

Vulnerability and Adaptation to Climate Change in the Arctic (VACCA): An analysis of the scoping study data

A report prepared for the Sustainable Development Working Group of the Arctic Council

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Executive Summary

Reducing vulnerability and implementing adaptation to climate change in the Arctic represents a significant challenge for the region. This Arctic Council project, VACCA (Vulnerability and Adaptation to Climate Change in the Arctic) was approved by the Arctic Council in 2007 and was designed to provide practical, useful knowledge and information sharing at different governance levels and for different sectors, so that this learning could be incorporated into policies and decision making.

The output from VACCA has two components:

- A survey on the expertise, previous and ongoing projects, and strategies and measures on adaptation to climate change in the Arctic.
- An international workshop on Arctic vulnerability and adaptation to climate change.

This report represents the background document analysing the scoping study for the workshop held in Tromsø, Norway from 22-23 October 2008.

Responses to the survey were solicited via the web, word-of-mouth, email lists, specific meetings, and by contacting individuals one-on-one. After duplicate entries and partially completed responses were removed from the database, 138 completed responses remained in the database.

This report provides data from the survey. 104 of the responses cover only one country, suggesting plenty of scope for multi-country approaches and comparisons. 83 of the responses were relevant to both vulnerability and adaptation, possibly implying that projects should not try to separate vulnerability and adaptation, but instead cover both activities.

Climate change as defined by changes in temperature and precipitation, and hence with connections to extreme events, were the dominant climate change issues considered by the responses. Many responses, though, indicated that issues and sectors not in the main survey form lists were of importance. Projects with a research component comprise the majority of the responses, with few projects addressing action in legislatures or on the ground.

The survey does not appear to be comprehensive, because several countries and groups were not able to provide much input or they were uncertain of the relevance of their input. The responses were also dominated by people who are comfortable reading and writing in English. Others were hesitant to submit responses due to time or lack of information regarding how the survey data might be used and interpreted.

Therefore, the data and results presented here cannot be considered to be a complete overview of vulnerability and adaptation to climate change in the Arctic. This report and the responses on which it is based represent only a first step towards understanding the topic.

Nonetheless, based on a strengths-weaknesses-opportunities-constraints analysis, the following questions are provided for further discussion:

1. Should the survey's scope be expanded to overcome the identified limitations and biases?
2. Should there be wider engagement with those not in the Arctic?
3. Is a coordination or information exchange mechanism needed?
4. Should an assessment be undertaken for Arctic climate change vulnerability and adaptation?
5. Should data sources, comparability, and availability be improved?

1. Background to VACCA

The Declaration from the Arctic Council Ministerial Meeting held in Salekhard, Russia in October 2006 states that the Ministers:

Request the SAOs to direct the SDWG, drawing on the expertise of other Working Groups, experts and stakeholders,

- to identify and share adaptation expertise and best practices and possible actions, unique to the needs and conditions of the Arctic, so that indigenous and other residents can better adapt to climate change,
- and to report on the status of this activity at the 2008 Ministerial meeting,
- and to make publicly available any results or lessons learned from this undertaking.

Reducing vulnerability and implementing adaptation to climate change in the Arctic represents a significant challenge for the region given the predictions in the Arctic Climate Impact Assessment (ACIA, 2005) as well as other work such as the Intergovernmental Panel on Climate Change (IPCC, 2007). Although ACIA did not specifically assess vulnerability or adaptation needs in the Arctic, it highlighted the climate trends and projected their impacts on Arctic environments and people. ACIA provides basic information that can inform the planning of vulnerability reduction and adaptation measures including at the local level.

This Arctic Council project, VACCA (Vulnerability and Adaptation to Climate Change in the Arctic) was approved by the Arctic Council in 2007 and was designed to provide practical, useful knowledge and information sharing at different governance levels and for different sectors so that this learning can be incorporated into policies and decision making. VACCA has direct and indirect links to several SDWG priority subject areas, and activities of other working groups, including follow-on to the Arctic Human Development Report (AHDR, 2004); management of natural resources; Arctic human, community, and environmental health; energy; marine shipping; and information and communication technologies.

The output from VACCA has two components:

- To undertake a scoping study which, via a survey (Appendix #1), collected information on the expertise, previous and ongoing projects, and strategies and measures on vulnerability and adaptation to climate change in the Arctic. The scoping study also forms the basis for the preparation of this background document for the workshop described in the next bullet point. Responses to the survey were solicited via the SDWG website, word-of-mouth, email lists, specific meetings, and by contacting individuals one-on-one to fill in the survey form.
- To arrange an international workshop to discuss relevant issues about, and to exchange information on good practices and lessons related to, vulnerability and adaptation to climate change. The workshop will prepare suggestions to give guidance for potential future work on climate change within the Arctic Council.

This report represents the background document analysing the scoping study for the workshop held in Tromsø, Norway from 22-23 October 2008. It reports on the data from the survey responses while analysing them through a strengths-weaknesses-opportunities-constraints analysis. Suggestions are made to assist the Arctic Council in moving forward with reducing vulnerability and implementing adaptation to climate change in the Arctic.

2. The VACCA survey

2.1. Main data and discussion

After duplicate entries and partially completed responses were removed from the database, 138 completed survey forms were in the database (Appendix #2). A single spreadsheet was developed to encode the data from the responses for the analysis presented here. This section presents only the principal data. Other data are used throughout this report where appropriate.

Tables 2.1 and 2.2 present the geographic distribution of the countries to which the responses apply. As shown in Table 2.1, many responses were relevant to more than one country, so the total in Table 2.2 is more than 138. Since no responses listed zero Arctic countries, the survey was successful in capturing only projects with Arctic relevance.

Table 2.1: Number of Arctic countries covered by responses (survey form question 5a)

# Arctic countries	# Responses
0	0
1	104
2	9
3	5
4	3
5	3
6	4
7	1
8	9

Table 2.2: Arctic countries covered by responses (survey form question 5a)

Arctic country	# Responses
Canada	47
Denmark/Greenland	19
Finland	43
Iceland	14
Norway	59
Russia	23
Sweden	21
USA	41

# responses marking "other countries"	5
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The overwhelming dominance of projects covering only one country might indicate the local nature of climate change vulnerability and adaptation. It might also provide scope for multi-country approaches and comparisons, especially multi-country comparisons of local approaches.

The large number of responses covering Norway was a direct result of one-on-one contact being made with people working on climate change across the country to request, and then to follow up continually, that they fill in the survey form. The language barrier likely affected the response from Russia and partially explains the low number of responses relevant to this country. However, the Northern Forum translated the survey form into Russian and both the English and Russian versions were circulated amongst many Russian contacts.

Table 2.3 on the next page shows the distribution of projects in terms of being relevant to vulnerability and/or adaptation. The decision was made to leave in the five responses marked as neither vulnerability nor adaptation because all these responses had relevance to one or both topics even though the submitter did not mark either box. The submitter had made an effort to fill in the survey form in these cases, in comparison to instances where other responders stated that they would not fill in a survey form since none of their projects were linked to vulnerability or adaptation.

The overwhelming dominance of projects covering both vulnerability and adaptation, rather than just one topic, suggests the strong links between reducing vulnerability and implementing adaptation. A lesson could be that projects should cover both vulnerability and adaptation rather than separating these activities, supporting the conclusions already reached by many involved in climate change research, policy, and implementation.

Table 2.3: Responses dealing with vulnerability and adaptation (survey form question 4a)

Category	# Responses
Neither vulnerability nor adaptation	5
Vulnerability not adaptation	15
Adaptation not vulnerability	35
Vulnerability and adaptation	83

The topics—referring to climate change issues and sectors—from the responses are shown in Tables 2.4 and 2.5. The totals add up to more than 138 because most responses covered several topics. The “other” issues (Tables 2.4) included additions such as access to resources, insurance, seasons changing, species changing, and technology. The “other” sectors (Table 2.5) included additions such as emergency planning, forestry, governance, immigration, public sanitation, and traditional knowledge.

