

TAKING STOCK OF ADAPTATION PROGRAMS IN THE ARCTIC

May 2013



*“Taking Stock of Adaptation Programs in the Arctic”
represents Component B of the Arctic Council initiative
“Adaptation Actions for a Changing Arctic”*

This project was co-led by Canada and Russia

Assistance was provided by Risk Sciences International



Table of Contents

EXECUTIVE SUMMARY.....	I
1. INTRODUCTION	1
2. METHODOLOGY.....	2
2.1 INFORMATION GATHERING	2
2.2 ANALYSIS AND CONSTRAINTS.....	4
3. OVERVIEW OF ADAPTATION INITIATIVES	6
3.1 TYPES OF ACTIVITIES.....	6
3.1.1 <i>Planning and decision-support tools</i>	6
3.1.2 <i>Awareness-raising</i>	9
3.1.3 <i>Monitoring and provision of data</i>	9
3.1.4 <i>Training</i>	10
3.1.5 <i>Mainstreaming</i>	10
3.2 INFRASTRUCTURE RELATED ACTIVITIES	11
3.3 TRADITIONAL LIFESTYLE RELATED ACTIVITIES	12
3.4 EMERGENCY PREPAREDNESS RELATED ACTIVITIES.....	12
3.5 LEGAL OR POLICY DRIVERS.....	13
3.6 PARTNERS OR STAKEHOLDERS AND THEIR ROLES	14
3.7 INTERNATIONAL COOPERATION	15
4. SUCCESS FACTORS	16
4.1 POSITIVE PARTNERSHIPS.....	17
4.2 INTEGRATING LOCAL AND TRADITIONAL KNOWLEDGE	17
4.3 EFFECTIVE COMMUNICATION FOR TARGET AUDIENCE	18
4.4 LEARNING FROM OTHERS' EXPERIENCE	18
5. CHALLENGES	19
5.1 CHALLENGES WITH PROJECT IMPLEMENTATION	19
5.2 CONVINCING DECISION-MAKERS OF THE NEED FOR ACTION.....	19
5.3 COMMUNICATION AMONG PARTNERS AND WITH IMPLEMENTERS	20
5.4 OBTAINING AND SELECTING THE RIGHT TOOLS	21
5.5 LACK OF ENVIRONMENTAL, CLIMATE AND OTHER DATA.....	21
5.6 LACK OF CAPACITY.....	22
5.7 CARRYING OUT ACTIVITIES IN LARGE AND ISOLATED NORTHERN REGIONS.....	22
6. SUMMARY CONCLUSIONS	22
6.1 PREDOMINANCE OF ADAPTATION-ENABLING ACTIVITIES.....	22
6.2 DOMINANT TREATMENT OF CLIMATE CHANGE IMPACTS AS ADVERSE	23
6.3 ADAPTATION ACTIVITIES REQUIRE PARTNERSHIPS.....	24
6.4 ARCTIC ADAPTATION ACTIVITIES ARE DIVERSE	26

7. OPPORTUNITIES FOR THE ARCTIC COUNCIL	26
7.1 FOCUS ON A PARTICULAR SECTOR	27
7.2 FOCUS ON TOOLS AND THEIR DISSEMINATION	27
7.3 FOCUS ON ADAPTATION AT THE COMMUNITY LEVEL	27
7.4 FOCUS ON PARTICULAR SUCCESS OR CHALLENGE FACTORS	27
7.5 DEVELOP A DATABASE OF ADAPTATION ACTIVITIES	28
7.6 ESTABLISH A NETWORK FOR SHARING INFORMATION AND EXPERTISE	28
7.7 ASSESS OTHER INTERNATIONAL OR REGIONAL ORGANIZATIONS' TREATMENT OF ADAPTATION	28
APPENDIX 1: THE TEMPLATE	29
APPENDIX 2: LIST OF TEMPLATES RECEIVED BY LOCATION OF ACTIVITY AND WITH ACTIVITY CONTACT INFORMATION	34
APPENDIX 3: DETAILED INFORMATION ON METHODOLOGY	50
APPENDIX 4: ARCTIC COUNCIL REPRESENTATIVES FOR THE PROJECT "TAKING STOCK OF ADAPTATION PROGRAMS IN THE ARCTIC"	52

Executive Summary

The impacts of climate change and other changes in the Arctic are occurring at a rapid pace and indigenous peoples, residents, governments and industry require information and tools to respond. In recognition of this reality, the Arctic Council adopted a new initiative, “Adaption Actions for a Changing Arctic”. “Taking Stock of Adaptation Programs in the Arctic” represents one element (Component B) of this larger initiative.

“Taking Stock of Adaptation Programs in the Arctic” focused on climate change adaptation activities that are being implemented at national, sub-national, regional and local levels within the Arctic region. The primary means to collect information for this project was by a written survey using a template that included a mix of open-ended and multiple choice questions. The information provided in survey templates was supplemented by follow-up consultations with Arctic Council state and Permanent Participant project representatives identified for the project.

The analysis of the information gathered provides a “snapshot” of a range of adaptation activities that are occurring in the Arctic region and has allowed for the elaboration of a number of descriptive factors related to these activities. The intent of the project was not to present a fully representative picture of all Arctic adaptation-related initiatives.

The adaptation activities fell into five main categories: planning and decision-support tools; awareness-raising; monitoring and provision of data; training; and, mainstreaming. By far, the majority of the activities were characterized as adaptation enabling and included the development of community adaptation plans, hazard and vulnerability assessments and maps, communications products, monitoring information, and training resources.

Many of the activities reflected an immediate need to respond to infrastructure issues. In some Arctic states, the effect of climate warming on permafrost is severely impacting roads, airstrips, buildings and drinking water utilities. In other states, the concerns focused on infrastructure risk due to coastal erosion and flooding because of sea level rise and storm surges.

An objective to support traditional lifestyles was a cross-cutting theme in many activities. The disruption of subsistence economies, including hunting, fishing, and animal husbandry has motivated the implementation of adaptation measures. Local and traditional knowledge was noted as central to understanding the changes that are occurring in Arctic communities and for developing appropriate responses. At

the same time, it was recognized that the uncertainty surrounding some changes means reliance on traditional knowledge is not always sufficient and it is the integration with scientific research that is key.

The presence of partnerships was an overwhelming component of the adaptation activities reported for this project. Partners included all levels of government, indigenous groups, civil society organizations, academic or research bodies, industry and community members. In addition, a number of activities involved multi-national collaboration. Consequently, positive and effective partnership arrangements were commonly cited as fundamental to the success of an initiative.

Respondents provided perspectives on the challenges faced in implementing adaptation activities. Many challenges revolved around practical issues like lack of funding, capacity, expertise, and data. Other challenges related to aspects of communication, for example, developing a common vision among many stakeholders; making scientific and technical information meaningful to practitioners; and, convincing decision-makers of the need for action in the face of competing priorities.

A common theme throughout this project was the demand for more information about adaptation in the Arctic. This ranged from a desire to learn the details about how a specific measure was implemented, to having greater access to expertise and tools, to gaining knowledge from others' experience in overcoming barriers and lessons-learned.

The Arctic Council produces valuable scientific and other research that contributes to adaptation planning and implementation. The Arctic Council could also play an important role by further facilitating the exchange of information and expertise about adaptation measures between Arctic Council states and organizations for decision-makers at all levels. This report presents a number of considerations for future adaptation-related initiatives by the Arctic Council that would support such a role.

1. Introduction

In the Arctic, the impacts of climate change are visible, prevalent and accelerating. Rising temperatures, shifting weather patterns, changes in precipitation, loss of sea ice, coastal erosion and permafrost degradation are just some of the impacts being experienced. Communities, cultures, human health, livelihoods, economies, ecosystems and local wildlife are all being affected at an unprecedented rate. Arctic countries and Arctic residents are developing and enacting adaptation strategies and measures in response to these impacts and to prepare for the future.

The Arctic Council recognizes that Arctic residents require appropriate information, expertise and tools to better inform and implement adaptation activities. In May 2012, Arctic Council Deputy Ministers adopted a new initiative, “Adaptation Actions for a Changing Arctic” (AACA). The overarching goal of the AACA is to enable more informed, timely and responsive policy and decision-making for adaptation to a rapidly changing Arctic.

AACA has three components:

- A) a synthesis of key findings and recommendations from existing Arctic Council assessments and other relevant national and international reports;
- B) a compilation and analysis of existing climate change adaptation efforts within or relevant to the Arctic; and,
- C) work with other scientific organizations to consider Arctic-focused climate and integrated environmental frameworks/models that can improve predictions of climate change and other relevant drivers of Arctic change.

This report represents Component B of the AACA. While AACA is framed to address multiple drivers of change, Component B focused solely on adaptation efforts in response to the impacts of climate change. The project is titled “Taking Stock of Adaptation Programs in the Arctic” and was co-led by Canada and Russia. It involved surveying and characterizing climate change adaptation actions, projects and tools that are currently being developed or were completed since 2008, at national, sub-national, regional and local levels within or relevant to the Arctic region. The year 2008 was selected to avoid duplication with the former Arctic Council project “Vulnerability and Adaptation to Climate Change in the Arctic” (VACCA) that was completed in that year. The findings of the VACCA report were considered in the new project.

“Taking Stock of Adaptation Programs in the Arctic” was based primarily on the collection, by written survey, of information on adaptation-related activities carried out in jurisdictions falling within the national boundaries of Arctic Council states. This information was supplemented by follow-up consultations, as time allowed, with individuals that completed the written survey, and with representatives of Arctic Council states and Permanent Participant Organizations that were assigned to the project.

The information collected has been synthesized and analysed with the aim of providing an overview of these adaptation activities and some insights into factors that contribute to success and to challenges that are being encountered. Considerations for future work concerning climate change adaptation by the Arctic Council are also provided.

2. Methodology

2.1 Information Gathering

The primary means to collect data for this project was by a written survey. The written survey was conducted by using a template that included a mix of open-ended and multiple choice questions. Table 1 provides a general sense of the array of questions asked of respondents. The full template is provided in Appendix 1.

Table 1. Types of questions included in the survey tool

Section A:
1. Activity title
2. Countries, subnational, local areas
3. Entities responsible for implementing activity
4. Short activity description
5. Partners and stakeholders and their roles
6. Start/end date; complete/ongoing
Section B: Insights and lessons learned
7. How did activity get started
8. What contributed to success
9. What challenges, barriers encountered
Section C: Additional information
10. Concerns that led to activity initiation (checkboxes)
11. Sectors activity covers (checkboxes)
12. Elements activity addresses (checkboxes)

Section D: Contact information
13. Related web links
14. Name, title, organization, email
15. Alternative contact information
Section E: Additional comments

The survey template was distributed by email to project representatives from each Arctic Council state and Permanent Participant organization, as well as to relevant Arctic Council observer organizations. In some cases, representatives were themselves able to complete the survey templates for projects with which they or their organizations were involved. In other cases, representatives distributed the survey template to individuals or groups within their jurisdictions overseeing recent or on-going adaptation-related activities. Completed survey templates were submitted via email to the project leads in Canada and Russia.

The information provided in survey templates was supplemented by follow-up communications with the identified contacts or by accessing websites provided in the templates. The project leads also carried out consultations with Arctic Council state and Permanent Participant project representatives via emails, telephone conversations and face-to-face meetings.

One hundred and seven survey templates were submitted to the project leads. Four templates were excluded from the analysis as they did not address climate change adaptation as defined for this project in the template. The majority of the templates were from Canada. This was due, in part, to the advantage the Canadian co-lead had in a network of contacts at the national and sub-national level that were engaged in adaptation activities. This should not be interpreted to mean that more adaptation is occurring in Canada than in other Arctic states. The analysis and description in this report attempts to reflect all countries' experiences as much as possible.

