

Integrating and Translating ArcticNet Science for Sustainable Communities and National and Global Policy and Decision-Making

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Abstract

Ecological changes, economic strains, cultural transformations and other factors are causing multiple stresses for the Indigenous peoples of the Arctic. The best available information, based on contemporary science and community and traditional knowledge (TK), must be used to ensure that Canadian Inuit, circumpolar Inuit and all Canadians make policy decisions that will contribute to sustainable development in the Arctic and the well-being of Arctic peoples. This research project is comprised of a series of case studies or sub-projects that provide insight to processes of decision making in different regions of Northern Canada. Our primary focus is to describe relationships within the Arctic policy landscape to in order to understand how ArcticNet science and IK/IQ (Inuit Knowledge) contributes to informing policy. There are several critical factors that influence this process of transformation of science or IK/IQ into policy and decision making action in the North. The case studies that contributing to our analysis reflect the diversity of Arctic policy interests. The ArcticNet scientific program contributes to inform policy decisions in Canada and globally. Conclusions from these case studies will help ArcticNet address policy makers in the most effective ways to use and translate ArcticNet research results on urgent issues (such as climate change), into 'action' or decision-making at the local, region, national or international levels and to understand the factors that influence this translation process. Recommendations are being generated from these studies to address the changing physical, political, social, economic, and cultural reality of the Arctic, and to identify information needs among decision-makers in Canada and the international community to make informed decisions on topics pertaining to Arctic climate and other forms of change. This project will contribute to our present knowledge on how to improve the use, translation and transformation of research results into sound policy or accessible and compelling information for decision support.

Key Messages

ArcticNet research has direct and indirect influences on decision making and policy that may be perceived at several levels. Tracing the flow of ArcticNet research outcomes into policy (and Arctic science into policy in general) has been measured using 3 approaches in this project. The first explores the ways in which ArcticNet has been recognized by federal and territorial governments that have responsibility for both decision-making and funding research. The second approach has focused on case studies where it is possible to improve understanding of how to improve the use, translation and transfer of scientific research results and TK/IQ into sound policy in a variety of different Arctic science-policy interface contexts, primarily at the local scale. The third and final way has been through surveying decision-makers at various scales about how they integrate research into decision-making and policy and the various barriers and facilitators they note in this process. The following conclusions have emerged from this research thus far:

- The time-lags in effective translation and uptake of research results are substantial and may be the result of several factors. Common factors that influence the knowledge translation process include the scope of the relevant scientific domain to current decision making issues and priorities, the thematic focus of the research within the science-policy interface, the accessibility of data, the history of the research paradigm and the practical relevance of the research for various users within society. Scientists and decision makers need to support each other in identifying the most effective ways to use and translate research results on urgent issues, such as climate change, into action at the local, region, national and international levels.
- An a priori understanding of the science-policy process may facilitate the design of research and results communication processes to enhance the likelihood of results/information use beyond the science community.
- There is a growing interest and body of literature on factors influencing the science-policy interface

and models that are useful for understanding the relationships from which best practices or lessons learned can be drawn. Many of these are applicable to ArcticNet and other northern science initiatives but have not yet garnered much attention.

- ArcticNet has limited visibility in Parliamentary records and Arctic research outcomes do not always make reference to ArcticNet as a source of funding or collaboration.
- Climate ‘knowledge’ and perception of change at the local level is drawn from a variety of sources, including land-based knowledge and personal observation of changes, scientific knowledge, and spiritual understandings of change.
- Institutions play an important mediating role in access to knowledge at the local level and in translating local knowledge for acceptance and utilization in regional and global scientific reports and policymaking.
- An effective science policy is most likely to be driven from a regional perspective, rather than by national agencies. Local (community or territorial) interest in and support for science is greatest when it addresses a local perception of risk and when it generates multiple sector outcomes, including employment opportunities for community residents.
- Knowledge is often presented or disseminated to various stakeholders very differently. Differences in capacity within stakeholder or knowledge user groups significantly influences the intention to translate and use or actual ability to translate and use the knowledge and this can lead to confusion or misinterpretation of information available (i.e. state of the art science and technology of offshore oil exploration). Attempts to level the knowledge playing field amongst the stakeholders would ensure more efficient decision making and partnership building and potentially, scientific knowledge use in decision making in the end.
- Ensuring all stakeholders can play a role in

a decision making process requires that they have access to the same information. We are examining how this process has evolved in different jurisdictions across northern Canada, in particular the development of territorial science plans and priorities.

- Ensuring confidence in research results and analysis as well as impartiality is paramount. Efforts to ensure transparency of methodologies and results is critical to building trust and confidence in the resulting knowledge, especially in resource sector projects and projects funded through the lens of a particular interest.
- Institutions and departments at the territorial level often lack sufficient organizational infrastructure and support for knowledge uptake and sharing; this challenge is exacerbated by a decentralized government structure. Key issues include high level of staff turnover at project management level, and lack of support for climate change initiatives by senior level staff.

Objectives

The objectives of this project are focused on obtaining a clearer understanding of where and how science outcomes have greatest impact and influence on the Arctic policy landscape at different levels, particularly in relation to climate change and adaptation. These objectives are being addressed at three scales: an integrative scale that examines the overall science-policy landscape in the context of ArcticNet contributions; a Case Study scale where the specific and often local impacts of research can be linked to decision-making and policy; and through a set of key informant interviews were linkages between research outcomes and policy can be described and quantified.