Table 2.4: Responses marking specific issues (survey form questions 2a at left & 2b at right).

Issue	# Responses
Damage to human settlements and infrastructure	70
Other	70
Loss of/changes in livelihoods	69
Change in resource base	67
Changes in economy	55
Loss/degradation of land	55
Cultural changes	50
Food security	44
Health related changes	35
Changes in demography	32
Water shortage	32

Issue	# Responses
Changes in temperature	106
Changes in precipitation	104
Increases/changes in extreme events	90
Flood	71
Changes in wind	63
Permafrost degradation	63
Melting sea ice	58
Sea level rise	58
Coastal inundation/erosion	47
Drought/aridity	43
Other	42
Avalanches/landslides	38
Vector-borne disease	27
Increased UV-radiation	23

Table 2.5: Responses marking specific sectors (survey form question 3).

Sector	# Responses
Infrastructure	74
Natural systems management	62
Coastal zones	53
Wildlife management	53
Water resources	53
Tourism	44
Protected areas management	42

Other	41
Energy production	40
Fisheries (including aquaculture)	38
Human health	38
Recreation	34
Agriculture	31
Energy consumption	31
Non-renewable resource extraction	30
Animal husbandry	29

Amongst the named (i.e. not “other”) issues, increased UV-radiation and vector-borne disease were the least covered, matching the comparatively low numbers of responses covering human health. Human health, though, was covered by more responses than some energy sectors and than the food sector represented by agriculture, animal husbandry, and fisheries.

Climate change as defined by changes in temperature and precipitation, and hence linked to extreme events, were the overwhelmingly dominant issues considered by the responses. That indicates a strong bias towards working with issues that can be most readily quantitatively modelled and with the most readily available data. It would also be important to investigate how the projects considering factors other than temperature and precipitation are conducting these analyses.

Appendix #3 compiles the survey responses by country and sector/issue, so that the issues and sectors being of more influence or less influence in each country could be identified, potentially suggesting areas to target more in specific countries. Lessons learned are provided in Appendix #4, from the 64 responses that provided answers to this question.

Table 2.6 lists the different types of projects. The total adds up to more than 138 because many surveys marked several types. The projects with a research component predominate, with far fewer focused on action in legislatures or on the ground. This result might be an artefact of the audience available for completing the survey, because researchers are more likely to be connected to research-orientated email lists, than policy makers and practitioners. This result might also be indicative of the dominance of research in adaptation work in the Arctic, which is similar to the state of adaptation in some other locations that are just starting to implement adaptation. Further work would be needed to identify the reason.

Table 2.6: Type of project (survey form question 4b)

Category	Type of project	# Responses
Study	Case study	25
	Research project	70
	Assessment	35
Action	Policy	30
	Strategy	26
	Legislation	8
	Regulation	15
	Planning tools	34
	Concrete physical actions	11
	Capacity building	29
	Communication, education and outreach	46

As well, 66 of the responses were classified as only one activity type suggesting a high level of focus for the projects rather than trying to encompass multiple interests, approaches, or outcomes in a single project. Within the single-activity projects, 36 were research, again indicating the survey's bias towards capturing research activities.

2.2. Limitations

The survey is unlikely to be comprehensive from many perspectives. Out of the 138 projects, 7 are under consideration, 75 are ongoing for a finite period, 31 are ongoing for indefinite period, and 25 are completed. The responses are dominated by projects that are currently ongoing, presumably because those are the projects at the forefront of people's thoughts when they are asked to fill in the form.

The survey might also not be comprehensive with respect to projects from several countries and groups who were not able to provide much input or who felt that their input might not be relevant. One comment was that much work in a country is relevant to climate change even though climate change is not the core focus or reason for that work. Hence, survey forms were not completed. The survey did not garner a sense of (i) how much material was collected compared to how much is available or (ii) how comprehensive the survey ought to be in order to reach robust and consistent conclusions.

The bias towards ongoing projects also means that, overall, limited content is available on findings and recommendations (see Appendix #4), since completed projects would provide much more. Even with the completed or nearly completed projects, variation is considerable in length and content of answers for the open-ended questions. Some entries provide 1-2 sentences or a link to a website, whilst others sent detailed material and long lists of references.

Another aspect of the non-comprehensiveness of the survey is differing views regarding the survey's relevance to particular work. Some people filled in the survey form for only those projects near or above the Arctic Circle, matching their definition of "Arctic". Others considered the survey to be relevant for the subarctic or for any project in an Arctic country that could apply to the Arctic region.

Further questions were raised regarding the relevance of projects that were more related to observations only or to climate change impacts, whereas others adopted broad definitions of "vulnerability" and "adaptation". Also on the latter point, some respondents suggested that vulnerability and adaptation should apply to only humans and society, incorporating species and ecosystems where directly linked, but not covering projects that were only about vulnerability and adaptation of nature.

Other biases evident in the data, suggesting more survey limitations are:

- Some projects were sent in more than once by different organizations. Sometimes the entire project was covered, but sometimes different responses covered different parts of the same project. Where duplicate responses from a project were submitted, they were removed, even though some of the data entries were different from different partners. Where different parts of the same project were submitted, they were retained as separate responses.
- Sometimes, the same climate change related process was adopted in different locations, but only one survey form was completed for covering all locations. If each location were considered to be a separate project, then the data reported would change significantly.

- Responses were dominated by people who are comfortable reading and writing in English.
- Responses were dominated by people who have good access to, and who are comfortable using, the internet.
- Several responses were not completed for projects because the project personnel stated that they did not have time.
- Some VACCA participants reported that they were hesitant to submit survey forms because they did not know how the data would be used or interpreted.
- The majority of the projects are research-related or are top-down, suggesting either that many bottom-up and practical endeavours were missed or that research and top-down work dominate Arctic climate change projects.

As such, the data and results presented here cannot be considered to be complete or comprehensive regarding vulnerability and adaptation to climate change in the Arctic. Instead, they are only a first step towards understanding this topic because there are many areas and aspects that need to be more thoroughly detailed. The opportunity exists to continue the work of the survey, especially to overcome the limitations by targeting the areas which might not have been covered in the current work—as long as continuing the survey work would enhance the conclusions and results.

3. SWOC analysis

A SWOC (Strengths, Weaknesses, Opportunities, Constraints) qualitative analysis was selected as being the most appropriate way of interpreting the data (Appendix #5).

3.1. Strengths

The greatest strengths of the survey are the large number and the impressive variety of responses, showing that interest and capacity are increasing for, and are being used to deal with, climate change vulnerability and adaptation in the Arctic. Despite being a minority, the number of community-based projects is also important in demonstrating the bottom-up approaches that are used. Examples are the *W010*, *W011*, *W012 Ealát* projects. The use of local knowledge for dealing with climate change is also highlighted as being particularly important, with projects such as *M010 Inuit Food* exemplifying the necessity and methods of doing so.

The variety of respondents and sectors is important. The respondents demonstrate interest and action from governments (e.g. the Government of Norway's Directorate for Civil Protection and Emergency Planning with *W021 CCA*), researchers (e.g. the University of Alaska Fairbanks with *M053 Alaska Infra*), international organisations (e.g. UNEP/GRID-Arendal with *W017 ECORA*), and non-governmental organisations including indigenous people's groups (some are noted in the previous paragraph). The sectors include comprehensive work on buildings (e.g. *S044 Climate2000*), energy (e.g. *W037 Barents Energy*), fish (e.g. *S043 FishExchange*), and health (e.g. *S021 Nunatsiavut GI* and *S022 Nunatsiavut Water*).