Templates were received from all Arctic Council states. Permanent Participants provided input for analysis, advice on the report and the Arctic Athabaskan Council submitted templates. Some templates were received from Arctic Council observer organizations including the Northern Forum, the University of the Arctic, and the WWF. Many other Arctic organizations were identified as partners in adaptation activities in the templates.

The breakdown of submissions by country where the adaptation initiative occurred or is occurring is shown in Table 2.

Table 2. Number of template submissions by location of activity

Domestic Programs	
Canada	58
Finland	9
Greenland	1
Iceland	3
Norway	6
Russia	10
Sweden	7
United States	2
Regional/Multi-state Programs	
Canada, Finland, Norway, Russia, United States	1
Canada, Finland, Russia, United States	1
Canada, Norway, Russia, United States	1
Canada, United States	2
Finland, Greenland, Norway, Sweden	1
Finland, Norway, Sweden	1
Finland, Norway, Russia	1
Finland, Norway, Sweden, Russia	3

Some templates addressed one adaptation activity while many templates described large, multi-year initiatives with a range of clearly delineated, discrete adaptation-related activities. For the purpose of analysis, each adaptation activity was identified separately and categorized. For example, one template could address planning related activities, project implementation activities, and related training and awareness-raising activities. A list of template titles and contact information is provided in Appendix 2.

2.2 Analysis and constraints

Information submitted in each template was organized thematically for entry into a database. More information about the analytical methodology is provided in Appendix 3.

The analysis of the submitted templates, consultations and related information provides a “snapshot” of a range of activities that are being undertaken and has allowed for the elaboration of a number of descriptive factors relating to climate change adaptation in the Arctic region. However, the characterization provided in this report should not be construed as either a comprehensive or fully

representative picture of adaptation-related initiatives in the Arctic. Some factors related to the survey approach and levels of participation deserve mention in this regard.

The voluntary nature of the survey, coupled with relatively tight timelines for the initiative, produced uneven levels of participation both among and within Arctic Council states. Canada, as one of the two project leads, was proportionally highly represented with respect to the number of templates submitted. Attempts were made to counteract this imbalance by focusing on examples from all Arctic Council states; however, this imbalance must be kept in mind with respect to generalizations that are made. In addition, in some cases, responses from within countries came in high numbers from certain northern regions and low numbers or not at all from others. It was also challenging for some Arctic Council Permanent Participant organizations to be fully engaged in “Taking Stock of Adaptation Programs in the Arctic” as this project was launched after their internal processes to budget resources to support Arctic Council work. Overall, the project leads did receive feedback from a number of organizations that they would have liked more time to contribute to the project.

Nearly all submitted templates reported on activities with ties to national governments and many were nationally-funded initiatives. This is not surprising, since those soliciting survey responses were generally themselves national-level officials. There were a limited number of templates that addressed private sector initiatives although the project scope did not provide for a concerted effort to elicit private sector input.

This project revealed that it is difficult to define “concrete climate change adaptation activities”. The stage when an activity becomes an adaptation measure separate from gathering information and planning for adaptation is not always clear. In addition, activities that could be climate change adaptation may also be considered disaster mitigation, risk reduction, or building resilience; or the activity may have become mainstreamed into regular practice and is no longer viewed as a distinct adaptation activity.

This project underlined the challenge in collecting information at the local level where most implementation is occurring. This concern was reiterated during consultations. It was also pointed out that an adaptation activity could be a very individual endeavour whereby someone adjusts his or her behaviour or practices to account for new climate conditions. For the most part, these types of adaptive actions would not be captured in this project.

The majority of respondents only briefly addressed questions in the written survey related to the success factors and key challenges. In some cases this was because an initiative was in early stages and it was too soon to assess these issues or the respondent did not feel qualified to provide this information. Additional insights on these issues were gathered during follow-up consultations and from Arctic Council project representatives.

3. Overview of adaptation initiatives

3.1 Types of Activities

Activities described in the templates fell into five main types: planning and decision-support tools; awareness-raising; monitoring and provision of data; training; and, mainstreaming.

3.1.1 Planning and decision-support tools

A majority of the activities reported were categorized as planning-related; that is, they involved the generation or gathering of information necessary for preparing for adaptation action; the development of plans or strategies; and/or other types of decision-support tools.

3.1.1.1 Community adaptation plans

The development of community plans was typically a multi-year project that began with consultations with community members to obtain information on the changing climate, valued ecosystem components and traditional values. The preparatory process may have included an assessment to produce a map of community hazards. Based on this information, community adaptation plans would be developed that were applicable to the particular community, ranging from small hamlets to small cities. These plans would be discussed with the community, along with information materials as needed, and priorities for action would be set.

Comprehensive community adaptation plans and more focused plans for the adaptation of infrastructure within a community were prevalent in the Canadian submissions. In Finland, an activity that aimed at incorporating climate change into all municipal planning was conducted for the city of Rovaniemi. In Norway, a comprehensive adaptation planning process targeting a number of northern municipalities in the County of Troms was launched in fall 2012. Also, in Norway, a municipal planning framework was prepared for the consideration of sea level rise and flooding in future land development activities. In Sweden, an analysis of the effects of climate change at the municipal level in preparation for the development

of adaptation strategies addressed technical systems related to communications, electricity and water supply; building infrastructure threats from landslides, flooding, and erosion; cultural heritage sites; and, human health. Adaptation plans were developed in Russia for local activities to protect ecosystem areas, endangered species, water resources, and the traditional culture of indigenous people.

3.1.1.2. Assessments

Hazard and vulnerability assessments of systems impacted by climate change constituted the second most common activity type. Assessments were conducted using a range of social and technical methods and focused on impacts on ecosystems, infrastructure, and communities.

Several countries reported on ecosystem impact assessments (Canada, Russia, Finland, Iceland and the United States). These ecosystem assessments often included general inventories of the state of the natural environment, sensitivity of the ecosystem to climate change and the identification of areas requiring conservation efforts. Examples included forest ecosystems and hydrological regimes in Canada, tundra vegetation systems in Finland, and, the Arctic cryosphere and marine ecosystems in Russia. Others assessed the sensitivity of climate change on an ecosystem that serves as a resource for communities, such as the impacts of permafrost degradation on agricultural potential or ecosystem changes that have implications for wild reindeer herding in indigenous communities.

Infrastructure assessments were also common. In Canada, most of these assessments focused on the vulnerability of transportation, built infrastructure, water supply and management systems to the impacts of permafrost degradation. In Sweden, assessments focused on the general infrastructure system and the rail and road transportation systems. These assessments were primarily carried out by subnational governments, covering a large region. However, there were also several local assessments on public infrastructure, such as an airport and a highway. One infrastructure assessment was conducted by a community association for water and built infrastructure in six small communities.

In Iceland, an assessment of energy production infrastructure addressed the potential impacts of glacier runoff on future hydro-electric electricity generation potential. Predictive models indicate an initial increase in energy production with higher river flows while a longer-term forecast indicates a decrease in energy production as glaciers and ice caps retreat. This is an example of the long planning range required for complex infrastructure systems that need to adapt physical

facilities and processes, as well as, potentially plan for alternative options as conditions change over time.

In the United States, the State of Alaska conducted a comprehensive, multi-year review that considered the effects of climate change in the region and adaptation activities occurring across the U.S. Arctic. The working group, consisting of representatives from State and village governments along with local community members, made recommendations for additional policy and adaptation efforts.

Submissions that described community vulnerability assessments focused on specific climate change impacts, such as sea level rise, coastal erosion and permafrost degradation. These assessments addressed water resources, water security, coastal erosion, emergency planning, and health issues such as the risk of contamination from flood waters. A number of these community vulnerability assessments focused on indigenous communities and maintaining local traditions, including the integration of traditional knowledge into adaptation planning.

3.1.1.3. Hazard or vulnerability maps

Decision-support tools developed as part of planning activities included hazard and vulnerability maps. Hazard maps portray the distribution of conditions or hazards related to climate change. Some were comprehensive maps of the hazards to which a community or region is subject. In Canada, issues of concern were sea level rise and storm surges, changes in sea ice, thawing permafrost and changes in precipitation patterns. In Finland and Sweden, projects included the mapping of precipitation, floods and landslides. These mapping exercises typically supported an assessment of relevant conditions and the production of inventories of potential infrastructure damage. In Alaska, a network established for scenario planning created datasets and maps to project future conditions in various Arctic communities, providing local leaders and policymakers with appropriate decision-making tools.

Vulnerability mapping was conducted as part of three adaptation initiatives, one each in Norway, Sweden and Canada. These exercises contributed to community land use planning, safety and emergency planning. For example, in Sweden, the risks of climate change to the traditional reindeer herding practices of the Saami people were mapped and potential adaptation options were developed from this information. An initiative to generate vulnerability maps of riverine and lake flood hazards in Canada used remote sensing surveys to produce flood plain models and maps of community vulnerability to the floods and to establish monitoring of conditions that would serve as indicators of floods.

3.1.2 Awareness-raising

Several awareness-raising activities were submitted, including preparing materials, conducting workshops and delivering information through meetings, broadcasts, publications or websites. Many of the awareness-raising activities were components of larger projects and consisted of the delivery of information gathered during that larger project. For instance, an initiative to identify climate change impacts and adaptation measures for hunters and trappers in a Canadian Aboriginal community involved workshops to present and discuss the findings and the traditional knowledge collected. In addition, a web portal was established to distribute the initiative's findings and recommendations more broadly to other Arctic communities. In Sweden, seminars and "information days" were held for regional and municipal decision-makers on local planning related to natural disasters.

Other activities had a specific focus on awareness-raising as their central objective. For example, a program for native youth in Alaska focused on increasing their understanding of permafrost thaw and encouraged them to think about adaptation options. In Canada, a homeowner's guide was developed to communicate information on the risks of permafrost degradation with advice on how residents can prepare and protect their homes. A publication prepared by the WWF Russia provided information on climate change impacts, policy and adaptation measures aimed at decision-makers, businesses and non-governmental organizations.

Websites were often highlighted as multi-pronged mechanisms for raising awareness of climate change impacts and adaptation options, and for providing climate data and practical tools for implementation. One website involving a partnership of countries (Scotland, Sweden, Finland, Norway and Greenland) under the European Union Northern Periphery Programme provides information on adaptation projects with an emphasis on identifying opportunities for community sustainability. In Canada, a territorial government has developed a multi-lingual website that offers educational resources, adaptation toolkits, research data, traditional knowledge and recent news on local climate change adaptation activities.

3.1.3 Monitoring and provision of data

Monitoring activities were often reported as a component or outcome of a larger initiative. They were focused on three target areas: community hazards such as sea ice melt or floods; infrastructure sensitivity such as conditions of roads and buildings, or coastal erosion from sea level rise; and, changes in ecosystem, cryosphere or meteorological conditions.

In Canada, as part of a larger initiative, an Inuit community-based monitoring and surveillance project was established to monitor ice and engage the community. Every ten years, the Finnish Forest Research Institute is obliged to monitor the Lapland timberline to ensure that it has not been affected by forest management practices and to determine if the timberline is moving towards lower latitudes and altitudes. In Russia, innovations are being introduced in hydro-meteorological monitoring for navigational safety and natural resources development in response to climate change. In Norway, a recently launched climate service center is collecting data and preparing climate information products to support adaptation.

3.1.4 Training

Training was a significant part of larger initiatives that involved awareness-raising, monitoring programs for community sea ice conditions and infrastructure conditions, and for conducting assessments of risks affecting a community. Local capacity building was an objective in many initiatives.

In Russia, an initiative to develop an adaptation strategy included developing an education and training program on water resources management for specialists at the municipal level. In Sweden, an initiative to protect drinking water from the risks of contamination from increased precipitation provided seminars and training activities at the regional and local levels.