- Examine the current policy and decision making context in which ArcticNet operates, and to provide recommendations for enhancing future knowledge translation activities. In 2012-2013 we focused on completing the analysis of media and Hansard records, and synthesis of science-policy documentation.

- Identify critical policy connections or decision making relationships through which ArcticNet may best be able to fulfill its objectives of “contributing to the development and dissemination of the knowledge needed to formulate adaptation strategies and national policies to help Canadians face the impacts and opportunities of climate change and globalization in the Arctic”. In 2012-2013, several of our Case Study activities were completed and/or are in the process of being finalized and prepared as manuscripts.
- Describe key Arctic climate related policy issues (e.g. human adaptation and challenges of importance to Inuit and other northerners, and sovereignty) and current Arctic policies relevant to these issues to determine if gaps exist in current policies and how to best apply available scientific information relevant to such policies. In 2012-2013, ICC continued to examine how ArcticNet research outcomes have influenced policy development around oil and gas exploration in the Arctic.
- Specifically determine how ArcticNet-generated information can be integrated into policy decision-making processes. This is being done via the conduct of case studies from both an examination of the ongoing IRIS process and from work conducted during Phase I (Project 4.7) of ArcticNet.
- Contribute to the body of work on the ‘science policy interface’ to make recommendations for improved information exchange between scientists and decision-makers. A particular focus here is the potential efficacy of adaptation strategies in Canada’s northern communities, as these strategies are informed through IRIS mechanisms currently being developed by ArcticNet. In 2012-2013, we also undertook an analysis of the role of ‘science advisors’.
- To identify the information needs of northern decision makers and leaders to assist in the development of policies, strategies and approaches to Arctic regional, or national

decision making on climate change issues. This information will specifically inform future IRIS methodology and the ArcticNet integrated assessment.

- Through the integration of sub project results and lessons learned, develop/adapt a new model for understanding science-policy linkages across different scales of organization (from local, regional, national and global perspectives). These are outcomes that can be used to shape future national and international interdisciplinary research programs like Future Earth. This synthesis and integration is the final piece of this project and will be drafted in 2013-14.

Introduction

From the very beginning of the program, ArcticNet has articulated a need to identify critical policy connections or decision making relationships through which ArcticNet research may best be able to fulfill its objectives of contributing to the development and dissemination of the knowledge required to formulate adaptation strategies and local, regional, national and international policies to help Canadians face the impacts and opportunities of climate change and globalization in the Arctic. The policy relevance of Arctic science is being both highlighted and questioned by different users, and the activities of ArcticNet provide a critically relevant context within which to increase our collective understanding of how to make these science to policy linkages more effective and meaningful (Hik 2009).

Significant environmental change is being observed in all parts of the Arctic system - physical, biological and human. Scientific research links these changes to a number of global environmental issues (IPCC, 2007). With the intermittent and increasingly frequent opening of the Northwest Passage and Arctic Ocean shipping routes, increases in non-renewable resource extraction and heightened pressure on issues of sovereignty, the Arctic is becoming a significantly more important geopolitical region globally. It is

projected that this new Arctic will represent a space of even greater national and international significance than was the case during the cold war.

Ecological changes, economic strains, cultural transformations and other factors represent multiple stresses for the people of the Canadian Arctic as well. More specifically, climate change and variability will dramatically impact the environment, culture and identity of Inuit and ultimately the face of Canada. However, not all changes may be negative, and some new opportunities may be created (e.g. Furgal and Prowse, 2008). But, the challenges and opportunities created by climate change must be met with sound policy decision-making. The best available information, based on contemporary science and community and traditional knowledge (TK), must be used to ensure that Canadian Inuit, circumpolar Inuit and all Canadians make appropriate and sustainable decisions with regard to the Arctic and its future.

The scientific knowledge currently being generated by large programs such as the Northern Contaminants Program (NCP) and ArcticNet, and that produced results under the years of the International Polar Year (IPY) program, will help ensure that Arctic policy decisions are informed and contribute to sustainable development in the Arctic and protect the interests of Inuit and other northern residents, other Canadians and members of the global community. These research programs have strived to bridge the gap between knowledge and action in the Canadian and circumpolar Arctic through strategic project funding and program orientation. In the case of the NCP, Furgal et al. (2003) identify a series of factors that were associated with that program's ability to affect domestic and international policy and successfully fulfill its strategic objectives in relation to the 'Arctic contaminants issue'. These included, but were not limited to, the production and promotion of leading edge scientific knowledge, flexibility in program design, open and ongoing communication, and meaningful participation and engagement of a variety of key actors in many aspects of the program to problem identification, to research, to program management and information synthesis and dissemination.

Currently, our understanding of how best to effectively translate research results on urgent issues such as climate change into "action" or decision-making at the local, regional, national or international levels remains limited. It is argued that it requires many of these same elements in addition to a strategic understanding of the policy and decision making landscape at many scales and an understanding of the pathways and mechanisms through which to translate or connect science and action (e.g. decisions and policies) (Saner, 2007; Cicerone, 2009). It is argued that it is important and of value for ArcticNet (or any other large science program with a similar vision and goal), to contribute to and develop a critical understanding of this process in order to enhance the chances for the knowledge generated under the program to be used and for the program to fulfill its stated objectives and responsibilities to Inuit, other northerners and Canadians in general. To address climate change threats and take advantage of opportunities created in the Canadian Arctic, decision-makers in Canada and the international community need access to the best available scientific research and an innovative method to translate research results into informed policy and other decisions.