Some projects show valuable integration of local, traditional, and scientific knowledge bases (e.g. *M032 CAVIAR Yukon* and *M047 Polar View*) yielding principles and methods that could be transferable elsewhere in the Arctic and beyond. This balance helps to bring local issues to the international arena such as *S015 NCE* and *W033 NordTrøndelag* focusing on local needs for climate change adaptation using comprehensive and participatory methods respectively that could be emulated elsewhere. *W023 WWFCW* is specifically set up to record local experiences and to publicise those internationally. Meanwhile, national (e.g. *M037 NRTEE*) and international (e.g. *W015 GFORS*) approaches can make their ways to the local level such as through combining art and science to better understand local experiences (e.g. *S034 Arts*); through state-of-the-art modelling of Arctic climate and adaptation processes (e.g. *M012 FINESSI*); and through improved monitoring of Arctic climate and ecosystems (*M042 Palsa*).

The number of policies and programs in place is useful, so that these projects are not just about collecting information. Instead, the information is being applied and used to help people who must deal with climate change. Examples are *M028 Finland WP*, which defines challenges imposed by the Finland's National Adaptation Strategy and the necessary measures to respond to these; *W039 NunaGIS* which suggests making as much geodata-based information available as possible online for Greenland; and *W031 Buying Time* which is producing a manual for building resilience to climate change in natural systems.

Looking at climate change adaptation within the context of other challenges is another strength of the survey. *W029 Barents Stressor* considers climate change as one stressor on the Barents Sea and *S010 Inuvialuit* examines the effects of melting permafrost on infrastructure within the context of other infrastructure challenges in one Canadian Arctic region.

3.2. Weaknesses

One weakness revealed by the survey is the lack of coordination and information exchange regarding initiatives on reducing vulnerability and implementing adaptation to climate change around the Arctic. Irrespective of the number of countries, sectors, or partners involved, few connections to or interchanges with other projects involving similar countries or sectors were explicitly identified. Sometimes, different parties at the same institution are involved in different but related projects, yet few links were obvious.

That is arguably fair if the projects are too different to permit overlap, but there might still be advantages in exchanging information and building on each other's work. The separation is not necessarily the fault of the project personnel. Sometimes funding and staffing mechanisms do not permit ongoing networking and exchange outside the project's remit.

Furthermore, projects continually start and finish and then the staff move on to other work which often results in a loss of institutional memory. This VACCA project (also provided as *W006*) was created to provide such links, but it, too, is temporary and it is dependent on people keeping their own project information up-to-date and using VACCA through their own initiative.

For instance, as discussed above regarding limitations of the survey, there are many more VACCA-relevant projects than responses that were filled in. Some countries, groups, and sectors have limited representation and the fault is rarely theirs. Barriers include language, time to support this form of networking, uncertainty regarding how the collected data would be interpreted and used, and access to the communications means used for disseminating the survey form. Reaching the most isolated people and projects will always present a challenge, but without appropriate effort, those who are already isolated will become even more isolated. An example of a project designed to help overcome this weakness is *S003UArctic Thematic Network*. More work could emulate this project.

The challenge of fragmentation is also seen in the wide diversity of approaches, vocabularies, and interests displayed in the responses. Diversity is not necessarily a weakness; in fact, it is often a strength. However, for an issue-focused project, such as VACCA highlighting climate change, using different approaches, starting points, and phrases can cause confusion and communication difficulties if deliberate effort is not made to overcome those.

From a technical standpoint, the responses demonstrate clear weaknesses of climate change aspects which must be improved to effect appropriate vulnerability reduction and adaptation. Baseline information comparable in different locations through time is lacking for many communities and regions—as evidenced by many responses with differing baseline information or lacking baseline information in their work—hence evaluating the success of projects can pose challenges. As well, there are limited projects which fully connect societal and environmental aspects, apart from projects submitted by indigenous groups. Sometimes, it cannot be clear whether or not climate change is the main issue to consider because climate change is only one of the many social and environmental changes which are affecting the Arctic positively and negatively. The survey also reveals an absence of the private sector, since very few responses had any such involvement apart from project-based consultants. Finally, although many projects implicitly include capacity building along with policy and practice impact, comparatively few projects mentioned such activities explicitly. That suggests that increased awareness is needed on the importance of highlighting that work.

3.3. Opportunities

Many opportunities have emerged from the projects available, most of them through imitating successful aspects of ongoing work. Given the applied research component of many of the projects (e.g. *M052 Upper Yukon*), connections amongst science, implementation, and communication would strengthen work across the Arctic. That encompasses communicating scientific results to non-scientists, basing research on community needs, and ensuring that the scientific results could be used to build capacity for vulnerability reduction and adaptation to climate change (e.g. *W040 Polar Affairs*).

Within that context, significant opportunities exist to deliver and pool baseline observations to facilitate an Arctic-wide assessment of vulnerability and adaptation to climate change, if that were deemed to be useful. Examples of possible contributors would be the data collected by *W009 DAMOCLES* and *S007 Nunavik Access* along with the methods described in *M011 MSV* and *W038 Crow Flats*. Such data, methods, and diverse approaches indicate the importance of and opportunities for transferring ideas and methods across the Arctic region. The higher education approach of *S003 UArctic* illustrates the coordination and networking that could be achieved, as does *S033 Survey*. In particular, opportunities could be considered for conducting multi-country projects in order to combine data and to learn from and exchange with places around the Arctic.

Transfer does not need to take place just within the Arctic. The submissions from Australia, Germany, Japan, and the UK indicate that interest in the Arctic exists from non-Arctic locations and is likely to increase with the expanding realisation that the polar regions represent barometers for climate change that the rest of the world will soon experience. Responses were also received from parts of the USA and Canada not close to the Arctic, such as Colorado, southern British Columbia, and southern Ontario. Therefore, the Arctic could play a leading role in addressing climate change vulnerability and adaptation worldwide, if the region felt that to be appropriate and worthwhile. If useful, that could happen not only by embracing the interest in the Arctic from the non-Arctic, but also by actively pursuing non-Arctic climate change opportunities in order to spread the Arctic's expertise and experience.

Strong opportunities exist to draw on indigenous knowledge to meld with and corroborate the scientific observations regarding dealing with climate change. Some projects were predominantly scientific (e.g. *W020 BlackC*) while others highlighted indigenous knowledge (e.g. *S016 Auyuittuq*) or local knowledge (e.g. *W007 Nature 2020*). These knowledge bases could be further linked—exactly as done by *M007 Nunavut Integrated*—especially through the normal indigenous approach of considering society and the environment together rather than separating them. An excellent example combining indigenous and non-indigenous approaches is *S024 Wetlands* which explores the feasibility of using constructed wetlands for treating wastewater.

Further opportunities exist to link research, policy, and practice. Some of the pure science projects could have significant input into policies and practices, yet the project scope does not cover any listed action. Some policy and practical projects are demonstrating innovative approaches which scientists could benefit from knowing about, yet research or publishing the material in an academic forum is not within the projects' mandates. Other policy and practice projects might benefit from a greater basis in past research and past experience. The VACCA project provides an opportunity to exchange such information.

3.4. Constraints

Time to deal with identified climate change concerns was a major constraint emerging from the responses. It is clear that climate change is already significantly affecting the Arctic but many of the projects do not have the resources to act in the manner in which they wish to act at the speed at which they would prefer to act. Some responses highlighted the urgency of action related to or involving climate change (e.g. *M020 Salluit* with regards to the community's housing), especially in terms of capacity building, but the options were not always available to act faster.