Several submissions from Canada addressed training and capacity building. There were many activities to support small communities in climate change adaptation planning by preparing toolkits and training modules. Technical training was provided to Inuit students in climate change data collection and the use of equipment to monitor water supplies in support of a regional adaptation plan. Vuntut Gwitchin youth in northern Yukon were trained in research and video skills to contribute to a project related to food security in response to concerns about changes to traditional harvesting and hunting areas and the distribution of traditional food species. More formal training is provided by Yukon College which offers a course on permafrost engineering.

3.1.5 Mainstreaming

The explicit aim of some initiatives was to mainstream climate change adaptation considerations into planning and operational decision-making. In Norway, the Water Resources and Energy Directorate has developed a strategy and measures to ensure adaptation is incorporated into its management responsibilities, for example, related to the preparation of flood inundation maps and dam safety. In Iceland, construction of new harbour infrastructure or modifications to existing facilities take

into account, during the planning phase, the latest information available on sea level rise. Also, in Iceland, the national power company has integrated predicted climate change impacts into its planning and operations as a consequence of extensive research since the 1990s. In Russia (Sakha Republic), a new regional environmental program includes a strong adaptation component and concrete policy planning tools are being applied.

In Canada, the territorial governments are taking action to mainstream climate considerations into their operations. The Northwest Territorial Department of Transportation is developing a climate change adaptation plan to direct current and future actions. In the Yukon, a Climate Change Information and Mainstreaming Program involves a partnership of academic and research organizations and the Yukon Department of the Environment which provides advice, technical expertise, training and data to government agencies to ensure climate change considerations are incorporated into decisions.

3.2 Infrastructure related activities

Infrastructure was noted in many submissions as a focus of adaptation activities. Transportation infrastructure activities were reported most frequently by Arctic Council countries, followed by built and water infrastructure.

Submissions reported that assessments constitute a key aspect of developing measures that protect infrastructure by providing information and improved understanding of the responses of infrastructure systems. These assessments inform technical or engineering measures that can be taken to adapt vulnerable components to new or more challenging conditions. Based on an infrastructure assessment, new technologies are being developed and tested for materials for airport runway and road surfaces to reduce damage from degrading permafrost, including frost heave and soil moisture fluctuations. Engineering and geotechnical assessments informed the development of techniques for the design and construction of building foundations (for example, testing thermopiles, guidance for thermosyphon foundation design and terrain analysis for foundation design) and transportation infrastructure (for example, marine networks, roads and airport runways). These assessments required the engagement of scientific and technical experts, and produced information for use by engineers, as well as for government transportation policy and program development.

Mapping of hazards, such as floods and permafrost degradation, for decision-making related to building locations and construction, and assessments of the vulnerability of road and rail infrastructure to landslides were common activities within the

infrastructure sector. Such activities supported the development of plans for land use or served as the basis for ongoing monitoring programs.

In Canada, efforts are in initial stages to develop codes, standards and other related instruments for the design, construction and planning of infrastructure that will be effective in addressing climate impacts on permafrost. In Russia (Archangelsk region) and in Alaska, construction is underway on facilities to protect banks from coastal erosion and to reinforce existing infrastructure to protect settlements from flooding.

There were also several awareness-raising activities conducted on the vulnerability of infrastructure. For example, in Alaska, the initiative to educate Native youth about the implications of thawing permafrost also provided technical awareness-raising for members of communities who are responsible for monitoring and maintaining local infrastructure.

3.3 Traditional lifestyle related activities

Concern for the maintenance of traditional lifestyles was integrated in many of the activity types described above, and in several cases, it was the key factor that prompted an activity. For example, activities reported by Sweden and Finland focused on Saami reindeer herding practices and were concerned with the sustainability of grazing practices on the tundra. Russia reported on the regular assessment and monitoring of wild reindeer populations in Dolgano-Nenetsk region of Krasnoyarsk kray and experiments of resettlement and acclimatisation of musk ox in the northern areas of the Sakha republic to support the lifestyles and socio-economic development of indigenous communities. In Canada, community level adaptation plans were often developed for small and remote communities that rely on local natural resources for traditional subsistence practices. Some activities were aimed specifically at addressing food security. Greenland chose to focus its first sectoral climate adaptation report on the fisheries and hunting industries due to their predominance and the recognition that climate change poses a range of challenges and potential opportunities to these sectors.

3.4 Emergency preparedness related activities

While many submissions noted safety and emergency planning as an element of adaptation initiatives, only a few had a strong focus on emergency preparedness, and in many cases, these were related to the risks of river flooding. An exception was a Russian activity that focussed on monitoring hydro-meteorological conditions and providing warnings to marine navigation and vessels in the Barents and Greenland seas.

In Canada, adaptation plans for small communities often integrated elements of human safety related to changing sea, ice and snow conditions and the potential dangers for hunters, trappers and fishers. One project delivered sea ice safety and self-rescue training sessions and provided a safety tool collection for the use of community residents. In Iceland, it was noted that warming temperatures have increased natural tree growth with a resultant risk of forest fires, which is a new challenge for municipalities to address.

3.5 Legal or policy drivers

Several activities were reported as required by a law or regulation. However, as pointed out in one submission, although there was a legal obligation to implement an adaptation measure, lack of enforcement meant that action was being unevenly applied in individual communities. In some circumstances, the requirement that these activities be completed was supported by funding provided under policy frameworks.

In Finland, an assessment of flood risks from three rivers in Lapland and the development of plans and flood risk maps were undertaken as required by the 2007 European Union Flood Directive and the national legislation for the implementation of that Directive.

Two Russian submissions were related to legislated requirements. One involved the development of climate change adaptation policies to protect the traditional cultures and social and economic development of indigenous people, as required by a federal law. The other activity related to legislation to protect species such as the polar bear and musk-ox and involved designating protected areas and developing management and breeding strategies.

A number of activities were described as elements of national-level policy frameworks that guide climate change adaptation action by regional or municipal level governments. Examples of these were described in submissions from Finland, Greenland, Iceland, Norway and Sweden. In most cases, the activities involved the development of plans for specific regions. For example, regional councils in Finland are to develop climate change adaptation strategies on the basis of the country's *Long-term Climate Energy Strategy* (2008). Lapland, Finland's northernmost region, completed its *Climate Strategy 2030* in 2011 and addressed how the economy and livelihoods are and will be impacted by climate change. In Russia, the national *Strategy for the Development of the Arctic zone* adopted in 2013, envisages joint consolidation of institutional frameworks for adaptation by the federation and federation subjects. In Sweden, a set of activities involving infrastructure

assessments, vulnerability assessments, awareness-raising and training were undertaken by a County Administrative Board for implementation by the municipalities in that county.

Generally, these policy frameworks were not identified as being legal requirements, but strategies that set out expectations for activities to be undertaken by each level of government. For instance, a review of adaptation activities occurring in the U.S. Arctic was initiated at the sub-national level but made policy recommendations and suggested adaptation actions for national, regional and community stakeholders. Typically, strategy articulation occurs at the national or regional level, while planning and support for more concrete application occurs at the local level.

3.6 Partners or Stakeholders and their Roles

Identified partners or stakeholders included governments, indigenous organizations, civil society organizations, academic or research groups, and industry. These could be domestic based or international crossing state boundaries. As a rule, roles played by each partner, regardless of category, could be classified as one of the following: a) project management; b) project funding; c) technical support; or, d) provision of local knowledge. Technical support applied broadly to subject matter experts providing input to an activity. Such support could be rendered through paid consulting; partially compensated or volunteer input as part of, for example, an advisory committee; or via the expertise of a government, research, civil society group, academic institution, or professional association.

The largest single partner type was national governments. (As noted earlier, the project process tended to elicit responses from national governments so this may account for this result.) Following national governments were sub-national or regional governments, universities and colleges, and local governments. All of these partner types had significant involvement in the management of adaptation activities. Aboriginal governments and organizations managed a number of projects in Canada, as discussed below.

National governments were the most frequently cited as funding partners for reported activities. In some cases, regional and indigenous organizations and civil society groups contributed funding. In a few cases, an industry group provided funding, such as in Canada and Iceland where projects assessed the energy generation potential of glacial rivers under climate change. In Russia, energy companies operating in the Russian North, fund adaptation measures as part of their corporate sustainable development strategies. Some large-scale scientific projects

received funding from national and international research sources as well as from international non-government organizations, such as the WWF.

In Canada, the three territorial governments have partnered on the preparation of a Pan-Territorial Adaptation Strategy. Under this strategy, the governments have identified shared priorities and collaboratively pool resources to undertake adaptation projects along with outreach products for community decision-makers.

Academic institutions often played a facilitative role. In the United States, for instance, a university hosts a climate change planning network that includes participation from all levels of government and local communities.

A number of adaptation activities involved indigenous or aboriginal organizations throughout the Arctic region. Local and traditional knowledge was recognized as important for the provision of accurate and relevant information on environmental factors, land-use planning policies, infrastructure decisions, population distribution, and broadly, for understanding the significance of climate change impacts on communities and lifestyles. In Finland and Sweden, several activities focussed on Saami reindeer herders, their traditional activities and their villages, and one project involved the Saami Parliament. A United States project partnered with Ilisagvik College, a tribally controlled institution. A Russian initiative that focused on the protection of the environment, traditional lifestyles, and economic development of indigenous people involved the Association of non-government organizations of indigenous people from the North of Krasnoyarsk kray.

In Canada, many reported activities were managed by an Aboriginal government or organization, including the Arctic Athabaskan Council, the Council of Yukon First Nations, the Déline Renewable Resources Council, the Dene Nation, the North Shore Micmac District Council, the Conseil Tribal Mamuitum, the Tlicho Government and the Nunatsiavut Government. Aboriginal governments provided funding to some projects, often in collaboration with federal, provincial or territorial governments. In other instances, activity management was also provided by university or research institutes, particularly when technical support or expertise was required. Aboriginal governments and organizations were involved in the development of planning and decision-support tools; the creation of training materials; the promotion and conduct of awareness-raising activities; and, in assessment and monitoring projects.

3.7 International Cooperation

Several initiatives described international collaboration. These included Canada and the United States partnering on an assessment of ecosystem resilience in the Beaufort Sea and on identifying areas of ecological pressure to support planning by

land managers. Other examples were a study on best practices for reducing conflict between humans and polar bears (Canada, United States, Norway, Russia); an eight-part research program on the arctic and sub-arctic tundra ecosystems (Norway, Sweden, Finland); and, a study to increase the production of berries and herbs in a warmer climate (Finland, Norway, Russia). In most multi-national initiatives, universities, multinational research networks and non-government organizations were participants along with national governments. One Russian-based initiative benefited from the contribution of numerous research institutes and universities in Russia, Norway, Canada, the United States, Japan, and Germany.

A different sort of international collaboration was a project conducted by the Northern Forum, an organization of Northern peoples with membership from regions in the United States, Canada, Finland and Russia. Under this initiative, remote Russian republics in Siberia were assisted with forecasting and monitoring floods on the Lena River caused by ice jams and other factors related to climate change.

4. Success Factors

In an attempt to provide guidance concerning best practices and opportunities to inform the development and application of climate change adaptation approaches, the written survey asked respondents to identify factors that they felt contributed to the success of the initiative. In addition, views related to perceived contributors for success were sought from Arctic Council project representatives through additional consultations.

Many submissions noted that it was not possible to describe success factors because the activity was incomplete or the outcomes are too long-term and uncertain to confidently attribute success. However, the intent of the survey queries was to obtain the perspectives of project proponents and partners rather than assess objective measures of success and several themes did emerge in responses to these questions.

The most frequently reported success factors were fairly consistent across activities and countries. These involved positive cooperation between partners and among stakeholder groups, and integrating local and traditional knowledge. Other factors linked to the above were a community-based project design, in-depth understanding of user needs, and internal and external expertise.