The activities being conducted by this project to examine and better understand the science-policy interface in the Arctic are presented as sub-projects or activities organized around three scales:

1. an Integrative scale that examines the overall science-policy landscape in the context of ArcticNet contributions;
2. a Case Study scale where the specific and often local impacts of research can be linked to decision-making and policy development and implementation; and
3. a Contextual scale where key informant interviews, surveys and literature review are being used to examine linkages between scientific research, its impacts, outcomes and decision making activities in a qualitative and quantitative manner.

At each scale, this project is studying how the Arctic policy and decision making landscape in Canada is linked to contributions that can be traced to ArcticNet science. A clear understanding of how current and new information is informing policies and actions on climate change and adaptation will be useful for ArcticNet researchers and the way that information is conveyed to decision-makers on a project by project basis or through such integrative mechanisms as the IRIS process. This project is not acting as an evaluation of the relevance or effectiveness of any one approach used in the program to date, but rather learning from these various experiences collectively to describe a framework for understanding which steps and factors in the knowledge translation process are most important or influential for this area of science-policy translation. It is taking advantage of the opportunity the ArcticNet program has created to study the intersections between and among communities of knowledge generators and knowledge users, and to enhance the abilities of both scientists and decision makers to improve knowledge exchange and utilization in the future.

This report has been edited to prioritize activities conducted during 2012-13, however much of the research is cumulative and connections between the goals of each project still requires a brief description of some previously reported work.

Activities

The Research Activities (also referred to as sub-projects) conducted this year are organized around three primary topics in this project. They are:

1. ***Integrative and Synthetic Studies***: activities or sub-projects examining the overall Arctic science-policy landscape in the context of ArcticNet contributions;
2. ***Case Studies***: activities or sub-projects conducted as case studies where detailed, specific and often local impacts of research can be linked to decision-making and policy;

3. ***Contextual Studies***: activities or sub-projects in which an examination of factors influencing the use and impact of Arctic science in society and on policy and decision making in the Arctic is possible.

All elements of the project are individually progressing towards completion, and will be integrated into a comprehensive qualitative and quantitative review of how Arctic research, and specifically ArcticNet research, can best fulfill the needs of multiple users and information consumers in the Arctic for policy and decision making in the future.

1. Integrative and Synthetic Activities

1a. Systematic Literature Review on Science-Policy Models and Factors Influencing the Science to Policy Process (Furgal, Hik, Buckham)

A systematic literature of online accessible literature on the science-policy interface (with relevance to Arctic environmental issues) has been completed following established methods. This systematic review has been conducted to identify existing best practices in moving science into policy, factors influencing the science to policy process, and models for understanding and analysing the science-policy interface environment. Analysis of the literature gathered and sorted using inclusion and exclusion criteria has been conducted to determine the trends over time in the exploration and understanding of the interface environment, disciplinary and thematic focus of previous work, and to suggest appropriate models for the analysis and interpretation of the ArcticNet – Arctic policy environment relationship. The results of this analysis are now being drafted into two manuscripts. This review and analysis has informed the questions included in the “Factors influencing the use of science in policy and decision making in the Arctic” survey (3a below) as well as the case study sub-project in Nunatsiavut (2a below).

1b. How does Arctic science inform Arctic policy?: weak evidence for strong linkages between research, media and political interest (Hik, Morris, Bieber, Zgurski)

We have been conducting a formal analysis / assessment of the extent to which ArcticNet science is visible within the policy making and decision making realms (federal and territorial governments). The entire Hansard of the House of Commons, Senate, and Territorial Legislatures has been reviewed from 2000-2012 for references to ArcticNet, International Polar Year, Arctic science and climate change (and other indicators of ArcticNet activity). This has been compared to the publication of key scientific results, media coverage of research outcomes and major Arctic events (including environmental changes (e.g. sea ice minimums), funding of major projects, etc). Several key public databases have been used for these searches. In addition, we needed to build a custom database for the various Hansard records (which are not available in any common format).

1c. The role of science advisors in facilitating science-policy linkages (Hik, Ogden, McGetrick, Bubela)

Some jurisdictions have a person or office who is responsible for managing the coordination of scientific information and providing scientific advice to government. In the absence of a central figure or office it can be difficult to determine where this advice comes from and how it is formulated. We identified people within the federal, provincial and territorial governments of Canada who might have some impact on the science policies in their jurisdiction. Academic and government science as well as traditional/local/ aboriginal knowledge was included.

We took advantage of the ongoing development of evolving territorial Science Agendas, in order to examine factors influencing the evolution and development S&T policy (including history, and involvement of various forms of knowledge / science and actors) in northern Canada. These new

territorial science and research agendas are driven by the increasingly urgent need for sound and reliable evidence-based information for making policy decisions. Strong partnerships with outside partners are essential, but the relationship between external research investments and needs of northern governments and residents are not as obviously aligned. In particular, the development of NWT and Yukon S&T Strategies has provided an opportunity to observe and investigate the influence of ArcticNet and other recent Arctic research investments in Canada on policy in the North.

1d. Quantitative Analysis of Linkages between Policy and Knowledge during the first cycle of ArcticNet (Hik, Morris, Bieber, Bubela)

The initial analysis of bibliographic impacts of ArcticNet scientific publications indicated that traditional metrics of update (citation rates, etc) were low. Consequently, this analysis was put on hold for much of the past year to allow for more time to measure the direct impact. Separately, team members have been refining methods for examining how collaboration both nationally and internationally can explain patterns of collaboration and the role of institutional affiliations. We have continued to develop this database for assessing research quality (average number of citations) rather than quantity (number of publications). As noted, these metrics are challenging to assessing real time. This work will be completed in Fall 2013.

