Community: protect village safety (coastal erosion, flooding, storm surge)
<b>Social disruption</b>	Timing of activities User conflict (native v. non-native) Bartering and other sharing of resources Conflict due to range extension (e.g., beavers)
<b>Services and infrastructure</b>	Water, sewer, roads, sinkholes Buildings and property Fuel tanks Barging Dumpsites
<b>Conservation of the natural environment</b>	Preserve options Protect key species, habitats, migration corridors Forest fires: effects on people, animals, and lichens
<b>Economic development</b>	Maximize local benefits and opportunities Minimize negative local impacts

**Table 3: Observed Climate Change Impacts in Northwest Alaska**

1. higher summer temperatures in recent years
2. warmer winters in recent years
3. decreased snowfall in some areas
4. more variable and unpredictable weather
5. changes in the timing of fall storms: earlier start, happen over longer period
6. thinning and loss of sea ice
7. more dangerous, unpredictable ice conditions
8. accelerated coastal erosion due to loss of sea ice, permafrost melting and storm surges
9. potential forced evacuations / relocations due to coastal erosion and storm surge (Kivalina)
10. damage to cultural and grave sites due to permafrost melting and riverbank erosion
11. timing of caribou migration has changed (e.g., last year it was late, because of warm weather, a lack of snow, and late freeze up)
12. more resident caribou due to change in migration patterns and timing
13. changes in the location of caribou calving (now starting to occur south of Kobuk River)
14. animals dying due to changed conditions (e.g. caribou falling through thin ice and drowning)
15. impacts on lichen and other food for caribou
16. shrubs, pussy willows, grasses encroaching on tundra
17. beaver range is expanding
18. moose hunting limited due to outside hunters
19. changes in the timing of resource harvests (sheefish, caribou)
20. changes in the location of hunting areas – where animals are available / accessible
21. changes to whaling, seal hunting, e.g. ice conditions change leads
22. disruption of fishing due to storms and loss of nets
23. permafrost thawing (thermokarsting), especially along major rivers
24. water level in rivers and lakes is lower in summer
25. changes in rivers affects fish migration and spawning success, partly due to higher water temperatures
26. fish spawning negatively affected by mudslides, erosion and new beaver activity
27. condition of some fish is worse, white pus from warmer water and more algae growth
28. new species of whitefish appearing
29. some whitefish appear to be getting fatter
30. damage to water and sewer systems due to permafrost melting or less snow

31. damage to roads from permafrost melting and sinkholes
32. mudslides are more frequent, affect river drainage and debris in water
33. barging is harder because of new islands / sand bars formed through sedimentation
34. transportation (goods, people) more difficult due to uncertain weather conditions
35. change in location and intensity and timing of insects

Table 4: Possible funding sources for future work on climate change adaptation  
(in no particular order)

Agency	Comments
U.S. Fish and Wildlife Tribal Grants Program	November deadline, \$240,000 / yr limit
Maniilaq's work plans with the US Environmental Protection Agency	Will help to put climate change issues onto the local agenda
Selawik Wildlife Refuge	Contact: Lee Anne Ayers. Could support household surveys, village meetings in Selawik and Noorvik.
U.S. National Parks Service	
U.S. Fish and Wildlife Service Marine Mammals Program	
University of Alaska, Fairbanks – perhaps also with the RISA program sponsored by NOAA	
NOAA Climate and Coastal Resource Management Project	Contact: Anthony Leiserowitz. Potential in-depth analysis of regional vulnerability to sea level rise, coastal erosion, and storm surge. Potential collaboration between NWAB, NPS, Selawik Refuge, and Columbia University (Leiserowitz). Deadline is July 25
Alaska Inter-Tribal Council, particularly the Circuit Rider Program	
Specific funding (US EPA?) to address key "to do" items, such as infrastructure priorities & emergency response plans	
Pilot project in support of the new Alaska Climate Change Commission	No funding available
The Denali Commission	
Invite and elicit support from key personalities (e.g., Robert Kennedy Jr., Al Gore, etc)	
The oil & gas industry, for example Conoco – Phillips or Beyond Petroleum (BP)	
AIDEA/AEA (Alaska Energy Authority) has been actively funding and gauging interest in renewable energy under its "Energy Cost Reduction Program." See website.	Funding to help move NW Alaska off its dependence on fossil fuels – alternative energy sources, solar & wind power.