Long-term reliable funding was also commonly cited as a factor contributing to success. Finally, it was noted that drawing from the knowledge and experience of earlier or similar initiatives helped ensure the success of a project.

4.1 Positive partnerships

The vast majority of reported activities relied on partnerships, often among a range of parties, including external and internal experts, funders, community or local participants, and other stakeholders. Over half of all reported activities involved at least two organizations in addition to the principal entity managing the project. Many projects had participation from several levels of government with differing roles. National governments were often particularly important for funding while management was reported as having been undertaken by sub-national, regional or local governments.

Partners were often from different geographical communities and cultural and educational backgrounds. For example, some initiatives involved Aboriginal councils, community members, university researchers, technical experts and a variety of government departments. Success was predicated on the ability of these diverse groups to develop a shared vision for the initiative and to work cooperatively together to meet common objectives. Open-mindedness, sensitivity, flexibility and innovative thinking were cited as positive characteristics leading to successful partnership arrangements. A willingness to share resources (e.g. financial, office space, data, and translators) was noted as a key value to partnership arrangements.

4.2 Integrating local and traditional knowledge

Local and traditional knowledge was underlined as important for the provision of accurate information on local conditions such as environmental factors, land use planning policies, infrastructure quality, population distribution, social change and overall, to fully understand the reality of climate change impacts at the community level. Community members, local governments, indigenous organizations, sector organizations and civil society groups were identified as making significant contributions to adaptation activities in this regard.

Local and traditional knowledge was seen to be pivotal for initiatives whose goals were to support the maintenance of traditional livelihoods like subsistence economies, commercial fishing and hunting, and reindeer herding. These activities were typically located in smaller communities and were predominant in Canada, Finland and Sweden.

Interviews, surveys, focus groups and workshops were frequently cited mechanisms to collect local and traditional knowledge. A community-based study design was an effective means to ensure local engagement at the outset and helped solidify buy-in for the delivery of the project. "Internal expertise" was often identified as a

contributor to success for projects that benefitted from local and traditional knowledge.

The success of many adaptation initiatives depended upon the ability of a partnership arrangement to integrate local and traditional knowledge with scientific data and technical expertise. One initiative integrated traditional knowledge with geoscience for the creation of socio-economic maps to identify community vulnerabilities to climate change impacts.

4.3 Effective communication for target audience

Easily understood messages and communication in indigenous languages were frequently mentioned as factors for successful awareness-raising activities. A community-based study design often provided the basis for the successful delivery of awareness-raising activities.

Various mechanisms such as community meetings, community newspapers, handbooks, brochures, posters and websites or portals were targeted at the local level and for Arctic residents. Written communications were often translated into a number of local languages. A few initiatives described the use of social media and “YouTube” videos as means to communicate information. Submissions also described the creation of web-based information tools, databases, workbooks, reports and workshops to support practitioners in making decisions for adaptation. While the use of a variety of communication methods was perceived to be successful, the uptake of individual methods may not have been evaluated.

4.4 Learning from others’ experience

Several submissions noted that an earlier project or knowledge of another initiative prompted an adaptation activity and provided helpful background and information. Often the transfer of knowledge was from one Arctic state to another.

One example was the Rapid Assessment of Circum-Arctic Ecosystem Resilience (RACER) tool developed under the auspices of the WWF. This tool, which assists in identifying places of conservation importance for the maintenance of functioning ecosystems to support nature and the livelihoods of Arctic residents, was first used in Canada, Russia and the United States, and is now being applied in Norway.

Another example was an initiative to develop an integrated climate change adaptation strategy for the North-West region of Russia which relied heavily on the experience of the Barents Euro-Arctic Council and Nordic partners.

5. Challenges

Respondents were asked in the written survey and during consultations to describe challenges, barriers or constraints they had encountered in implementing adaptation activities. Many challenges that were identified related to practical issues due to limited or inaccessible resources. Other challenges cited related to the need to raise awareness about climate change impacts and adaptation options and to motivate decision-makers to take action. Challenges in ensuring effective communication was a common theme as many adaptation activities involved multi-disciplinary teams, aimed to integrate local and traditional knowledge, and/or required the participation of community residents. Difficulties were also noted in obtaining the appropriate tools, information and expertise required to implement adaptation measures.

5.1 Challenges with project implementation

Many submissions noted challenges relating to project implementation, such as limited funding resources, high staff turnover rate, inaccessibility to stakeholders and expertise, and absence of data. It was mentioned that due to a lack of ongoing and reliable resources, projects are often initiated for short periods and then lose momentum. Often attempts made to restart these projects fail because knowledge and expertise have been lost. These challenges were especially noted for initiatives at the community level and with respect to the implementation of community plans. Other challenges conveyed related to diffuse responsibilities of project partners and the lack of a coordinating or implementing authority.

Even with informed and qualified people on project teams, there were also challenges coordinating schedules and aligning visions and expectations. This was reported as particularly challenging for large projects with several partners from different sectors or situated at great distances from each other.

5.2 Convincing decision-makers of the need for action

While many impacts of climate change in the Arctic are evident and predicted to accelerate at a rapid pace, it was noted that convincing key decision-makers of the necessity to take action now could be challenging. This challenge was manifested in a number of ways.

In many Arctic regions, communities are facing numerous changes which means they need to balance a number of priorities. Addressing climate change adaptation became less a priority while other issues such as housing, employment and economic development seemed more immediate and urgent. Respondents also

noted encounters with scepticism of the severity of climate change impacts which undermined the conduct of an activity or the implementation of an adaptation action.

In some indigenous and isolated communities, there was the perspective that they have adapted to many changes in past generations and climate change would be one other challenge that they would adapt to over time as it occurred. Science data and predictions were not especially valued and consequently given little attention.

In some larger municipalities, it was difficult to convince decision-makers to trust climate models and focus decades in the future when this could mean limiting current revenue-generating activities. One example was the allocation of sought-after landscapes for housing and cottage development near coastlines which are predicted to face flooding and erosion in the future.

Similarly, activities that focused on encouraging and supporting the mainstreaming of climate considerations into ongoing operations faced the challenges of competing priorities and a reliance on individual commitment that would vary. For example, it was reported that a transportation consultant felt that climate change is likely to be so gradual that transportation authorities will be able to easily adjust their regular operations without the need for a concerted plan.

5.3 Communication among partners and with implementers

While effective communication among partners was cited as a success factor, the inverse was cited as a challenge. In some cases, the challenge was “bridging lexicons” between scientists and practitioners, stakeholders, and community members. Translating scientific and technical information into language that was meaningful for all partners was a complex task, as was effectively integrating scientific information and traditional knowledge. These challenges were especially prevalent for initiatives that involved training and capacity-building activities for practitioners at the local level and when developing strategies for specific sectors.

Initiatives that specifically aimed to incorporate traditional or local knowledge into adaptation planning and implementation encountered related challenges. Practical considerations like the extra time and resources required to access residents and other stakeholders were noted. “Consultation fatigue,” especially in small communities, was cited as a barrier. At the same time, it was noted that there are many community voices that are not being heard. Workshops were mentioned as useful to garner this input; however, these may require substantial resources to support meaningful participation.

Generally, the number of conversations and amount of effort required to achieve a common vision and a commitment to an initiative's objectives were cited as challenging. The types of difficulties in communication noted above were thought to contribute to a lack of buy-in by crucial partners or to not reaching the target audience for the initiative.

5.4 Obtaining and selecting the right tools

The submissions often described elements that could be considered adaptation tools, for example, protocols, guidelines, mapping techniques, and databases. During consultations respondents stated that they were under the impression that in some areas, there are many tools available to support adaptation implementation. However, the challenge is that these tools are often not disseminated to practitioners or to the appropriate people at the community and municipal level where they could be applied. There are a number of reasons for this challenge.

Adaptation tools may not be in a format that is easily accessible. They may be too technical, too scientific, or not available in native languages. Sometimes there is a reliance on websites that are not well communicated or are difficult to access, or the tools themselves demand a high comfort-level with web-based applications. On the other hand, an adaptation tool might not be readily shared but instead, the experience and knowledge about a particular adaptation rests within the community where it was applied.

In addition, it was pointed out that it is often challenging to select the right tool for the specific circumstances being faced. It was recommended that more guidance should be provided in determining which tools would be the most beneficial.

5.5 Lack of environmental, climate and other data

Some respondents noted the lack of environmental data and climate and meteorological monitoring stations in large and often sparsely populated areas. For example, a multi-national ecosystem related initiative encountered a lack of basic data for some regions. Another assessment of hydro-meteorological events and processes was challenged by the inadequate coverage of certain areas for assessments of basic climate parameters to support emergency response.

Infrastructure-related activities were hampered by the lack of historical design, construction and maintenance records. Also, data required to establish baseline information, e.g. related to understanding the terrain, were also limited.

In addition, deficiencies in socio-economic data to contribute to climate change impact and risk assessments were noted as hindering effective decision-making.

5.6 Lack of capacity

Several submissions noted one objective to be capacity building through training and awareness-raising. Nevertheless, insufficient capacity at many levels was identified as a significant challenge. This challenge was prevalent for smaller and isolated communities in that did not have the necessary skills, expertise or the ability to obtain training and relevant information to make adaptation decisions. Some smaller states also cited capacity challenges at all levels of government.

5.7 Carrying out activities in large and isolated northern regions

There were many references to the vastness of Arctic regions and the isolation of some communities in a number of submissions. The size and relatively undeveloped character of many areas posed challenges such as costs and complexity of carrying out studies and projects in remote locations. Besides financial costs, practical logistics could be challenging in the Arctic. One respondent noted that arranging contact with project partners and stakeholders was complicated by the different time zones in which they were located.

6. Summary Conclusions

While recognizing the constraints that this analysis faced, some factors stand out in a general characterization of the adaptation initiatives reported and are outlined below.

6.1 Predominance of adaptation-enabling activities

Almost all activities described in the submissions addressed “adaptation-enabling” activities, such as, undertaking assessments, developing plans and tools, and providing information, training or other resources in support of the eventual development or implementation of adaptation actions. This could suggest that adaptation to climate change in Arctic regions remains at an early stage. Indeed, in many cases, reported adaptation activities amounted to the beginning of the discussion in a community on climate change and approaches to adapting to the impacts.

In consultations with Arctic Council representatives, the above perspective on the state of adaptation in their jurisdictions was agreed to by most, but not all. In some

cases, there was the view that adaptation implementation has advanced considerably over the last few years.

It is clear that “adaptation-enabling” activities, being purposeful and discrete, were suited to the completion of a template for information gathering purposes. Adaptation activities that have become general practice or “mainstreamed” into operational and other decision-making may have lost a distinct project status that would have prompted a contribution to this project. In addition, few concrete community level activities that are occurring in response to community plans were captured. This may be due to the project scope and some constraints which did not facilitate information gathering at the community level.

Nevertheless, it is notable that across all submissions, few activities met the description of concrete adaptation actions or the actual implementation of adaptation plans or techniques. This project did not capture the outcome of these activities and many activities are recent so there has not been time for implementation and to determine practical outcomes.

6.2 Dominant treatment of climate change impacts as adverse

The overwhelming majority of submissions approached climate change impacts as negative drivers of action, primarily focusing on how sectors needing adaptation activities were being adversely affected by climate change. The general negative impacts of climate change are reflected in the number of hazard and vulnerability assessments, the projects that focused on protecting or adapting infrastructure, and the projects that addressed human health and emergency planning.

It is clear that permafrost degradation is a primary concern in the North American Arctic and Sub-Arctic regions, and Greenland and Russia have also acknowledged this as a concern. Impacts to permafrost are already having problematic effects on infrastructure of all types, requiring studies of the characteristics of permafrost, the physical details of its degradation and the distribution of thawing permafrost.