2. Case Studies

Case studies are allowing us to examine and test specific hypotheses and develop a broader understanding of science-policy linkages within the context of ArcticNet and pan-Arctic research often at the local scale.

2a. The Role of Inuit Knowledge in Environmental Policy Development in Nunatsiavut. (M Buckham, C Furgal, T Sheldon)

Although the consultation and collection of IK has been generally recognized by policy makers as useful in the development of environmental policies and

programs, there is still a lack of understanding and very few examples of how IK can be effectively incorporated into, or how it may influence, environmental policy. Therefore, a need exists to study the interaction between IK and policy communities to further our understanding of how best to engage and involve IK in the development of environmental policies and programs. In cooperation with the Nunatsiavut Government, this project is examining the role of IK in environmental policy development in Canada. This research project is using a qualitative single-instrumental case study approach to investigate the role of Inuit Knowledge in environmental policy development in the Nunatsiavut region of Labrador. The Nunatsiavut Government's Department of Lands and Natural Resources has recently developed and introduced environmental protection legislation and associated policies that are to reflect Inuit Knowledge principles. The development of these policies is the focus of this project.

Central research questions are:

1. What are the processes through which IK can be incorporated into environmental policy and decision-making?
2. What are the barriers and facilitators of IK inclusion in those processes?

In 2012-13, in an effort to better understand what processes and tools are used to incorporate IK into policy and their effectiveness, a framework of critical elements of Indigenous Knowledge integration was developed. The framework was built to enhance our understanding of the topic and create a tool that could be used in other jurisdictions (primarily by policy and decision-makers and analysts) to aid in the evaluation of IK incorporation in their contexts. As well, M. Buckham completed all thematic data analysis, and a first draft of the thesis was submitted for review. Two field trips (March 2012 and June 2012) to the region were conducted to report results back to the Nunatsiavut Government, participants, and the Nain community and discuss the final form of results presentation and next steps. Additionally,

Buckham attended a General Assembly meeting during the March 2012 trip, as the EPA (Environmental Protection Act: the piece of legislation being studied in this case) was being discussed and brought into legal force.

2b. ICC consideration and development of a position on oil and gas in the Arctic (Meakin, Moss-Davies)

This case study examines factors that influence Inuit policy decisions (including the role of ArcticNet and other science activities, and IK) on: 1) natural resource development (e.g. involvement of ArcticNet science or not, availability of science, rights to use different data sources including IK to make decisions and arguments, contextual factors including rights, social and economic realities inside and outside the Arctic), 2) climate change; and, 3) mercury and the Global Mercury Negotiations. These current and timely issues and the high level engagement of Inuit in each of them, has provided an opportunity to investigate not only the use of current ArcticNet science in and impact on policy and decision making on topics of importance to Inuit but also how the science generated by the larger scientific community globally, contributes to policy and decision making on these key issues of interest to Inuit. Through involvement in negotiating sessions, workshops and Inuit specific meetings, Inuit are directly participating to these processes of science and IK / policy interaction on these topics. This case study is using the access provided by this participation to explore each of these three processes using document review, semi-directive interviews, focus groups, and facilitated workshop discussions.

In association with the ICC case study on oil and gas, we have been tracking the evolution of the offshore oil and gas development issue in the Arctic. The connection between the three issues ICC has prioritized for this project (see above) has been discussed in a variety of fora, including the United Nations Framework Convention on Climate Change. As Inuit developed a pan Arctic policy on climate change it became apparent that the issue of climate

change and hydrocarbon development in the Arctic were intrinsically linked and that Inuit needed a comprehensive discussion on the challenges and opportunities associated with these activities. Further, it was determined that this discussion must be supported by a foundation of concrete knowledge. ICC therefore has been reviewing the process developed through the Inuit Leaders Summit (Feb 2011) and has since developed a post summit process that will build on the discussions, and fill the gaps, from that meeting. The Inuit Leaders' Summit was just the beginning, not the end, of a series of actions among Inuit on this topic. The Summit provided a venue for Inuit to ask and answer many of the complex and sensitive questions related to Arctic resource development and exploitation impacting individuals socially, environmentally, physically, economically at the community level. It also provided the opportunity to determine next steps for Inuit on this important issue.

Since the time of the Summit team, members (SM, PMD) have:

- Reported on the ICC Inuit Leaders Summit on Natural resources which led to the ICC Declaration “Circumpolar Inuit Declaration on Resource Development Principles in Inuit Nunaat” May 2011.
- Developed the 2012 Inuit Leaders Call To Action prior to the UNFCCC Doha COP. This document relies heavily on the recent Arctic Net science that illustrates the knowledge and capacity needs for Inuit communities. Adaptation strategies can be developed more effectively when based on a current understanding of the change occurring in the Arctic. It is these needs that are communicated internationally through ICC participation at the UNFCCC.
- Identified the information needs to support decision-making and the development of policies and strategies to address climate change issues in the Arctic at the regional, territorial and national scales, and to influence international decision making.