Simultaneously, although somewhat conversely, several projects reveal that another constraint could be trying to do too much too quickly. That is evident in the number and extent of non-climate change challenges noted by the responses. For instance, *052 Upper Yukon* highlights "the economic, institutional, and state and regulatory frameworks that structure and influence everyday activities" as being challenges throughout the Yukon Flats in addition to climate change.

Compiling these responses suggests that tackling climate change should be done within the context of other challenges and opportunities, supporting the conclusions already reached by many involved in climate change topics. A balance should be achieved between (i) lack of speed of action constraining vulnerability reduction and adaptation and (ii) the need for proper time and planning to have adequate information to make appropriate and effective decisions which are not confined to climate change. Given the prominence of climate change in the Arctic, it could constrain knowledge and appropriate action if climate change overshadows other topics, such as by attributing other trends and changes to climate change.

Within that context, limited knowledge of the past is a significant constraint. As noted earlier, the responses tended to highlight ongoing projects with limited input regarding past work. To some extent, it appears as if previously completed work might not be fully accounted for in much ongoing work. That is not the case with all projects. *W001 Nesseby* deliberately builds on past and ongoing work by *S039 CAVIAR Norway*. If that approach were adopted elsewhere, this constraint could be overcome.

The second component of limited knowledge of the past is with regards to data to understand the trends being witnessed. Many of the projects are confined to a contemporary snapshot, rather than involving the context of past decades and centuries of Arctic change. To do so might not be feasible given the lack of long-term baseline data, as noted earlier. Attempts to deal with climate change might therefore be constrained by the lack of historical perspective emerging from the lack of comparable, historic data, both qualitative and quantitative.

Differences in interests and terminology are a further constraint to overcome. The scientific community extensively uses the terms "vulnerability" and "adaptation" even though those terms and concepts are difficult to translate for, and communicate to, many other contexts. Where projects are focused on a place, yet are by people not from that place, competing interests and different communication modes could constrain the project's success.

Finally, significant constraints appears to be the English focus of the survey and its dissemination through English-speaking networks which leaves out many non-Anglophone projects, along with a heavy reliance on the internet which might exclude those who have poor internet access or who are not comfortable with the medium.

4. Questions for discussion

Based on the results, the following questions are asked for further discussion:

1. Should the survey's scope be expanded to overcome the identified limitations and biases?

Future work related to this survey could be completed, including specific mechanisms for targeting the groups and people who are underrepresented in the current survey. Examples could be travel to key institutes by a native speaker of the first language of those institutes, translating the survey form into several non-English Arctic languages, having someone delve into completed projects in order to fill in survey forms for them, and spending time to contact policy and decision makers (rather than researchers) one-on-one to interview them and to fill in survey forms on their behalf. Before embarking on any tasks, it would be useful to have a further indication of how much material is missing, whether or not the analysis is robust irrespective of the missing data, and what level of comprehensiveness might be needed for the survey to move forward with addressing climate change. Would more completed survey forms assist in reducing vulnerability and adapting to climate change in the Arctic? How could any concerns be overcome about the survey and the use of the data?

2. Should there be wider engagement with those not in the Arctic who could contribute to the Arctic?

Climate change is a global concern and different regions might be able to assist each other, not only through exchanging ideas and information but also through collective action. The Arctic could potentially learn and teach through further engagement with those outside the Arctic, as long as the effort would justify the results. That could include those with interests in the Arctic as well as those focused on their own region but who could nevertheless contribute to the Arctic. Examples are places dealing with coastal erosion, less winter freezing, loss of indigenous and local knowledge, and changing species habitats and life cycles. Mountain areas, coastlines, and islands, in particular, have similarities to the Arctic. Yet other mechanisms and fora exist for such interaction. How relevant would such engagement be for the Arctic Council?

3. Is a coordination mechanism or information exchange mechanism needed for Arctic climate change work?

Diversity has advantages, but much work inside and outside the Arctic is being completed in isolation from similar work elsewhere. Sharing ideas, pooling resources, and comparing similar methods in different case studies has strong advantages, but the resources would need to be available to do so along with a focal point that could take a proactive role in fostering these links and collaborations. Would it be appropriate to seek resources to create a coordination mechanism or information exchange mechanism? If so, what form would it take?

4. Should an assessment be undertaken for Arctic climate change vulnerability and adaptation?

ACIA (2005) was groundbreaking in assessing climate change impacts. That report is continually used as a benchmark for its topic. Similar work beyond impacts—covering vulnerability and adaptation—might help in knowing what is being done and what else needs to be done as well as supporting sharing and exchange of ideas, data, projects, policies, and actions. If such an assessment were needed, should the Arctic Council take the lead or would other bodies be more suited to conducting and disseminating it?

5. Should data sources, comparability, and availability be improved?

Much qualitative and quantitative data about Arctic climate change are being collected in many forms, but not always by Arctic partners and not always in a manner which is comparable across case studies or which is accessible to those who ought to have access. Possibilities should be explored to improve this situation—as long as the ultimate goals of such an exercise were clear and agreed upon. Existing databases and inventories should not necessarily be stopped or integrated, but they could be made more available. If such an effort were deemed to be appropriate, then the usefulness and usability of different data sets could be continually evaluated for improvement as part of this work.

5. References

- ACIA. 2005. *Arctic Climate Impacts Assessment*. Cambridge University Press, Cambridge, UK.
- AHDR. 2004. *Arctic Human Development Report*. Edited by N. Einarsson, J. Nymand Larsen, A. Nilsson, and O.R. Young. Stefansson Arctic Institute, Akureyri, Iceland.
- IPCC. 2007. *IPCC Fourth Assessment Report*. IPCC (Intergovernmental Panel on Climate Change), Geneva, Switzerland.

Appendix #1: VACCA survey form

Vulnerability and Adaptation to Climate Change in the Arctic Scoping Study Survey

The Sustainable Development Working Group under the Arctic Council has, on the asking of the Council itself, undertaken a process to identify and share adaptation expertise and best practices and possible actions, unique to the needs and conditions of the Arctic, so that indigenous and other residents can better adapt to climate change. In this regard the project "Vulnerability and Adaptation to Climate Change in the Arctic" (VACCA) has been initiated.

The aim of VACCA is to undertake a scoping study which will collect and disseminate information on the expertise, existing and ongoing research and strategies/measures on adaptation to climate change in the Arctic.

The scoping study will also form basis for the preparation of a background document for a planned workshop in which leading experts, policy makers, working group representatives and key stakeholders will meet and discuss relevant issues related to vulnerability and adaptation to climate change, preparing recommendations for potential future work related to the issue within the Arctic Council.

The following survey questionnaire has been developed with the aim of collecting the appropriate information for this purpose. Relevant experts and contacts within the climate change work of the members and observers of the Arctic Council are hereby encouraged to submit information on relevant activities using the questionnaire below.

The survey questionnaire should be filled in for each identified vulnerability or adaptation activity. An activity in this context is defined as any action, process, project or study initiated to consider issues related to vulnerability or adaptation to climate change in the Arctic.

A. TITLE OF THE ACTIVITY

1. Provide a brief but descriptive title for the activity

B. ISSUES ADDRESSED

2a. Please indicate which issue(s) (consequence for society) the activity addresses

- Water shortage*
- Loss/degradation of land*
- Loss of/changes in livelihoods*
- Change in resource base*
- Damage to human settlements and infrastructure*
- Health related changes*
- Food security*
- Changes in demography*
- Changes in economy*
- Cultural changes*
- Other (please describe):* _____

2b. If relevant, please indicate which of the below issue(s) (impacts of climate change) the activity addresses.