The climate change impacts of reported concern in the Iceland, Greenland, Finland, Sweden, Norway and the United States were largely flooding from river systems and sea level rise, which affected both marine infrastructure and land use planning in coastal areas. The sensitivity of tundra vegetation to climate change and associated ecosystem changes was reported as a matter of concern in the far northern regions of Finland, Sweden and Norway, and in particular, with respect to the sustainability of traditional Saami reindeer feeding practices. Concerns for traditional and subsistence economies affected by climate change were also noted in a cross-section of submissions.

There were a few submissions that mentioned the possibility of some positive aspects of climate change. In Canada, one initiative noted opportunities a changing climate may present for new industrial and economic development, for example, the reduction of year-round sea ice could support increased shipping and cruise tourism. In Greenland, a national level study on the large fishing and hunting sector, noted the possibility of new opportunities and the need for retraining and education of fishermen and hunters. As previously mentioned, initiatives between Finland, Norway and Russia are searching for alternative opportunities within traditional economies, including the cultivation of new strains of berries of commercial interest and opportunities for Saami reindeer herders that may be presented by a changing climate. In Iceland, the national power company anticipates an increase in the availability of power with changes in river flow as glaciers diminish.

In consultations, there was some discussion of the opportunities that may be experienced with climate change. One area often cited was the potential for new tourism endeavours. A few countries noted that a warmer climate makes Arctic regions more accessible to tourists. At the same time, some Arctic regions may become a destination of choice due to the colder weather and availability of snow for certain recreational activities (e.g. skiing). Some places are considering whether income from tourism could subsidize traditional lifestyles while also noting concerns that there could be negative environmental and societal impacts associated with increased tourism. It was also pointed out that existing tourism operations in the Arctic tended to be small businesses, and therefore have limited capacity to proactively pursue potential opportunities.

In terms of other benefits, in Sweden it was recognized that a longer growing season could be a positive for forestry; in Iceland it is expected that additional plant cover will help prevent erosion and there may be opportunities for new crops; and, in the Faroe Islands an increase in shipping could provide economic opportunities. In Russia, the combination of negative and positive impacts of Arctic warming was also recognized.

6.3 Adaptation activities require partnerships

Climate change adaptation as reported by all countries is multi-faceted and requires participation from all levels and sectors of society. Governments often provided policy leadership and funding. External expert advice and specialized advocacy were instrumental both for producing the scientific information that is vital to planning adaptations at all levels, and for guiding and supporting adaptation planning at the municipal and community level. Scientific research was undertaken both within countries to better understand the hazards of climate change impacts, and among

countries, as international research collaboration was seen in several studies of ecosystems that spanned two or more countries. It is not surprising, therefore, that good cooperation among partners stood out as the most commonly cited success factor in adaptation activities.

The roles played by the different levels of government and the scale at which activities were applied were similar in the countries involved. While most planning activities were conducted at the local scale, it was the sub-national or regional level of government that drove, facilitated or supported many of the activities. In Norway and Sweden, regional governments were instrumental in encouraging the development of adaptation plans by municipalities, under national (or European Union) policy frameworks. In Canada, the territorial governments promoted community planning through developing planning guides and supporting mainstreaming of climate change into routine planning activities. They also undertook large-scale assessments of public infrastructure and hazards, such as flood plain hazard assessments that could be used for local planning. In the United States, the State of Alaska conducted a comprehensive assessment of climate change impacts and adaptation activities occurring in the U.S. Arctic in order to support officials across all levels of government in implementing adaptation measures.

National level governments often contributed the funding for many adaptation activities under programs that support and encourage the regional and local governments to conduct the activities. It is also at the national level that many of the legislative and policy frameworks that directed some activities were created. Russia has national legislation that guarantees the right of indigenous Arctic peoples to continue traditional cultural practices prompting regional and local organizations to develop adaptation plans for indigenous communities. The Norwegian *Green Paper on Climate Change Adaptation* was the vehicle that prompted Norwegian counties to initiate adaptation planning in their municipalities.

In most cases, it was the local or municipal level where detailed adaptation plans were developed and assessments or hazard mapping exercises were carried out. These initiatives often included the active participation of community members, non-government organizations, academics and various government bodies.

Most countries reported activities with a marked focus on indigenous peoples and communities. Russia, Sweden, Norway, Canada, Greenland and the United States all addressed the vulnerability of indigenous peoples and cultures to climate change impacts. In these countries, members of the indigenous community participated in

adaptation activities; however, activity descriptions suggest that the substantive nature of these roles varied considerably.

6.4 Arctic adaptation activities are diverse

This project highlighted the diversity of the Arctic region as represented by Arctic Council states. The differences in geography, societies and climate change impacts were evident in the adaptation activities reported and during consultations. Some regions were notable for their small isolated communities that may or may not have road access. In other areas there was a relatively higher density of population living under harsh and variable climatic conditions. In contrast, there were a few areas where temperatures were more moderate and quite stable throughout the year.

Clearly adaptation activities were location and circumstance-specific. Even within individual states, there often was a variance of user needs that required differentiated responses. Typically, activities to support traditional lifestyles were distinctly local in nature.

7. Opportunities for the Arctic Council

This report has underlined the breadth and complexity of climate change adaptation activities underway in the Arctic. All participants in this project expressed strong interest in the Arctic Council continuing work to address climate change adaptation. They noted that many resources are already being devoted to adaptation planning and implementation, and that the demand for concrete action is growing. There is a desire to learn more about others' experience and to share knowledge so that adaptation efforts can be efficient, effective and successful.

It was also noted that the many changes facing Arctic residents are linked in one way or another to the impacts of climate change. For example, the increased attention to resource exploration and extraction relates to the accessibility of these resources as a result of a warming climate. Therefore, discussions on adapting to climate change need to be integrated with broader discussions on adapting to new economies and lifestyles.

The Arctic Council has an important role to play in facilitating the generation and exchange of information aimed at decision-makers at all levels on circumpolar issues. The following are some potential directions for further work on climate change adaptation by the Arctic Council that have emerged from the analysis of information collected for this project and in consultations with project representatives. These recommendations for consideration are not necessarily discrete and a combination of initiatives or a phased approach could be prudent.

7.1 Focus on a particular sector

A survey, broad assessment or case study approach could be useful if it is focuses narrowly on a particular sector. This specific focus could assist in targeting resources, support an in-depth analysis and facilitate the identification of relevant experts and practitioners to contribute to the initiative. Sectors of high interest and concern across Arctic Council states for climate change adaptation efforts include infrastructure, transportation, human health, fisheries and natural resource development.

7.2 Focus on tools and their dissemination

Further scoping an initiative to focus on tools could facilitate capturing concrete and practical adaptation activities. Tools could include guidelines, protocols, processes and techniques to implement adaptation activities. Guidance is also required for practitioners and decision-makers at the community level to assess which tool is appropriate for their particular circumstances. In addition, learning about how tools are communicated and assessing the effectiveness of these methods would be useful. For example, a variety of mechanisms were cited in the information collected for this project including workshops, handbooks, newsletters, traditional and social media, sector associations, and non-government or academic organizations.

7.3 Focus on adaptation at the community level

This project has underlined the challenge in collecting information at the community and individual level. At the same time, it is felt that there is considerable practical adaptation experience that is occurring that could be very useful if it was shared. While “consultation fatigue” was mentioned as a concern in some smaller communities, more often the message conveyed was that there is a desire for additional mechanisms to discuss impacts being witnessed, and the projects and changes in behaviour being undertaken to respond to these changes. Therefore, it was recommended that further delving into successful methods to access and communicate personal accounts at the community level would be beneficial.

7.4 Focus on particular success or challenge factors

This report has identified a number of issues that are perceived as contributing to the success of an initiative and issues that present challenges or barriers. Additional analysis of these cross-cutting issues could advance an understanding of best-practices related to implementing adaptation activities. For example, as noted in the report, partnerships are integral to adaptation activities; however, it was not

always clear what elements determined whether or not a partnership arrangement would be effective. The inclusion of traditional and/or local knowledge was also cited as important but, more specific details on how best to do this in the context of implementing adaptation measures could be helpful. Overall, how success can be measured in the realm of adaptation could also warrant further examination.

7.5 Develop a database of adaptation activities

A comprehensive database, potentially building on the templates collected for this project could be considered. In determining the scope for a database, it would be helpful to evaluate processes that would be required to gather information to populate it. For example, this project faced process challenges as mentioned earlier, and the previous VACCA project encountered similar challenges, namely in reaching relevant project proponents and in collating consistent information. A streamlined database approach that provides a basic description of adaptation activities and related contact information might be feasible. This would require users of the database to directly communicate with the identified contacts for the adaptation activity to obtain details and insights. The scope, management and long-term value of a database would require further analysis.

7.6 Establish a network for sharing information and expertise

The Arctic Council could consider playing a facilitative role to support capacity building, knowledge development and the exchange of experience related to adaptation by providing mechanisms for this to occur. A web-based platform or portal that provides access to adaptation activities, tools and links to other resources is one option. A portal could also support greater accessibility and increase the utility of the reports produced by Arctic Council working groups that could inform adaptation action. Another, or complimentary option, would be a network of sector-related or other practitioners that could be organized to meet on-line (e.g. shared workspaces, webinars) and/or at face-to-face workshops.

7.7 Assess other international or regional organizations' treatment of adaptation

There are a number of international and regional organizations that provide data, advice, tools, strategies and general information on adaptation for a variety of target audiences. It could be useful to survey these resources to assess if there is a particular gap that could be filled by the Arctic Council and to determine good models for the exchange of information.

Appendix 1: The template

TAKING STOCK OF ADAPTATION PROGRAMS IN THE ARCTIC

Instructions for Completing the Climate Change Adaptation Activity Information Template

The Arctic Council is launching a project to gather information about climate change adaptation activities in the Arctic region. The objective is to learn about progress being made and opportunities and challenges that are being encountered as communities, regions and countries adapt to a changing climate.

Who should complete a template and participate in this project?

If you have received this message, you have been identified by an Arctic Council representative as possessing knowledge of a climate change adaptation activity of interest to this project.

If you and/or your organization is solely responsible for a climate change adaptation activity (as described below), your time to complete a template is greatly appreciated. If you and/or your organization is involved in a climate change adaptation activity with other partners, it is recommended that you consult with your partners and submit one completed template per activity.

What is meant by climate change adaptation (in the context of this project)?

Climate change adaptation is action to prevent or reduce the negative impacts of climate change; action to help people adapt to risks that cannot be eliminated or reduced; and/or action that aims to take positive advantage of climate change.

What climate change adaptation activities should be included?

This project is seeking information about existing (or completed after 2008¹) national, sub-national, regional and local climate change adaptation activities (including marine and terrestrial) within, or relevant to, the Arctic region.

A climate change activity is a process, project, tool or strategy to respond to the impacts of climate change or the combination of climate change and other impacts from changes occurring in the Arctic. Examples of climate change adaptation activities include: new construction technologies or codes; infrastructure projects to protect water resources, reduce coastal erosion or assist transportation; community planning tools; experiments with new crops; new fishing, hunting, herding or harvesting practices; policies to preserve sites of archeological importance; new recreation and tourism proposals; revised policies or regulations for natural resources management; improved emergency/hazard warning systems; communication materials about

¹ The year 2008 was selected to avoid duplication with an Arctic Council project about climate change adaptation activities that occurred in that year.

survival skills or health risks; and, educational initiatives integrating traditional knowledge and climate change information. These are just some examples and this is not an exhaustive list.

It is important to note that the objective of this project is not to include scientific research on the impacts of climate change. The focus is on actual adaptation activities that are being implemented.

How will the information be used?