Implementing the Circumpolar Inuit Declaration on Arctic Resources

Canadian Inuit leaders asked ICC Canada to move forward in implementing and analyzing provisions of the Inuit Declaration on Arctic Resources, and to do so from a Canadian Inuit perspective. ICC Canada developed 18 specific activities to conduct over a period of two to three years. ArcticNet funding is being used to address one of the important activities that underpins and gives intellectual guidance to the implementation plan, which is to “research, write, and commission a series of policy papers” (ICC Canada internal document). From March 2012 until 28 January 2013, ICC Canada has developed formal outlines of what needs to be addressed regarding resource policy development. From January to March 31st 2013, ICC Canada expects to complete several of the policy papers. The work involves taking each of the principles in the Resource Declaration and developing a set of questions that need to be addressed for Inuit leadership and consideration. In other words, the policy-writing process will answer the more general question of what do Inuit leaders mean by each of the principles and to give colour and nuance to each of the principles (start the process of implementation). These will form the background papers for the next workshop (2013 tbd) on implementation that will include Canadian Inuit leadership and other interested persons and organizations.

2c. Community adaptation planning in Nunavut (Johnson, Hirsch, Meakin, Furgal)

In Nunavut, two case studies are in the process of being completed.

- This first Nunavut Case Study focused on “Climate change policy and science as exploration of Inuit – government relations in Clyde River and Iqaluit”. Led by Noor Johnson, the approach used in this study involved semi-directive interviews in Clyde and Iqaluit and assessment of Auditor General’s scope, timeline, assessment of investment in climate change.

In-depth interviews with community members (n=39), researchers (n=10), and decision-makers in Clyde River, Iqaluit, and Ottawa (n=37) were conducted focusing on the role of Inuit in research and decision-making on climate change. A survey on environmental knowledge and learning of 60 community members in Clyde River to determine prioritization of environmental issues and access to different knowledge and information sources was completed. In 2012-13 much of the analysis and writing was completed and an article of the case study was submitted for publication and is in review. As well, the results were presented in an oral presentation at the IPY 2012 “From Knowledge to Action” Conference in Montreal.

- The second Nunavut Case study focused on “Sharing research findings in the Canadian Arctic: Assessing the integration of community-based knowledge in policy communications about climate change related food insecurity.” Led by Rachel Hirsch and Gwen Healey (QHRC) this project is examining the network of actors that are connected in the knowledge translation process when moving information from research results, to knowledge update and use or implication in decision making. This project is using the case of climate change impacts to food security in Nunavut and the results of the QHRC project on this topic in Iqaluit as its focus. In 2012-13 a preliminary network analysis was conducted and the visualization was used to draft a community-oriented guide to knowledge tracking. As well a preliminary analysis of the qualitative interview data was completed and a participatory results workshop was held in Iqaluit, and more recently Ottawa (Jan 2013), with all project partners.

2d. IRIS Case Studies: the ‘IRIS’ as a science to policy mechanism (Furgal, Nickels, Meakin, Moss-Davies, Hik, Buckham, Kelley)

One of original motivations of the science-policy project was to examine the factors influencing process and outcome of the four ArcticNet IRIS initiatives, the relevant documents and meetings, and the factors influencing

policy and decision makers’ perspectives on the utility and value of the ‘products’ for policy and decision making in the regions. The first of the case studies (Nunavik and Nunatsiut) includes document review, semi-directive interviews with actors involved in the IRIS process and regional decision makers, as well as observations of the IRIS meetings and process. With IRIS 4 complete and having been released, the project is now undertaking its planned research on the process as a science-policy mechanism or tool. Ethics approval has been sought and received and research tools (interview guides, analytical protocols for document review and analysis) have been established and staff has been hired at the Inuit Knowledge Centre (K Kelley) and Trent U (M Buckham). Research has started via document collection and review and interviews in the Nunavik and Nunatsiavut IRIS region will commence this summer. Over the next year we will complete interviews with key decision makers in the regions and the researchers and coordinators of the process to look at facilitators and challenges to this process as a science-policy mechanism and to gain perspectives on the decision making impact/uptake of the products of this exercise (products including engagement, discussions, and written materials and other forms of communication and not solely the written report). Our original goal was focused on documenting the development of each IRIS, but given the very different pace and schedule the IRISs are on compared to one another and the need to allow each IRIS to complete its process before conducting a retrospective case study of it, we are aiming to complete this current IRIS case study in the coming year (2013-14) before undertaking further IRIS case studies for the other regions. However, collection of IRIS documents and participant observation via attendance to IRIS meetings in Inuvik and Iqaluit were still achieved this year in preparation for any future research on the other IRIS cases.

2e. Geographic Information Systems as Communication Tools for Health Impact Assessment (McGetrick Master’s thesis, Bubela, Hik)

Freja’s thesis research investigates the potential for expanding the current functionality of GIS to coordinate health impact assessment and community-

based monitoring between indigenous organizations, researchers, proponents, and regulators in the context of regulatory processes for natural resource developments. This study is linked with concurrent efforts to expand applications of GIS for planning and decision-making at around the Arctic. This study provides a specific investigation of how Health Impact Assessments (HIA) are currently being implemented to mitigate the potential health hazards of resource development projects. Accelerating natural resource development in northern Canada and the circumpolar north presents ecological and socio-economic challenges for the health of indigenous people. The study examines how health impact assessment guidelines could inform multi-stakeholder decision-making. Part of this case study focuses on environmental assessment and public hearings for Fortune Minerals' proposed Nico Gold-Cobalt-Copper-Bismuth mine. Transcripts have been analysed according to two sets of parameters developed by the Alaska Health Impact Assessment Program and Health Canada. The findings highlight the potential for improved risk communication between natural resource development stakeholders through the adoption and implementation of health impact assessment guidelines as part of environmental assessments in northern Canada. A second outcome of this project will also be relevant to the development of initiatives that will provide access to spatially related reliable information to facilitate monitoring and decision making, such as the territorial science agenda's, proposed CHARS initiatives, and the Arctic Council's Spatial Data Infrastructure project. Interviews with twenty-nine experts in GIS, health impact assessment, medical geography, epidemiology and surveillance, natural resource policy, aboriginal law, aboriginal health, and community-based participatory research were conducted in 2012 under this project as part of HQP Freja McGetrick's Master's thesis. This work has been focused in the NWT because of the extensive availability of public records and the opportunity to directly observe a regulatory review process unfold. The results should be broadly relevant to other resource development activities in northern Canada.