- Changes in temperature*
- Changes in precipitation*
- Changes in wind*
- Increases/changes in extreme events*
- Sea level rise*
- Drought/aridity*
- Flood*
- Permafrost degradation*
- Melting sea ice*
- Avalanches/landslides*
- Coastal inundation/erosion*
- Vector-borne disease*
- Increased UV-radiation*
- Other (please describe):* _____

C. SECTOR

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

- Agriculture*
- Animal husbandry*
- Wildlife management*
- Fisheries (including aquaculture)*
- Water resources*
- Coastal zones*
- Tourism*
- Recreation*
- Human health*
- Non-renewable resource extraction*
- Energy production*
- Energy consumption*
- Infrastructure*
- Natural systems management*
- Protected areas management*
- Other (please describe): _____*

D. TYPE OF ACTIVITY

4a. Please indicate whether the activity considers issues related to vulnerability to climate change or adaptation to climate change.

- Vulnerability*
- Adaptation*

4b. Please indicate whether the activity is best described as a "study" or as an "action" and, if possible, provide further detail by selecting the description in the pull-down list that most appropriately fits the activity.

- | | |
|--|---|
| <ul style="list-style-type: none"><input type="checkbox"/> <i>Study:</i><ul style="list-style-type: none"><input type="checkbox"/> <i>Case study</i><input type="checkbox"/> <i>Research project</i><input type="checkbox"/> <i>Assessment</i> | <ul style="list-style-type: none"><input type="checkbox"/> <i>Action</i><ul style="list-style-type: none"><input type="checkbox"/> <i>Policy</i><input type="checkbox"/> <i>Strategy</i><input type="checkbox"/> <i>Legislation</i><input type="checkbox"/> <i>Regulation</i><input type="checkbox"/> <i>Planning tools</i><input type="checkbox"/> <i>Concrete physical actions</i><input type="checkbox"/> <i>Capacity building</i><input type="checkbox"/> <i>Communication, education and outreach</i> |
|--|---|

E. GEOGRAPHIC LOCATION OF ACTIVITY

5. Please indicate by checking off the appropriate box(es) which country/countries are involved in the activity. You can check more than one country. Provide also name of specific community/communities where appropriate.

5a. Country/countries:

- Canada
- Denmark/Greenland
- Finland
- Iceland
- Norway
- Russia
- Sweden
- USA

5b. Community/communities (specify):

F. STATUS OF ACTIVITY

6. Indicate the status of the activity, whether it is under consideration, ongoing or completed. If it is an ongoing project, please note whether it will be ongoing for a finite or indefinite period.

- Under consideration
- Ongoing
 - Finite period (if possible, note estimated date of completion):
 - Indefinite period
- Completed

G. DESCRIPTION OF ACTIVITY

7. Give a short description of the activity (~200 words). Provide enough details so that others can understand the basic nature of the activity.

H. LESSONS LEARNED

8. *If there already are lessons learned (both positive and negative) from the activity, please briefly outline them. Consider issues such as effectiveness, suitability, opportunities, challenges, barriers, constraints, gaps, etc.*

I. PRODUCTS AND OTHER REFERENCES

9. *Provide information about any products associated with the activity and any other relevant references.*

9a. Products

- Report (title/link):*
- Film (title/link):*
- Website (address):*
- Other (describe):*

9b. Other references (list):

J. KEY CONTACTS

10a. List relevant key persons related to the activity. Provide name, institutional association and an e-mail address where this person can be contacted.

<i>Name</i>	<i>Institution</i>	<i>E-mail</i>

10b. Please provide contact details for yourself (ie. the person who has submitted the information about the activity) in order for us to know whom to contact if we need clarification regarding the input. This information is solely for the use of the project team and will not be distributed further.

<i>Name:</i>	
<i>Institution:</i>	
<i>E-mail address:</i>	

Norway is responsible for the implementation of the SDWG Climate Adaptation and Vulnerability Scoping Study. Ms. Birgit Njåstad at the Norwegian Polar Institute has been designated project leader. If you have any questions regarding the survey which cannot be answered by the person who sent you this survey, you can contact Birgit at:

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Norway

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Appendix #2: Survey responses submitted

Project #	Short Title	Full Title
M003	FINADAPT	Assessing the adaptive capacity of the Finnish environment and society under a changing climate
M006	Pribilof	Pribilof Islands Climate Change Vulnerability Assessment
M007	Nunavut Integrated	Integrated Assessment of Climate Change Impacts and Adaptation Options in Nunavut Communities
M010	Inuit Food	Impacts of environmental changes on traditional food security of Inuit
M011	MSV	Many Strong Voices – Climate Change Impacts and Adaptation in the Arctic and Small Island Developing States
M012	FINESSI	Integrated assessment modelling of global change impacts and adaptation
M013	Finland Strategy	Finland's National Strategy for Adaptation to Climate Change
M014	ISTO	Climate Change Adaptation Research Programme ISTO
M015	Finland Energy	Government foresight report on climate and energy policy
M016	ASTRA	Developing Policies & Adaptation Strategies to Climate Change in the Baltic Sea Region
M017	Finland Roads	Adaptation to climate change in the road management; Prestudy
M018	Finland Power	Climate Change in Planning and Building of the Power-Distribution Network
M019	Espoo	Assessment of the Preparing for Climate Change in the City of Espoo
M020	Salluit	Salluit: Analysis of significant climatic events relevant to public safety and town planning and assessment of their future frequency and intensity
M022	Uusimaa	Climate Strategy for the Uusimaa region
M023	MIL Forests	Functioning of forest ecosystems and use of forest resources in changing climate (MIL) –research program
M024	Finland Comms	Finland's Climate Change Communications Programme
M025	Uusimaa2020	The Environmental Program 2020, Uusimaa Regional Environment Centre
M026	AFLRA	Promoting Adaptation to Climate Change in Municipal Sector (Association of Finnish Local and Regional Authorities)
M027	YTK	Climate Change in Community Planning -information package (Centre for Urban and Regional Studies (YTK))
M028	Finland WP	A Work Programme on Adaptation to Climate Change (The Ministry of the Environment)
M030	Metsähallitus	Assessment of climate change in Finnish state-owned land and water areas, Metsähallitus, Finland
M031	PALSALARM	Global change impacts on sub-arctic palsa mires and greenhouse gas feedbacks to the climate system
M032	CAVIAR Yukon	"Climate change, vulnerability and institutional capacity in

		the City of Whitehorse": A case study the IPY funded "Community Adaptation Vulnerability in Arctic Regions Project"
M033	Canada Disasters	Disaster management and climate change adaptation policy in the Canadian North
M035	Canada Codes	The role of codes, standards and related instruments in enabling better management of climate change-related risks in respect of Canada's northern physical infrastructure
M036	Canada Infra	Understanding the significance of insurance, alternative risk spreading mechanisms, and related public policy for management of physical infrastructure in the face of climate change
M037	NRTEE	Program on Climate Change Adaptation Policy National Round Table on the Environment and the Economy
M038	Nunavut Capacity	Capacity for Adaptive Planning in Nunavut Communities
M039	Norway BioAssess	Assessment of effects of climate change on ecosystems and biodiversity in Norway
M040	Norway BioData	Database for projects and results on effects of climate change on ecosystems and biodiversity in Norway
M041	Norway Nature	Assessment of possible nature management measures to counteract effects of climate change
M042	Palsa	Monitoring of palsa mires
M043	Noradapt	Community Adaptation and Vulnerability in Norway
M044	Norway Workshop	Workshop on Adaptation to climate change in the Arctic, 26-27 June 2006, Oslo. Hosted by MFA, organised by CICERO
M046	Transport	Climate knowledge in the transport sector
M047	Polar View	Earth Observation for Polar Monitoring
M048	AWRVI	Arctic Water Resources Vulnerability Index (AWRVI) project
M049	IGERT	The University of Alaska Fairbanks (UAF) Resilience and Adaptation Program (RAP): An NSF sponsored Integrated Graduate Education and Training Program (IGERT)
M050	ACCAP	Alaska Center for Climate Assessment and Policy (ACCAP): A NOAA sponsored Regional Integrated Sciences and Assessments (RISA) Program
M051	Tundra Lakes	Tundra Lakes: Terrestrial water balance affecting tundra travel & access to resources
M052	Upper Yukon	The Synergistic Effects of Climate Change and Land Use in the Upper Yukon River Watershed
M053	Alaska Infra	Estimating Future Costs for Alaska Public Infrastructure at Risk to Climate Change
M054	CC Alaska	Climate Change in Alaska project
M055	USGCRP	Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change. Produced by the activities of the U.S. Global Change Research Program.
M056	Pew	A Pew Center series by on Global Climate Change Within this research series is the Alaska Climate Plan.