Information collected will be shared with representatives from the Arctic Council states and the six aboriginal organizations that are Permanent Participants. The information provided by the templates will be analyzed to learn about best practices, challenges and opportunities to inform other jurisdictions in their development and implementation of climate change adaptation approaches. A report will be prepared for Arctic Council Ministers and made publically available in 2013. While excerpts from the templates may be included in the final report, the full templates will not be published publically.

How to complete the template:

Please complete one template for each climate change adaptation activity. Simply, type in your responses to the questions and save the document. Provide as much information as you can, there is no space limit. If a question is not relevant to your activity, it may be left blank.

Once the template is completed and saved, please return it by email to your Arctic Council representative. An Arctic Council representative has been identified for each Arctic Council country to coordinate information within their jurisdiction. Their contact information is below.

Each representative will forward completed templates to the co-leads of the project, Canada and Russia. All Arctic Council representatives will be involved in analysing the information received to prepare advice for Arctic Council Ministers.

Your Arctic Council representative:

Name:

Organization:

Telephone:

Email:

Please forward completed templates to your Arctic Council representative by:

If you have any questions or require assistance in completing the template, you may contact the above Arctic Council representative or co-leads for the project:

Matt Parry (Canada) Environment Canada +1819 934 0257 matt.parry@ec.gc.ca	Elena Nikitina (Russia) EcoPolicy Research & Consulting +795 773 3687 elenanikitina@bk.ru
--	--

CLIMATE CHANGE ADAPTATION ACTIVITY INFORMATION TEMPLATE

A. DESCRIPTION OF THE ACTIVITY

1. Provide a brief but descriptive title for the activity.
2. Please indicate which country/countries are involved in the activity, level of the activities and the name of specific areas where appropriate.

2.a. Country/countries: ☐ Canada ☐ Denmark/Greenland/Faroe Islands ☐ Finland ☐ Iceland ☐ Norway ☐ Russia ☐ Sweden ☐ USA	2.b. Level of the activity: ☐ National ☐ Sub-national ☐ Regional ☐ Local
2.c. Please specify subnational, regional or local areas:	

3. Please indicate and identify who are responsible for implementing the adaptation activity. This could be one or many implementers.
☐ Authorities/government department or agency:
☐ Civil society/non-government organizations:
☐ Business/industry:
☐ Scientific community:
☐ International organization/agency:
☐ Other (please describe):
4. Please provide a short description of the activity including, for example, the objectives/expected outcomes and the intended audience, if the activity addresses a challenge or an opportunity to climate change (or both), etc.
5. Please describe other partners and/or stakeholders involved in the activity and their roles.
6. a. Please indicate the start date of the activity:

b. Please indicate status of the activity.
☐ In Progress
☐ Finite period (note estimated date of completion):
☐ Indefinite period
☐ Completed (note date):

B. INSIGHTS AND LESSONS LEARNED

7. How did this activity get started? For example, what event/research/policy prompted your organization to do this activity?
8. What contributed to the success of this activity?
9. What challenges, barriers or constraints have been encountered?

C. ADDITIONAL INFORMATION TO ASSIST OUR ANALYSIS

10. Please check the box(es) to indicate what concerns/issues led you to initiate the activity.

- ☐ Human health and safety concerns
- ☐ Food security
- ☐ Human settlement/community changes
- ☐ Infrastructure vulnerability/change
- ☐ Ecosystem quality or resilience
- ☐ Water availability or quality
- ☐ Natural resource management
- ☐ Economic changes
- ☐ Business opportunities or risks
- ☐ Funding opportunity
- ☐ Political or legislative requirement
- ☐ Demographic changes
- ☐ Cultural changes
- ☐ Other (please describe):

11. Please check the box(es) that best describes the sector(s) that the activity covers.

- ☐ Agriculture
- ☐ Animal husbandry
- ☐ Forestry
- ☐ Fisheries (including aquaculture)
- ☐ Oceans management
- ☐ Protected areas management
- ☐ Water resources management
- ☐ Wildlife and/or habitat management
- ☐ Tourism
- ☐ Human health
- ☐ Human safety and emergency planning
- ☐ Non-renewable resource extraction
- ☐ Energy production/consumption
- ☐ Built infrastructure
- ☐ Transportation infrastructure

- ☐ Waste management
- ☐ Cultural resources
- ☐ Social services
- ☐ Community planning
- ☐ Other (please describe):

12. Please check the box(es) to indicate which elements below the activity addresses:

- ☐ Policy
- ☐ Strategy
- ☐ Legislation
- ☐ Regulation
- ☐ Guidelines
- ☐ Codes and Standards
- ☐ Planning tools
- ☐ Incentive tools
- ☐ Management tools
- ☐ Technology innovation
- ☐ Physical projects
- ☐ Finance/insurance mechanisms
- ☐ Institutional change
- ☐ Capacity building
- ☐ Communication, education and outreach
- ☐ Other (please describe):

D. ACTIVITY CONTACT INFORMATION

13. Please provide any web links related to the activity.

14. Please provide contact details for the activity.

Name:	
Title:	
Institution:	
Email:	

15. Please provide contact details for yourself if this is different from above.

Name:	
Title:	
Institution:	
Email:	

E. ADDITIONAL COMMENTS

16. Any other comments/information on the activity not captured above are welcome.

Appendix 2: List of templates received by location of activity and with activity contact information

Canada

1. Adaptation Planning for Climate Change and Subsistence Economies in Inuvialuit Communities, Northwest Territories
Name: Dr. Tristan Pearce, Partner / Dr. James Ford, Partner
Institution: ArcticNorth Consulting
Email: tristanpearce@gmail.com / james.ford@mcgill.ca
2. Adaptation Platform Northern Working Group
Name: Carrie Spencer, Manager
Institution: Climate Change Impacts and Adaptation Division, Natural Resources Canada
Email: Carrie.Spencer@NRCan-RNCan.gc.ca
3. Adaptive Management for Water Users Responding to Climate Change, Yukon
Institution: Climate Change Secretariat, Government of Yukon,
Email: ClimateChange@gov.yk.ca
4. Addressing Arctic Sea Level Rise and Coastal Impacts: A Collaborative Approach in Support of the Nunavut Climate Change Adaptation Plan
Institution: Ilisaqsivik Society - Ittaq Heritage and Research Centre / Canadian Institute of Planners
Email: coordinator@ilisaqsivik.ca
5. Addressing Data Need for Monitoring and Mapping Vulnerable Water Supplies: A Collaborative Approach in Support of the Nunavut Climate Change Adaptation Plan
Institution: Nunavut Research Institute
6. Agriculture Adaptability to the Effects of Melting Permafrost in the Yukon
Name: Kam Davies, Agriculture Spatial Database Administrator
Institution: Agriculture Branch, Department of Energy, Mines and Resources, Government of Yukon
Email: kam.davies@gov.yk.ca
7. Aquatic Climate Change Adaptation Services Program
Name: Helen Joseph, Director
Institution: Climate and Oceanography Branch, Fisheries and Oceans Canada
Email: Helen.Joseph@dfo-mpo.gc.ca

8. Assessing the Vulnerability of Atlin, British Columbia to Severe Climate Change Impacts
Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: lkinnear@yukoncollege.yk.ca
9. Assessing the Vulnerability to Climate Change and Adaptive Capacity of Yukon Forest Tree Species and Ecosystems
Institution: Climate Change Secretariat, Government of Yukon
Email: ClimateChange@gov.yk.ca
10. Assessment of Permafrost Conditions and Implementation of Adaptation Measures for Runway at Kuujuaq Airport, Quebec
Name: André Leclerc, Technologue en génie civile et municipal
Institution: Transport Canada
Email: andre.leclerc@tc.gc.ca
11. Building Capacity for Community Climate Change Adaptation Planning in Nunavut
Institution: Canadian Institute of Planners
Email: general@cip-icu.ca
12. Characterizing Hydrological Processes in the Headwater Region of the Yukon River: Implications for Hydroelectric Security
Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: lkinnear@yukoncollege.yk.ca
13. Climate Change Adaptation Plan for the Northwest Territories Department of Transportation
Name: Greg Cousineau, Senior Transportation Planner
Institution: Department of Transportation, Government of the Northwest Territories
Email: greg_cousineau@gov.nt.ca
14. Climate Change Information and Mainstreaming Program, Yukon
Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: lkinnear@yukoncollege.yk.ca
15. Climate Change Risk Assessment Tool Workshop, Canadian Arctic
Name: Maria M'Lot, Manager and Research Associate
Institution: Centre for Indigenous Environmental Resources
Email: mm'lot@yourcier.org

16. Climate Change Risk Assessment and Scenarios to Support Adaptation Initiatives in the Yukon

Institution: Council of Yukon First Nations
Email: reception@cyfn.net

17. Coastal Geo-Risks, Vulnerabilities, and Adaptation of Aboriginal Communities of the North Coast of the St. Lawrence River, Quebec in the Context of Climate Change

Name: Pascal Bernatchez and Stephanie Friesinger
Institution: Laboratory of dynamics and integrated management of the coastal zones, Université du Québec à Rimouski
Email: pascal_bernatchez@uqar.ca and stephanie_friesinger@uqar.ca

18. Community Climate Change Adaptation Project – Developing Plans and Implementing Actions, Yukon

Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: lkinnear@yukoncollege.yk.ca

19. Department of Transportation Marine Climate Change Vulnerability Assessment Workshop, Northwest Territories

Name: Greg Cousineau, Senior Transportation Planner
Institution: Department of Transportation, Government of the Northwest Territories
Email: greg_cousineau@gov.nt.ca

20. Developing Climate Change Action Plans for Tlicho Communities and the Tlicho Government, Northwest Territories

Name: Doug Ritchie, Former Program Director
Institution: Ecology North
Email: dougritchie@ykdene.com

21. Development of an Inuit Focused Climate Change Program in Nain, Nunatsiavut: Determining Impacts and Adapting for a Healthy Future While Building Capacity, Newfoundland and Labrador

Institution: Nunatsiavut Government

22. Development of Bioclimate Envelopes and Interpretation of Climate Projections to Frame Adaptation Strategies for Yukon's Boreal Forest

Name: Nadele Flynn, Ecological and Land Classification Coordinator
Institution: Department of Environment, Government of Yukon
Email: Nadele.Flynn@gov.yk.ca

23. Evaluating Convection on Adfreeze Piles for the Western Arctic Research Centre
Institution: Aurora Research Institute
24. Examining Forest Vulnerabilities to Climate Change and Developing Resilience Enhancement Strategies, Yukon
Name: Robin Sharples, Research Forester
Institution: Forest Management Branch, Department of Energy, Mines and Resources, Government of Yukon
Email: Robin.Sharples@gov.yk.ca
25. Flat Loop Thermosyphon Foundations in Warm Permafrost, Northwest Territories, Nunavut, Quebec, Yukon
Name: Sukhi Cheema, Director, Design and Technical Services
Institution: Department of Public Works and Services, Government of the Northwest Territories
Email: sukhi_cheema@gov.nt.ca
26. Flood Plain Risk Mapping, Yukon
Name: Michael Templeton, Manager
Institution: Emergency Measures Organization, Department of Community Services, Government of Yukon
Email: michael.templeton@gov.yk.ca
27. Food Security and Adaptation Workshop, Old Crow, Yukon (*submitted by Arctic Athabaskan Council*)
Name: Bob Van Dijken, Acting Director, Circumpolar Relations
Institution: Council of Yukon First Nations
Email: bob.vandijken@cyfn.net
28. Food Security and Adaptation Workshop, Teslin, Yukon (*submitted by Arctic Athabaskan Council*)
Name: Bob Van Dijken, Acting Director, Circumpolar Relations
Institution: Council of Yukon First Nations
Email: bob.vandijken@cyfn.net
29. Gwich'in Climate Change Adaptation Planning Project, Northwest Territories
Name: Doug Ritchie, Former Program Director
Institution: Ecology North
Email: dougritchie@ykdene.com