3. Contextual Studies

Literature review, key informant interviews and a survey are being used to study linkages between research outcomes and policy / decision making activities and how to assess, and what constitutes, "impact" of science activities in society.

3a. Factors influence the use of science in policy and decision making in the Arctic. Key informant interviews regarding linkages between research outcomes and policy (Furgal, Hik, Meakin, Nickels, Moss-Davies, Buckham, Kelley, McBean)

Quantitative and qualitative analysis of factors that influence (and identification of critical factors) the Arctic science-policy interface are being investigated through a general online survey and interview process with a diversity of scientists and decision makers entitled "Factors influencing the use of science in policy and decision making in the Arctic". This survey is being launched after gaining ethics review and approval and finalizing question inclusion based on the literature analysis (1a above). This survey is also building upon the relevant elements of Project 4.7 from Phase I of the program in that key themes were identified that we are inquiring about with a diversity of scientists and decision makers throughout the Arctic (Indigenous and non-Indigenous) at various scales to determine what influences the use and uptake of scientific results into decision making. This part of our project will allow us to obtain views and input from key informants responsible for the practice of science-policy integration in northern Canada. This input will place our other research in context. The questionnaire has been approved by ethics, is being launched this summer, and will be completed in fall/winter 2013.

3b. Assessment and indicators of Arctic science impact (Furgal, Hik, Braithwaite, Meakin, Nickels, Moss-Davies, Durkalec)

A critical literature review, synthesis and analysis is being conducted on the topic of indicators and the assessment of the benefits of investment in, conduct of and outcomes from scientific activities relevant to the Canadian Arctic. Significant attention has

been given to this topic in other countries and large programs around the world, yet relatively little attention has been given to this topic in a systematic way in the Canadian North to date. This project strives to review the existing knowledge, with emphasis on its relevance for the Canadian Arctic context, and make recommendations for potential indicators and assessment techniques to understand the many benefits and impacts of the investment in Arctic science in Canada to northerners and other Canadians. In 2012-13 the literature review was updated with government indicator / survey tools not available online and other gaps in the literature review were filled. The RA on this project was also successfully completing her MA at the time (A Durkalec) and this completion of this sub-project was not achieved as anticipated. Plans for its completion this summer / fall are now confirmed.

Results

Most of the work we have been conducting over the past 3-years is nearing completion. Here, we update and highlight the results from the past year.

1. Integrative and Synthetic Studies

1a. Systematic Literature Review on Science-Policy Models and Factors Influencing the Science to Policy Process

Two manuscripts are currently being prepared from this sub project and will be completed in summer/fall 2013; one focuses on the literature and trends in the literature on science policy relevant to the Arctic and the other on a critical review of science-policy frameworks for understanding the interface and factors influencing this interface and their relevance to Arctic science. The literature review and analysis looks at over 250 articles on the science-policy interface and shows a significant increase in the literature on this topic/year since 1970, peaking in the early 1990s possibly in relation to the Rio Earth Summit and Agenda 21 adoption in 1992. Thirty-two articles include frameworks to understand or analyse the science-policy environment and some show insight

into the apparent influence and importance of such things as relationships between actors in the system over knowledge content, timing of information delivery, and other extrinsic factors in the policy environment outside the particular subject area which may have significant influence in the Arctic science to policy process.

1b. How does Arctic science inform Arctic policy?: weak evidence for strong linkages between research, media and political interest

There is a distinct lag between the events that generate media interest in Arctic research initiatives (such as ArcticNet and IPY), the publication and dissemination of results, and incorporation into science policy. The entire Hansard of the House of Commons, Senate and Territorial Legislatures have been reviewed since 2000 for references to ArcticNet, International Polar Year and Arctic science. While there are frustratingly (and surprisingly) few references to ArcticNet, IPY or Arctic science in debates, we have examined over 1,080,000 records from Hansard alone to determine the context of references to Arctic research and policy. We are also examining the territorial Hansard records as well as public committee documents to examine how and where the impact of ArcticNet is evident.

This analysis of massive volumes of text required the development of new multi-code parsing techniques (using java) which has greatly streamlined this process and accelerated progress (e.g. what used to take 150 hrs of processing time can be done in 10 minutes).

There appear to be three distinct ‘pulses’ where ArcticNet and Arctic science (e.g. IPY) might have an influence on policy. The first is related to the high profile events (funding announcements, conferences, other events with high media interest). The second follows the publication of results in primary literature. And the third is associated with sometimes unrelated policy discussions, including budgets, international events, PM’s annual northern tour, as examples. Tracking the influence of ArcticNet and Arctic science into policy decisions is difficult, however some

evidence is emerging that earlier activities will affect subsequent decision making. However, in the absence of a clear national policy, new initiatives are often motivated by other factors. A manuscript describing these patterns is in preparation.

1c. The role of science advisors in facilitating science-policy linkages

The development of territorial research agendas provides an opportunity for studying how science is used by and integrated into government decision making. Given that science is not constant, the institutions that are efficient in supporting science at one point in time may be less appropriate at a later point of time. One objective of this project has been to identify various ways to effectively elicit input from external contacts for gathering a range of perspectives on science needs in the North. As well, many of the issues identified in Case Study 2a (Nunatsiavut) also apply in other jurisdictions.