M057	ConsSol	Alaska Conservation Solutions
M058	Sub Cabinet	Alaska Climate Change Sub-Cabinet within the Alaska Governor's office (State Executive Branch)
M059	Alaska CIAC	Joint Alaska Climate Impact Assessment Commission (State Legislative Branch)
M060	North by 2020	North by 2020: A Forum for Local and Global Perspectives on the North
M061	Alaska SocVuln	Social Vulnerability to Climate Change in Alaskan Coastal Communities
M062	Sea Ice	Meeting Stakeholder Sea Ice Information Needs In A Changing Climate (Alaska Center for Climate Assessment & Policy)
M063	Newtok	Village of Newtok Relocation Planning and Action Group
M064	Rangifer	Heterogeneity and Resilience of Human-Rangifer Systems: A Circumpolar Social-Ecological Synthesis
M065	Knowledge Co-op	Arctic Borderlands Ecological Knowledge Co-op
S003	UArctic	University of Arctic Thematic Network on Global Change in the Arctic
S004	NWT Plan	NWT Climate Change Impact and Adaptation Plan
S007	Nunavik Access	Climate change in Nunavik: Access to territory and resources
S008	EcologyNorth	Climate Change Adaptation Awareness and Policy Development
S009	RADARSat	Community-based sea ice and weather forecasting and implementation of RADARSAT Ice Floe Edge Service
S010	Inuvialuit	The Impacts of Climate Change on the Availability of Granular Resources in the Inuvialuit Settlement Region, NWT.
S011	CAVIAR Canada	Community Adaptation and Vulnerability in Arctic Regions (CAVIAR)
S013	Atlin	Preparing for Change. Managing Climate Change Risks in the Atlin Area
S015	NCE	NCE Community Adaptation Project
S016	Auyuittuq	Inuit Perspectives on Land Use Safety in and around Auyuittuq National Park, Nunavut
S017	NEI	Northern Ecosystem Initiative- we are a Environment Canada (Government of Canada) program funding research across the Canadian North
S019	Clyde/Hall	Climate Change Adaptation Action Plans for Clyde River and Hall Beach
S021	Nunatsiavut GI	Climate change, water quality, and gastrointestinal illness in Nunatsiavut, Canada
S022	Nunatsiavut Water	1) Drinking water and potential threats to human health in Nunavik : adaptation strategies under climate change conditions 2) Drinking water quality and climate change in Nunatsiavut : a pilot project for two Inuit communities
S023	Ecosystems	(no title provided)

S024	Wetlands	Assessing the efficacy of constructed wetlands for treatment of municipal wastewater.
S025	Yukon	(no title provided)
S026	Canada Policy	Developing policy to facilitate adaptation to climate change impacts.
S027	Boreal	Climate change adaptation and sustainable forest management in the boreal forest
S028	Polar Bear	Expert assessment of the uncertainties of polar bear population dynamics under climate change
S030	Beyond IPY	International Symposium: Looking beyond the International Polar year. Emerging and re-emerging issues in International Law and Policy in the Polar Regions
S031	Alaska Integrated	Integrated Assessment of Climate Change Impacts and Adaptation on the North Slope of Alaska
S032	Bering	Climate change impacts on traditional hunting and gathering practices in the Bering Sea area
S033	Survey	Survey of adaptation activities, policies, measures in northern countries including the Canadian arctic and Norway, Finland and Sweden for opportunities and comparison with climate challenges in Alaska and its adaptation efforts.
S034	Arts	Arts/Science collaborative expeditions to the Arctic
S035	Insurance	Understanding the significance of insurance, alternative risk spreading mechanisms, and related public policy for the risk management of physical infrastructure in the face of climate change
S036	Permafrost	Permafrost Test Section - Alaska Highway km 1928. (full scale testing of various adaptive techniques to mitigate highway distress due to melting of ice-rich permafrost)
S037	Oslo	Adapting to climate change in the Oslo-region (Norway)
S038	Rainy Day	Preparing for a rainy day: Configuring climate science for future society
S039	CAVIAR Norway	CAVIAR - community adaptation and vulnerability in Arctic regions
S040	Maps	Research project on the geography of social vulnerability, environmental hazards and climate change in Norway and middle Norway in particular
S041	Power stations	Director, Emissions Trading Authority at the Federal Environment Agency, Berlin, providing the administrative infrastructure for CO2-emissions trading in Germany; previously international climate change negotiator for Germany, with academic interest in Arctic affairs (law)
S042	Halogens	Observation of halogenated climate gases in the Arctic
S043	FishExchange	FishExchange- Expected change in the fisheries in the Barents Sea (a Norwegian Research Council-NORKLIMA project)
S044	Climate2000	Climate 2000 - Impact of climate change on the built environment

S046	Eider	Inuit, Eider Ducks and Sea Ice: Implications of environmental change in Hudson Bay
W001	Nesseby	Nature relations and perceptions of Weather in Nesseby, a coastal Sámi community in Norway
W002	ACTOR	Arctic Climate Change, Tourism, and Outdoor Recreation
W003	Russian1	Многолетний мониторинг изменений параметров многолетней мерзлоты и ресурсов грунтовых вод под воздействием глобального климатического потепления
W004	ClimATIC	Climate Change - Adapting to The Impacts, by Communities in Northern Peripheral Regions (Clim-ATIC)
W005	ArcAct	Unlocking the Arctic Ocean: The climate impact of increased shipping and petroleum activities
W006	VACCA	Vulnerability and Adaptation to Climate Change in the Arctic
W007	Nature 2020	The future of Norway's natural and cultural heritage: applying scenario, foresight and forecast methodologies within an ecosystem context
W008	Extreme	Adapting to extreme weather events in municipalities.
W009	DAMOCLES	Developing Arctic Monitoring and Observing Capabilities for Long-term Environmental Studies. EU 6th Framework Integrated Project and an EU contribution to IPY 2007-2008
W010	Reindeer Portal	IPY EALÁT-Outreach Reindeer Portal: Reindeer herding and climate change. (Reindeer Herders Vulnerability Network Study: Reindeer Pastoralism in a Changing Climate.)
W011	Reindeer Info	SDWG EALÁT-Information: Reindeer herding, traditional knowledge and adaptation to climate change and loss of grazing land
W012	Reindeer Comm	IPY EALÁT-Outreach Community-based workshops: Reindeer herding and climate change. (Reindeer Herders Vulnerability Network Study: Reindeer Pastoralism in a Changing Climate.)
W013	Municipal	Municipal actions in adaptation and mitigation
W014	Waterfront	Adaptation and Mitigation in Urban Planning and Waterfront Development
W015	GFORS	Governance for Sustainability
W016	Social Justice	Climate change and social justice
W017	ECORA	An Integrated Ecosystem Management Approach to Conserve Biodiversity and Minimise Habitat Fragmentation in Three Selected Model Areas in the Russian Arctic
W018	Fish	Investigation of how climate change might affect the fishing industry in Norway
W019	Elec	Three linked projects: CELECT: climate change impacts in the electricity sector (Under NRC's program NORKLIMA); ICEPS: Impacts of Climate Change and Energy Policies in the Electricity Sector (Under NRC's program RENERGI), and ADAM: Adaptation and