30. Identification of Climate Change Impacts and Adaptation Measures for the Hunters, Trappers and Communities of Eeyou Istchee, Quebec
Institution: Cree Trappers Association
31. Identifying Adaptation Strategies for Climate Change and Sea Level Rise in Community Planning, New Brunswick
Institution: North Shore Micmac District Council
32. Impacts and Adaptation in Yukon Communities: Raising Awareness and Building Capacity
Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: lkinnear@yukoncollege.yk.ca
33. Incorporating Climate Change into Land Development, Nunavut
Institution: Community and Government Services, Government of Nunavut
34. Increasing Resilience and Adaptive Capacity Through Knowledge Sharing and Improved Communication, Nunavut
Institution: Department of Environment, Government of Nunavut
35. Infrastructure Vulnerability to Permafrost Degradation, Yukon
Name: Sarah Laxton, Outreach Geologist
Institution: Yukon Geological Survey, Department of Energy, Mines and Resources, Government of Yukon
Email: Sarah.Laxton@gov.yk.ca
36. Landscape Hazards in Yukon Communities: Geological Mapping for Climate Change Adaptation Planning
Name: Bronwyn Benkert, Research Project Coordinator
Institution: Northern Climate ExChange, Yukon Research Centre, Yukon College
Email: bbenkert@yukoncollege.yk.ca
37. Mine Wastes (rocks and tailings) and Climate Change, Yukon
Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Centre, Yukon College
Email: lkinnear@yukoncollege.yk.ca
38. Northern Infrastructure Standardization Initiative
Name: Kelly Montgomery, Program Manager, Adaptation and Roadmaps
Institution: Standards Council of Canada
Email: kmontgomery@scc.ca

39. Northern Transportation Adaptation Initiative

Name: Janice Festa, Manager/Senior Policy Advisor
Institution: Transport Canada
Email: janice.festa@tc.gc.ca

40. Northwest Territories Highway 3 Climate Change Vulnerability Assessment

Name: Greg Cousineau, Senior Transportation Planner
Institution: Department of Transportation, Government of the Northwest Territories
Email: greg_cousineau@gov.nt.ca

41. Nunavut Climate Change Centre (NC3) Resource Website

Name: Colleen Healey, Climate Change Program Manager
Institution: Government of Nunavut
Email: chealey@gov.nu.ca

42. Pan-Territorial Adaptation Outreach

Name: Rebecca World, Acting Director
Institution: Climate Change Secretariat, Department of Environment, Yukon Government
Email: Rebecca.World@gov.yk.ca

43. Pan-Territorial Adaptation Strategy

Institutions: Climate Change Unit, Environment Division, Department of Environment and Natural Resources, Government of the Northwest Territories
Climate Change Unit, Environmental Protection Division, Department of Environment, Government of Nunavut
Climate Change Secretariat, Environment Yukon, Government of Yukon

44. Planning for Climate Change Impacts on the Aquatic Ecosystems of Great Bear Lake and its Watershed, Northwest Territories

Institution: Déline Renewable Resources Council

45. Sea Ice and Freshwater Ice Behaviour Near Maritime Infrastructure – Input of Local Knowledge and Remote Sensing, Quebec

Institution: Institut national de la recherche scientifique / régionale Kativik
Email: communications@adm.inrs.ca

46. Sensitivity of Yukon Hydrological Response to Climate Warming to Support the Development of Sectoral Adaptation Strategies
Name: Ric Janowicz, Manager, Hydrology
Institution: Water Resources Branch, Department of Environment, Government of Yukon
Email: Richard.Janowicz@gov.yk.ca
47. Supporting Northwest Territory Communities in Planning for and Adapting to Climate Change
Name: Doug Ritchie, Former Program Director
Institution: Ecology North
Email: dougritchie@ykdene.com
48. Towards a Protocol for Airport Infrastructure Risk Assessment, Northwest Territories
Name: Greg Cousineau, Senior Transportation Planner
Institution: Department of Transportation, Government of the Northwest Territories
Email: greg_cousineau@gov.nt.ca
49. Traditional Knowledge and Climate Change in Tr'ondëk Hwëch'in Traditional Territory, Yukon (*submitted by Arctic Athabaskan Council*)
Name: Bob Van Dijken, Acting Director
Institution: Circumpolar Relations, Council of Yukon First Nations
Email: bob.vandijken@cyfn.net
50. Training, Monitoring, and Sharing Sea Ice Expertise: Implementing the Clyde River Climate Change Adaptation Action Plan
Institution: Ilisaqsivik Society and Ittaq Heritage and Research Centre
Email: coordinator@ilisaqsivik.ca
51. Understanding Climate-Driven Ecological Changes in Canada's North, Arctic National Parks
Name: Paul Zorn, Monitoring Ecologist
Institution: Parks Canada
Email: Paul.Zorn@pc.gc.ca
52. Vulnerability Assessment of Permafrost Degradation on Community Infrastructure in the Northwest Territories
Name: Sara Brown
Institution: Northwest Territories Association of Communities

53. Vulnerability of the North Alaska Highway to Climate Change, Yukon

Name: Bronwyn Benkert, Research Project Coordinator
Institution: Northern Climate ExChange, Yukon Research Center, Yukon College
Email: bbenkert@yukoncollege.yk.ca

54. Vuntut Gwitchin Climate Change and Health Research in Northern Yukon, including Food Security Adaptation Strategies

Name: Megan Williams, Heritage Manager
Institution: Vuntut Gwichin First Nation
Email: nrd@vgfn.net

55. Water Adaptation Project: Adaptive Management for Water Users Responding to Climate Change, Yukon

Name: Erin Light, Water Information Specialist
Institution: Government of Yukon, Water Resources Branch
Email: Erin.Light@gov.yk.ca

56. Yeendoo Nanh Nakhweenjit K'atr'ahanahtyaa: Environmental Change and Traditional Use in the Old Crow Flats, Yukon (*submitted by Arctic Athabaskan Council*)

Name: Bob Van Dijken, Director Circumpolar Relations
Institution: Council of Yukon First Nations
Email: bob.vandijken@cyfn.net

57. Yukon Climate Change Needs Assessment (*submitted by Arctic Athabaskan Council*)

Name: Bob VanDijken, Director
Institution: Circumpolar Relations, Council of Yukon First Nations
Email: bob.vandijken@cyfn.net

58. Yukon Climate Trends and Projections

Name: Lacia Kinnear, Manager
Institution: Northern Climate ExChange, Yukon Research Centre, Yukon College
Email: lkinnear@yukoncollege.yk.ca

Finland

59. Climate Programme for the City of Rovaniemi 2012-2020

Name: Martti Anttila, Deputy Mayor
Institution: City of Rovaniemi
Email: martti.anttila@rovaniemi.fi

60. Ecological Tourism and Reducing Carbon Footprint, Lapland

Name: Joanna Karinen, toimitusjohtaja
Institution: Ylläksen Matkailuyhdistys ry
Email: joanna.karinen@yllas.fi

61. Enhancing Corporate Social Responsibility at Oulu University

Name: Outi Virkkula, Co-ordinator of Sustainable Development
Institution: Oulu University of Applied Sciences
Email: outi.virkkula@oamk.fi

62. Flood Risk Management Planning, Lapland

Name: Niina Karjalainen, Water System Engineer
Institution: Lapland Centre for Economic Development, Transport and the Environment
Email: niina.karjalainen@ely-keskus.fi

63. Forest Management Monitoring, Lapland

Name: Mikko Hyppönen, Senior Researcher
Institution: Finnish Forest Research Institute (Metla)
Email: Mikko.Hypponen@metla.fi

64. Lapland Climate Strategy 2030 by Regional Council of Lapland

Name: Marko Varajärvi, Development Director
Institution: Regional Council of Lapland
Email: marko.varajarvi@lapinliitto.fi

65. Protection of Forest Tree Genetics for Sustainable Use of Forest Resources Changing Climate

Name: Katri Kärkkäinen, Professor
Institution: Finnish Forest Research Institute (Metla)
Email: Katri.Karkkainen@metla.fi

66. Reindeer Forage and Winter Feeding in Changing Climate

Name: Minna Turunen, Senior Scientist, PhD, docent
Institution: Arctic Centre, University of Lapland
Email: Minna.turunen@ulapland.fi

67. Vulnerability Assessment of Ecosystem Services for Climate Change Impacts and Adaptation

Name: Martin Forsius, Head of Unit, Professor
Institution: Finnish Environment Institute
Email: martin.forsius@ymparisto.fi

Greenland

68. Sectoral Climate Adaptation Reports

Name: Andreas Lysholt Mathiasen, Head of Section
Institution: Climate and Energy Office, Government of Greenland
Email: alma@nanoq.gl

Iceland

69. Climate Change Adaptation and the Operation and Financial Planning of Landsvirkjun (Icelandic National Power Company)

Name: Óli Grétar Sveinsson, Managing Director Development Division
Institution: Landsvirkjun

70. Siglingastofnun Íslands – Using Projections of Sea Level Rise for Harbour Construction and Modification

Name: Gísli Viggóson, *Director*
Institution: Research and Development, Icelandic Marine Administration
Email: gisli@sigling.is

71. Strategic Planning for Adaptation for the Icelandic Road System

Name: Skuli Þórðarson, Engineer
Institution: Vegsýn Consult.
Email: skuli@vegsyn.is

Norway

72. Avalanche Protection From Increased Precipitation

Name: Tom Eirik Ness, Environmental Advisor
Institution: Hammerfest Municipality
Email: tomness@hammerfest.kommune.no

73. Climate Change Adaptation Framework for Land Use in Balsfjord Municipality

Name: Siri Skaalvik, Land Use Planner
Institution: Balsfjord municipality
Email: Siri.skaalvik@balsfjord.kommune.no

74. Climate Service Center Norway

Name: Hans Olav Hygen
Institution: Norwegian Meteorological Institute
Email: Hans.olav.hygen@met.no

75. Mainstreaming Climate Change Adaptation into Troms Municipal Planning

Name: Lill-Hege Nergård, Advisor
Institution: Governor of Troms
Email: lhn@fmtr.no (lilln83@hotmail.com)

76. Norwegian Water Resources and Energy Directorate – Strategy and Measures 2010-2014

Name: Hege Hisdal, Section Head
Institution: Norwegian Water Resources and Energy Directorate
Email: hhi@nve.no

77. Rapid Assessment of Circum-Arctic Ecosystem Resilience (RACER) Norway – Arctic Marine Ecoregions (*submitted by WWF*)

Name: Martin Sommerkorn, Head of Conservation
Institution: WWF Global Arctic Program
Email: msommerkorn@wwf.no

Russia

78. Adaptation and Low-Carbon Development in Key Russian Regions (*submitted by WWF*)

Name: Alexey Kokorin, Programme leader
Institution: WWF Russia
Email: akokorin@wwf.ru

79. Creation of Climate Change Adaptation Plan for Vaygach Island (*submitted by WWF*)

Name: Oleg Sutkaitis, Programme leader
Institution: WWF Russia
Email: osutkaitis@wwf.ru

80. Development of the Network of Special Arctic Protected Areas in the Sakha Republic

Name: Grigoriev Vladimir Afanasievich, Minister
Institution: Ministry for Environmental Protection of Sakha Republic (Yakutia)
Email: minopr@sakha.gov.ru

81. EcoNet – Protected Areas and Ecological Corridors (*submitted by WWF*)

Name: Mikhail Stishov, Arctic Programme Leader
Institution: WWF Russia
Email: mstishov@wwf.ru