One clear result so far is that a leadership team within each territorial government and respective departments, is essential for the development and implementation of a science policy. In the territories this process has been led by territorial science advisors. Interestingly, only the three territories (Yukon, NWT, Nunavut) and Quebec appear to have an identified point of contact (science advisor) for government. Although individual departments may have a capacity to assimilate science outcomes and link these to policy development, these roles are always obvious externally. A manuscript describing the evolution of research agendas and advisors relevant to northern Canada is in preparation.

1d. Quantitative Analysis of Linkages between Policy and Knowledge during the first cycle of ArcticNet

As noted above, this analysis will be completed in fall 2013. Initial results indicated that lags in citation rates would benefit from more time prior to analysis to show relationships between science production and knowledge uptake.

2. Case Studies

2a. The Role of Inuit Knowledge in Environmental Policy Development in Nunatsiavut

The main findings of this research suggest that opportunities for IK integration are provided in three primary ways:

- Governance & Institutions (formal decision and policy-making structures and processes);
- Processes for Participation & Public Engagement (formal avenues and processes that affect how Indigenous people engage with and exercise influence over policy-making); and,
- IK Research & Programs (indirect avenues and sources of IK that affect how IK is accessed and if IK is available to decision-makers).

In applying the evaluative framework developed in this research project, overall, the Nunatsiavut context supports the majority of the framework elements influencing IK incorporation into policy, thus reinforcing the findings of studies reported in the literature. However, the Nunatsiavut case did bring new insight in several areas. First, despite the political autonomy to envision government structures and processes as desired, Indigenous groups may still be immobilized in integrating IK into policy and other formal decision making processes due to the existing influence and dominance western governance structures present in management institutions. Second, in the decision and policy-making world, public meetings remain a highly employed, but inappropriate and less effective method to garnering IK input for decisions and policies. Next, the inundation of meetings from a variety of government departments and industry in small Indigenous communities may actually be deterring community participation, forcing us to re-think approaches to engagement. The Nunatsiavut case also reveals that despite the proliferation of literature outlining the risks of IK documentation and storage, it is seen as an essential and useful decision-making support tool that can be executed in ways that mitigate potential dangers.

This case study project is contributing to an enhanced understanding of IK integration into decision and policy-making that identifies current avenues and facilitators of IK integration based on reports and learning from scholars, Indigenous communities, and governments immersed in IK/policy work. Upon completion this summer, M Buckham will be producing two manuscripts from this work (the first focusing on the building and presentation of the framework, and the second chronicling the application of the framework tool to the Nunatsiavut case) and presenting and working with the Nunatsiavut Government on the development of an IK Working Group for the implementation of some of these findings to enhance IK input into policy and decision making in that region.

2b. ICC consideration and development of a position on oil and gas in the Arctic

The role of science in informing both resource development and adaptation to change has been the focus of work conducted by ICC this year through four main activities including the developing the non-renewable resource positions of Inuit; informing international climate change policy at the UNFCCC; shaping the IPY 2012 From Knowledge to Action Conference; and, through the UNEP Global Hg Negotiations. Work conducted this year expanded on ICC's existing activities to ensure the integration of ArcticNet science in ICC decision making at all levels and in all fora. ArcticNet has supported the development of the Declaration on Resource Development through the ArcticNet Science to Policy Project. The team examined research decision paths on key Arctic issues and how knowledge, both western science and Inuit knowledge, informs these processes.

Using the case study of the ICC Declaration on Resource Development, this sub-project has detailed: 1) how knowledge is used in decision making on a complex subject with multiple drivers, and issues of access and communication of knowledge/ data; 2) the development of a process to work with industry to make available and share data to

understand the social and environmental impacts of mining and development; and, 3) a path for the future identification of Inuit needs. Much of this will continue to be investigated in 2013. ICC has identified 18 priority tasks grouped under the following thematic areas: 1) Liaison and Outreach; 2) Resource Development Research and Analysis; 3) Political Strategy Development; and 4) Policy Research and Development. ICC is supporting the 'next phase' survey developed by Chris Furgal and team at Trent University (Part 3 below).

Efforts have also been made to inform the Arctic Council and the upcoming Canadian Chairmanship from 2013-2015 about the most important principles that follow from the work of ICC, including:

- Ensuring Inuit are primary beneficiaries of resource development;
- Respect for the UN Declaration on the Rights of Indigenous Peoples and Inuit legal rights;
- Continuing to compile the state of the art science to inform decision making;
- Balancing of risks and benefits of development and ensuring development is sustainable;
- Respecting the Arctic Council's "Arctic Offshore Oil and Gas Guidelines" as minimum standards;
- Support for an international mechanism for funds targeted towards liability and compensation for oil pollution damage resulting from offshore oil exploration and exploitation;
- Continued collaboration by Inuit leaders in working together and with their respective governments to address and pursue responsible resource development issues; and
- Proper assessment of the environmental and social impact of resource development.

IPY 2012 From Knowledge to Action Conference

ICC was a member of the International Steering Committee for the IPY conference From Knowledge to

Action. In doing so and in partnership with ArcticNet ICC helped shape the conference agenda as well as develop the Indigenous Knowledge Exchange (IKE). ICC convened or co-convened a number of sessions on integrating Indigenous Knowledge and contributing to the Action Forums.