		Mitigation in Europe (under EU's 6th framework program). All with partners, analyse how mitigation and adaptation influences the electricity sector, both through demand and supply.
W020	BlackC	Climate effects of reducing black carbon emissions
W021	CCA	Norwegian climate adaptation program (a national response to climate change which aims to assist responsible authorities in their effort to adapt to climate changes)
W022	PhenoClim	PhenoClim - "Effects in Sapmi" – part of Phenology as an indicator of climate change effects
W023	WWFCW	Climate Witness is WWF's ongoing initiative to document the impacts of climate change on people and communities around the world and use the power of their stories to urge governments, business and individuals to take necessary actions to avoid dangerous climate change.
W024	Norway CC	Climate Change Impacts, Vulnerability, and Adaptation in Norway
W025	Stormwater Roads	Stormwater and roads - dimensioning for climate change (2007-2009)
W026	Airports Roads	Pollution risks and water management at airports and roads in a changing climate (2005-2008)
W027	Sectors	Towards assessing socioeconomic impacts of climate change in Norway: Sensitivity in the primary sectors: fisheries, agriculture and forestry
W028	Transport	Research and development program "Climate and Transport" 2007 – 2010, financed and managed by Norwegian Public Roads Administration
W029	Barents Stessor	Climate Vulnerability in the Barents Sea Ecoregion: A Multi-Stressor Approach
W030	Oil	Research Synthesis
W031	Buying Time	BUYING TIME: A User's Manual for Building Resistance and Resilience to Climate Change in Natural Systems
W032	Institutional	Institutional adaptation to climate change
W033	NordTrøndelag	Nord-Trøndelag fylkeskommune: Temadag om flom og rassikring; 9.mai 2006
W035	PLAN	(no title given)
W034	Troms	Action Plan – cross-sectoral actionplan on clima changes, Troms fylkeskommune 2007 -2010
W036	NorACIA	NorACIA Temagruppe 4, Virkninger på folk og samfunn
W037	Barents Energy	Energy / Environment / Climate in the Barents region. Bilateral project on industrial cooperation between Västerbotten and Norrbotten in Sweden and Karelia and Murmansk in Russia. Focus on renewable energy supply for heating of houses and also waste management system.
W038	Crow Flats	International Polar Year (IPY) project: Environmental Change and Traditional Use of the Old Crow Flats in Northern Canada
W039	NunaGIS	NunaGIS; a web-GIS passed system for geodata in Greenland including data related to climate change

W040	Polar Affairs	Bringing together science, impacts, policy and law, politics, economics, and ethics and equity for both polar regions together.
W041	NSFRPP	Climate Change Adaptation in Norway, Sweden, and Finland – Do Research, Policy and Practice Meet?
W042	WMOWCRP	WMO/WCRP/IPY Workshop on CLIPS in Polar Regions: Climate product generation, user liaison and training.
W043	CCCRP	Climate Change Community Response Portal.
W044	Julia2030	Mitigation of and Adaptation to the Climate Change in the Helsinki Metropolitan Area – From Strategy to Implementation (Julia 2030).
W045	VACCIA	Vulnerability assessment of ecosystem services for climate change impacts and adaptation.
W046	temp health	Climate change and temperature related health effects.
W047	UVEUR	UV radiation over Europe (COST Action 726 and SCOUT-O3 EU project).

Appendix #3: Survey responses by country and sector/issue

Each table cell provides the total number of survey responses matching the combination of country with issue or sector.

	Canada	Denmark /Greenland	Finland	Iceland	Norway	Russia	Sweden	USA	Other
Survey form question 2a: Climate change issues									
Water shortage	14	5	9	4	9	4	5	11	0
Loss/degradation of land	23	8	12	6	24	10	9	22	1
Loss of/changes in livelihoods	25	10	18	8	29	12	11	27	2
Change in resource base	22	8	18	6	31	14	9	26	1
Damage to human settlements and infrastructure	24	8	24	6	27	8	9	21	2
Health related changes	19	6	12	5	14	7	8	11	1
Food security	22	7	12	7	17	11	9	20	1
Changes in demography	10	4	7	4	16	7	5	11	0
Changes in economy	16	8	17	8	28	12	10	20	2
Cultural changes	22	9	9	7	22	8	9	21	2
Other	23	13	20	9	31	14	14	27	3
Survey form question 2b: Climate change issues									
Changes in temperature	35	12	29	10	47	14	15	31	1
Changes in precipitation	31	10	26	9	43	13	12	28	1
Changes in wind	23	7	16	7	32	10	10	16	1
Increases/changes in extreme events	31	9	25	8	41	11	11	24	1
Sea level rise	20	8	14	6	27	6	8	15	2
Drought/aridity	11	4	13	4	17	4	6	15	0
Flood	22	7	21	5	33	6	9	17	3
Permafrost degradation	29	11	15	8	25	10	14	26	2
Melting sea ice	31	13	15	9	24	12	13	22	2
Avalanches/landslides	19	8	8	6	22	6	9	11	1
Coastal inundation/erosion	20	7	10	5	23	7	9	18	1
Vector-borne disease	11	4	6	4	16	4	6	7	0
Increased UV-radiation	9	4	9	4	11	4	6	7	0
Other	15	8	16	6	16	10	11	17	1
Survey form question 3: Sectors									
Agriculture	7	6	10	4	15	4	5	13	0
Animal husbandry	7	5	12	6	20	10	9	14	1

Wildlife management	21	11	19	8	25	13	11	24	1
Fisheries (including aquaculture)	12	9	12	7	24	12	10	20	1
Water resources	17	8	17	5	22	7	7	19	0
Coastal zones	16	8	14	6	27	9	9	23	1
Tourism	14	9	20	7	23	9	11	16	2
Recreation	8	6	15	5	14	4	7	11	1
Human health	19	6	14	5	13	6	8	14	1
Non-renewable resource extraction	9	8	11	8	17	12	10	16	1
Energy production	12	9	19	8	19	10	11	14	1
Energy consumption	10	4	12	4	11	4	5	9	0
Infrastructure	21	10	29	8	32	11	10	20	1
Natural systems management	20	12	23	8	29	14	12	26	1
Protected areas management	13	8	15	5	17	8	8	18	1
Other	14	4	10	4	15	3	6	9	2
	Canada	Denmark /Greenland	Finland	Iceland	Norway	Russia	Sweden	USA	Other

Each table cell provides the normalised number of survey responses; that is the number of responses in the table cell divided by the total number of responses for the country.