82. Environmental Monitoring of Oil and Gas Development Impacts and Adaptation in Krasnoyarsk Kray, Taimyrsky Dolgano-Nenetsk and Evenkisky Municipal Regions
Name: Shefer Vera Vladimirovna, Deputy Head
Institution: Kraevaya State Budget Organization Center for Implementation of Environmental Protection and Natural Resources Use Activities in Krasnoyarsky Kray
Email: kgucr@mail.ru
83. Innovations in Hydrometeorology Networks and Forecasting in Murmansk Oblast in Response to Climate Change
Name: Kurinova E.V., Specialist
Institution: Hydrometeorology and Environmental Monitoring Service of Murmansk Oblast
Email: leader@kolgimet.ru
84. Murmansk Oblast Climate Change Strategies
Name: Bulatova Svetlana Viktorovna, Consultant
Institution: Committee for Industrial Development, Environment and Natural Resources of Murmansk Oblast
Email: kpr@kpr-murman.info, bulatova@gov-murman.ru
85. Policy for the Protection of the Environment and Indigenous People (traditional lifestyles, economic development, craftsmanship) of the Northern Krasnoyarsk Kray Territory in the Changing Arctic
Name: Bokova Valentina Ivanovna, Head
Institution: Agency on Northern affairs and support for indigenous population of Krasnoyarsk Kray
Email: kmns@krsn.ru
86. Prevention of Negative Impacts on Water Resources for Settlements and Economy in Archangelsk Oblast
Name: Mirgorodskiy Aleksey Aleksandrovich, Head of Department
Institution: Water Use and Protection, Agency for Natural Resources and Ecology of Archangelsk Oblast
Email: Mirgorodskiy@dvinaland.ru
87. Reindeer Monitoring in Krasnoyarsk kray, Taimyrsky Dolgano-Nenetsk Municipal Regions
Name: Kelberg Gennady Vasilievich, Head of the Department
Institution: Biodiversity Protection, Ministry of Natural Resources and Forestry of Krasnoyarsky Kray
Email: kooksy@mpr.krskstate.ru

Sweden

88. Actions to Reduce Vulnerability of Drinking Water from Climate Change Impacts in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

89. Analysis and Communication of the Consequences of Climate Change in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

90. Analysis of Risks and Vulnerability as a Consequence of Climate Change in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

91. Analysis of Risks and Vulnerability of Climate Change Impacts on Housing and City Planning in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

92. Climate Challenges and Opportunities for Reindeer Keeping – a Case Study of Vilhelmina North Sami Village

Name: Annette Löf
Institution: Umeå University
Email: Annette.lof@pol.umu.se

93. Knowledge Gathering: Species, Ecosystems, Nature and Biological Diversity and Climate Change Impacts in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

94. Vulnerability Assessment of Climate Change Impacts on Road and Railway Transport in Norrbotten County

Name: Micael Bredefeldt
Institution: Länsstyrelsen i Norrbottens län, Krishanteringsenheten
Email: micael.bredefeldt@lansstyrelsen.se

United States

95. Overview of Adaptation Activities Occurring in Alaska

Name: Stefanie Moreland, Senior Advisor
Institution: Fisheries, Oceans, and Arctic Policy, Alaska State Governor's Office
Email: stefanie.moreland@alaska.gov

96. Understanding Our Climate and Changing Permafrost Summer Camp 2012 (*submitted by the University of the Arctic*)

Name: Erin Weinman, IT Applications Manager
Institution: National Museum of the American Indian
Email: WeinmanE@si.edu

Canada, Finland, Norway, Russia, United States

97. Kryozone Adaptation for the Sakha Republic of Russia

Name: Alekseeva O.I., Science Secretary
Institution: Institute of Permafrost of P.I.Melnikov, Siberian Branch of the Russian Academy of Sciences
Email: o.i.alekseeva@mpi.ysn.ru

Canada, Finland, Russia, United States

98. Northern Forum Water and Climate Change Working Group

Name: Natalie Novik, Coordinator
Institution: Northern Forum
Email: NNovik@northernforum.org

Canada, Norway, Russia, United States

99. Polar Bear Conflict Reduction (*submitted by WWF*)

Name: Geoff York, Head, Species, Global Arctic Programme
Institution: WWF Canada
Email: gyork@wwfcanada.org

Canada, United States

100. Alaska-Canada Climate-Biome Shift

Name: Dr. Nancy Fresco, Coordinator
Institution: Scenarios Network for Alaska & Arctic Planning (SNAP), University of Alaska Fairbanks
Email: nifresco@alaska.edu

101. Rapid Assessment of Circum-Arctic Ecosystem Resilience (RACER) - Beaufort Sea
(submitted by WWF)

Name: Dan Slavik, Senior Officer, Beaufort Sea Program
Institution: WWF Canada
Email: DSlavik@WWFCanada.org

Finland, Greenland, Norway, Sweden

102. Adapting to the Impacts by Communities in Northern Peripheral Regions

Name: Miikka Halonen, Administrative Director
Institution: Centre for Economic Development, Transport and the Environment
Email: miikka.halonen@ely-keskus.fi

Finland, Norway, Russia

103. Development and Cultivation of Local Plant Resources in Barents Region

Name: Antti Hannukkala, Research scientist
Institution: MTT Agrifood Research Finland
Email: antti.hannukkala@mtt.fi

Finland, Norway, Sweden

104. Nordic Centres of Excellence – Tundra

Name: Pekka Niemelä, Professor
Institution: University of Turku
Email: pekka.niemela@utu.fi

Finland, Norway, Russia, Sweden

105. Capacity of Protected Areas in the Barents Region to Conserve Biodiversity and Adapt to Land-Use Changes Threatened by Climate Change

Name: Christer Nilsson, Professor, Project manager
Institution: Umeå University
Email: christer.nilsson@emg.umu.se

106. Climate Change and Water Resources Management in Barents Region of Russia

Name: Mirgorodskiy Aleksey Aleksandrovich, Head of Department
Institution: Department of Water Use and Protection, Agency for Natural Resources and Ecology of Archangelsk Oblast
Email: Mirgorodskiy@dvinaland.ru

107. Impacts of Climate Change on Biodiversity and Ecosystem Goods and Services in the Barents Region

Name: Christer Nilsson, Professor, Project Manager

Institution: Umeå University

Email: christer.nilsson@emg.umu.se

Appendix 3: Detailed Information on Methodology

High-level overview of the database structure.

General Info	• Template ID • Arctic Council state or Permanent Participant • Data entered by
Identification and Administrative Information	• Project title • Start/ end dates • Project status (complete, ongoing) • Organization leading activity • Type of organization (jurisdiction. . .) • Contact information • Websites
Activity Profile	• Core activity ○ Activity type: multiple choice ○ Activity description: text from template ○ Objectives: text from template ○ Adaptation activity / adaptation enabling activity: multiple choice ○ Activity initiators / driving concerns: multiple choice, text from template ○ Level of implementation: text from template ○ Location: text from template
Climate Change Impact: multiple choice, text from template text	• Sectors and Partners ○ Sectors comprising principal users of activity output: multiple choice, text from template ○ Stakeholders and partners involved: multiple choice, text from template ○ Stakeholders and partners involved, role: multiple choice, text from template
Cross-Cutting Evaluation	• Contributors to success ○ dropdown box ○ description • Challenge type ○ dropdown box ○ description

A consulting team was assembled and was provided with all submitted templates for review and analysis. The first step of analysis involved the coding of responses to open-ended questions, for the identification of shared elements (e.g., activity types) and themes (e.g., dynamics posing challenges to the effective conduct of adaptation projects). Lists of common elements and themes were then used, together with other aspects of the original survey template to inform the development of a Microsoft Access database structure, enabling further standardization of information, its compilation in formats conducive to analysis and ease for future updates.

Within the database, primary elements and themes were translated into type and subtype “fields” where relevant and possible, and adjusted as needed as template information was entered. Types were developed for activity, partner role, success factors, and challenges. Subtypes were developed for some but not all activity types. It is worth noting that all narrative descriptions from the templates were preserved in full within the database, with respect to

each adaptation activity, partner roles, initiating and success factors for activities, and challenges encountered.

Two factors related to the number of activities reported and counted should be noted. First, many templates described activities that involved more than one activity; in these cases multiple activity records were entered for those templates, so that the activities reported reflect the types and number of those activities independent of the larger projects under which some were carried out. The second factor that was not able to be reflected in the activity count involved the report in a single template of single or sets of activities that were repeated in more than one location. For example, some community planning activities were developed and conducted in up to 13 different communities, but the higher incidence of that type of activity is not reflected in the results.

Once the template information was entered in the database it was reviewed by the team to ensure consistency with respect to the terms, criteria, and conceptual understandings used in classifying information. Analysis was done primarily through the use of database queries, to extract, sort and relate information within and across fields. This allowed for the identification, enumeration and characterization of relationships between and among elements. Database queries were carried out for fields and pairings noted in Table 3.

Table 3. Types of queries guiding the analysis

1. Activity description and geographical area
2. activity type and sub-type with: a. Climate change effect b. (success) contribution type c. Challenge type d. Sector (under sectors and partners) e. Partner type and role
3. Climate change effect and sector
4. Climate change initiator and geographical area
5. Partner type and geographical area
6. Contribution [to success] type and a. geographical area b. partner type and role
7. Challenge type and a. geographical area b. partner type and role

Appendix 4: Arctic Council representatives for the project “Taking Stock of Adaptation Programs in the Arctic”

States	
Canada (co-lead)	Matt Parry, Executive Director, Policy Development, Strategic Policy Branch, Environment Canada Email: matt.parry@ec.gc.ca
Russia (co-lead)	Dr. Elena Nikitina, Director, EcoPolicy Research and Consulting Email: elenanikitina@bk.ru Victoria Dobromyslova, Leading Advisor, Department of Strategic Planning of the Ministry of Regional Development of the Russian Federation Email: Viktoriya.Dobromyslo@minregion.ru
Denmark	Andreas Lysholt Mathiasen (Greenland), Head of Section, Climate and Energy Office, Ministry of Housing, Infrastructure and Transport, Government of Greenland Email: alma@nanoq.gl Margretha Nónklett (Faroe Islands) Email: margrethan@tinganes.fo
Finland	Seija Tuulentie, Senior Researcher, Nature-based Tourism, The Finnish Forest Research Institute Email: seija.tuulentie@metla.fi
Iceland	Halldór Björnsson, Head of Climate Research, Icelandic MET Office Email: halldor@vedur.is
Norway	Birgit Njaastad, Head of Section, Environment and Mapping, Norwegian Polar Institute Email: birgit.njaastad@npolar.no
Sweden	Åsa Sjöström, Manager, National Knowledge Centre for Climate Change Adaptation, Swedish Meteorological and Hydrological Institute Email: Asa.Sjostrom@smhi.se
United States	Roberta Burns, Arctic Affairs Officer, Office of Ocean and Polar Affairs, U.S. Department of State Email: BurnsRR@state.gov

Permanent Participants	
Aleut International Association	James Gamble, Executive Director Email: aia@alaska.net
Arctic Athabaskan Council	Cindy Dickinson, Executive Director Email: cdickson@mac.com Bob Van Dijken, Council of Yukon First Nations Email: Bob.Vandijken@cyfn.net
Gwich'in Council International	Bridget Larocque, Executive Director Email: blarocque_gci@northwestel.net
Inuit Circumpolar Council	Corinne Gray, Executive Director (Canada) Email: cgray@inuitcircumpolar.com Eva Kruemmel, Senior Health Research Officer (Canada) Email: EKruemmel@inuitcircumpolar.com
Russian Association of Indigenous Peoples of the North, Siberia and Far East	Dr. Rodion Sulyndziga Email: Rodion@raipon.info
Saami Council	Gunn Britt Retter, Head of Arctic and Environmental Unit Email: gbr@saamicouncil.net