	Canada	Denmark /Greenland	Finland	Iceland	Norway	Russia	Sweden	USA	Other
Survey form question 2a: Climate change issues									
Water shortage	0.30	0.26	0.21	0.29	0.15	0.17	0.24	0.27	0,00
Loss/degradation of land	0.49	0.42	0.28	0.43	0.41	0.43	0.43	0.54	0,20
Loss of/changes in livelihoods	0.53	0.53	0.42	0.57	0.49	0.52	0.52	0.66	0,40
Change in resource base	0.47	0.42	0.42	0.43	0.53	0.61	0.43	0.63	0,20
Damage to human settlements and infrastructure	0.51	0.42	0.56	0.43	0.46	0.35	0.43	0.51	0,40
Health related changes	0.40	0.32	0.28	0.36	0.24	0.30	0.38	0.27	0,20
Food security	0.47	0.37	0.28	0.50	0.29	0.48	0.43	0.49	0,20
Changes in demography	0.21	0.21	0.16	0.29	0.27	0.30	0.24	0.27	0,00
Changes in economy	0.34	0.42	0.40	0.57	0.47	0.52	0.48	0.49	0,40
Cultural changes	0.47	0.47	0.21	0.50	0.37	0.35	0.43	0.51	0,40
Other	0.49	0.68	0.47	0.64	0.53	0.61	0.67	0.66	0,60
Survey form question 2b: Climate change issues									
Changes in temperature	0.74	0.63	0.67	0.71	0.80	0.61	0.71	0.76	0,20
Changes in precipitation	0.66	0.53	0.60	0.64	0.73	0.57	0.57	0.68	0,20
Changes in wind	0.49	0.37	0.37	0.50	0.54	0.43	0.48	0.39	0,20

Increases/changes in extreme events	0.66	0.47	0.58	0.57	0.69	0.48	0.52	0.59	0,20
Sea level rise	0.43	0.42	0.33	0.43	0.46	0.26	0.38	0.37	0,40
Drought/aridity	0.23	0.21	0.30	0.29	0.29	0.17	0.29	0.37	0,00
Flood	0.47	0.37	0.49	0.36	0.56	0.26	0.43	0.41	0,60
Permafrost degradation	0.62	0.58	0.35	0.57	0.42	0.43	0.67	0.63	0,40
Melting sea ice	0.66	0.68	0.35	0.64	0.41	0.52	0.62	0.54	0,40
Avalanches/landslides	0.40	0.42	0.19	0.43	0.37	0.26	0.43	0.27	0,20
Coastal inundation/erosion	0.43	0.37	0.23	0.36	0.39	0.30	0.43	0.44	0,20
Vector-borne disease	0.23	0.21	0.14	0.29	0.27	0.17	0.29	0.17	0,00
Increased UV-radiation	0.19	0.21	0.21	0.29	0.19	0.17	0.29	0.17	0,00
Other	0.32	0.42	0.37	0.43	0.27	0.43	0.52	0.41	0,20
Survey form question 3: Sectors									
Agriculture	0.15	0.32	0.23	0.29	0.25	0.17	0.24	0.32	0,00
Animal husbandry	0.15	0.26	0.28	0.43	0.34	0.43	0.43	0.34	0,20
Wildlife management	0.45	0.58	0.44	0.57	0.42	0.57	0.52	0.59	0,20
Fisheries (including aquaculture)	0.26	0.47	0.28	0.50	0.41	0.52	0.48	0.49	0,20
Water resources	0.36	0.42	0.40	0.36	0.37	0.30	0.33	0.46	0,00
Coastal zones	0.34	0.42	0.33	0.43	0.46	0.39	0.43	0.56	0,20
Tourism	0.30	0.47	0.47	0.50	0.39	0.39	0.52	0.39	0,40
Recreation	0.17	0.32	0.35	0.36	0.24	0.17	0.33	0.27	0,20
Human health	0.40	0.32	0.33	0.36	0.22	0.26	0.38	0.34	0,20
Non-renewable resource extraction	0.19	0.42	0.26	0.57	0.29	0.52	0.48	0.39	0,20
Energy production	0.26	0.47	0.44	0.57	0.32	0.43	0.52	0.34	0,20
Energy consumption	0.21	0.21	0.28	0.29	0.19	0.17	0.24	0.22	0,00
Infrastructure	0.45	0.53	0.67	0.57	0.54	0.48	0.48	0.49	0,20
Natural systems management	0.43	0.63	0.53	0.57	0.49	0.61	0.57	0.63	0,20
Protected areas management	0.28	0.42	0.35	0.36	0.29	0.35	0.38	0.44	0,20
Other	0.30	0.21	0.23	0.29	0.25	0.13	0.29	0.22	0,40
	Canada	Denmark /Greenland	Finland	Iceland	Norway	Russia	Sweden	USA	Other

Appendix #4: Categories for lessons learned from the responses

64 of the responses reported lessons learned. This appendix consolidates those lessons into general points, deliberately not making them sector-specific or project-specific even when they were reported as such. Instead, the points consolidate and group many of the themes within the lessons learned that appeared in the responses.

The lessons are clustered into two groups based on the titles of the workshop panels, but significant overlap exists for all categories.

Local approaches to vulnerability and adaptation to climate change

National initiatives supporting local climate change adaptation

- Climate change does not occur in isolation from other stresses, but the various stresses interact. Effective adaptation strategies address other stresses in conjunction with climate change. Adaptation is hindered by existing community weaknesses, but is also assisted by existing community strengths. Considering all stresses, with climate change as one that interacts with the others, can help in tackling the weaknesses while maintaining the strengths.
- The Arctic is diverse and complex, including the ecosystems, cultures, and governance. Lessons or approaches are contextual and might not be generalisable.
- Uncertainties surrounding climate change impacts influence strategies for vulnerability and adaptation. The best approach is to ensure that climate change factors are incorporated into decision processes as much as possible in such a way that the uncertainties are accounted for or that management techniques in the face of uncertainties are used.
- Often, it is known what needs to be done, but the capacity or resources do not exist to do it. Decision-making should be strategic rather than reactive and adequate resources need to be available to proceed.
- Environmental monitoring systems of diverse forms are needed so that observations can input into strategies.

Exchange, teaching, and learning for climate change

- Partnerships amongst all people and all sectors are needed. These partnerships should include scientists, planners, community groups, community members, and governments amongst many others. Consultation should be completed before acting with all these partners to involve them in developing policies and strategies. Top-down imposition does not work, so approaches should be locally-based. As part of the partnerships, knowledge acquired in or from a community should be returned to that community to help the people there.
- Often, information is available, but those who need it do not know that it is available or cannot access it. Improved dissemination of, availability of, and access to material would help.
- More awareness is needed about climate change and how to tackle it.
- Materials for and approaches to education, communication, and training need to be tailored for different audiences and different venues and made available to them.
- Not all aspects of climate change will be negative. There will be winners and losers. Yet all is not lost for the losers. There are always actions that can be taken, but the time is now to start systematically working out what actions to take, by whom, and where.
- Various tools should be used to deal with climate change, including indigenous knowledge, art, science, and insurance. Combinations are needed, such as systematic monitoring plus

giving equal respect to local anecdotes and local knowledge; such as involving governance at all levels; and such as using storytelling in small groups and websites with technical information. No single approach can be successful. Together, they strengthen vulnerability reduction and adaptation activities.

Appendix #5: Background to SWOC

From T. Corsellis and A. Vitale. 2005. *Transitional Settlement: Displaced Populations*. Oxfam, Oxford, U.K., p. 179.

Full text downloadable from:

http://www.sheltercentre.org/shelterlibrary/items/pdf/Transitional_Settlement_Displaced_Populations_2005.pdf

Section 4.5.6: Strengths, Weaknesses, Opportunities, and Constraints (SWOC)

SWOC (also known as SWOT – Strengths, Weaknesses, Opportunities, and Threats – analysis) provides a framework for group analysis of a given situation. It encourages input from many people, helps people to brainstorm potential solutions (opportunities) and constraints, and is a way of gathering information that can be useful in problem analysis, monitoring, and evaluation.

The idea is to brainstorm under the following headings:

- Strengths: what has worked, why it worked; lessons learned for the future.
- Weaknesses: what has not worked very well; times when things could have gone better.
- Opportunities: ideas for how to overcome weaknesses and build on strengths.
- Constraints: the constraints that reduce the range of opportunities for change.