2c. Community adaptation planning in Nunavut

Actor and Institutional Networks in Climate Knowledge and Policy

This study has been examining the social context of climate knowledge production by examining the relationships among individual actors and institutions at different scales. Climate change is a complex phenomenon that is understood and prioritized very differently by scientists, Inuit hunters, Inuit community members who rarely travel on the land, and policy makers and territorial government staff. The study shows that:

- When pursuing collaborative climate change projects, including community adaptation planning, it can be helpful to begin by exploring and documenting the different ways that actors understand and conceptualize climate change as part of an initial ‘problem framing.’ The goal is not to have all actors agree or accept a shared definition and understanding, but rather to identify overlap on which collaboration can be based.
- Climate ‘knowledge’ and perception of change at the local level is drawn from a variety of sources, including land-based knowledge and personal observation of changes, scientific knowledge, and religious understandings of change. Institutions play an important mediating role in access to knowledge at the local level and in translating local knowledge for reception and uptake in regional and global scientific reports and policymaking.
- Local (community) interest in and support for science is greatest when it addresses a local

perception of risk and when it generates multiple outcomes, including employment opportunities for community residents.

- Institutions and departments at the territorial level lack organizational infrastructure and support in sharing knowledge; this challenge is exacerbated by a decentralized government structure. Key issues include high level of staff turnover at project management level, and lack of support for climate change initiatives by senior level staff.

Tracking the exchange and use of a community-based research message on country food security from Iqaluit to Ottawa

This project is working to understand how research is (or could better be) moved into action by working with the Qaujigiartiit Health Research Centre (QHRC) to track a key message from their photovoice project on climate change and food security (health) conducted in 2009. The network of policy actors (local to national) who are exchanging and acting on the following message: “A changing climate and warming North will change the amount of time community members will safely be able to go out on the land. Climate change challenges an individual’s freedom and a community’s access to country foods.” is being studied. The results of this study is identifying who receives, transmits and acts upon the QHRC’s message about climate change and health in Nunavut. It is also showing that the visualization of a policy or knowledge exchange network is a useful participatory evaluation tool as it easily facilitates an interactive experience with partners where, for example, structural changes in the network can be observed in simply by adding or removing actors who are the intended or unintended recipients or participants in the network.

2d. IRIS Case Studies: the ‘IRIS’ as a science to policy mechanism

We have observed that all four IRIS processes have taken a slightly different approach, have evolved

differently, but may eventually reach the same outcome. Considerable learning is taking place within and between the different IRISs that is being captured by this study to share in terms of lessons learned and benefits of the IRIS model of integrated assessments and as a science-policy mechanism. Case study methods being employed in this study include document review (review of successive iterations of IRIS Table of Contents and workshop / meeting reports, presentations on the process and lessons learned etc), key informant interviews (with scientist contributors, IRIS leaders and decision maker recipients / intended knowledge users) and participant observation (notes of team members participating to IRIS meetings and process). Questions for interviews aim at understanding the process, factors influencing the process, identification of facilitators and barriers to the IRIS process and use and uptake of the resulting information/knowledge at the regional scale. Training with M Buckham and K Kelley for the conduct of key informant interviews has taken place and interviews will commence during the summer. We will continue to observe the other IRIS processes but until the completion of IRIS case study 4 (Nunavik and Nunatsiavut) this year we will not propose case studies on the other IRIS processes at this time.

2e. Geographic Information Systems as Communication Tools for Health Impact Assessment

Content analysis on the complete public record of Nico public hearings was parsed by individual stakeholders, who were coded as belonging to one of the proponent, regulatory, government, or aboriginal stakeholder groups. The first stage of data analysis for the Nico case study was completed in October 2012 and results were presented at both the Insights' 12 Symposium (Edmonton, Canada) and Northern Research Day 2013 (Edmonton, Canada).

Using stakeholder group as the unit of analysis, an 'a priori' coding framework was applied with a hierarchy based on (a) the eight Alaskan Health

Effects Categories, and (b) nine of Health Canada's Determinants of Health. The results show that proponent (industry), federal government, territorial government and regional stakeholder perspectives are tightly clustered, but quite divergent from citizen and local government perspectives. This suggests that very different information is being utilized and integrated by different parties. Some of these differences may be a results of access to research results. Pending further content analysis of six additional projects in the Northwest Territories, we recommend that guidelines to facilitate multi-stakeholder dialogue about health impacts during environmental assessments. Future research will evaluate the use of geographic information systems (GIS).

Initially, interviews with twenty-nine experts in GIS, health impact assessment, medical geography, epidemiology and surveillance, natural resource policy, aboriginal law, aboriginal health, and community-based participatory research were conducted in 2012 under this project as part of HQP Freja McGetrick's Master's thesis. Results to-date indicate a strong consensus that spatial representations (e.g. using GIS) will support communication to facilitate a more extensive collaboration with communities that produces higher quality data outputs. For example, to ensure that collaboration improves health outcomes, the experts recommended improving communities' access to technology and training, community stewardship of the data, utilizing data for ongoing monitoring of development impacts, and coordinating cumulative impact monitoring within regions. These results were presented at ASSW 2013.

3. Contextual studies

3a. Factors influence the use of science in policy and decision making in the Arctic. Key informant interviews regarding linkages between research outcomes and policy

Ethics was received and the survey was mounted onto the online survey software (Poll daddy.com) for release as an online survey and administration also through

interview processes with individuals via iPads. The survey is being launched in the summer of 2013 and will run until September/October 2013 (dependent upon response rate) at which time we will complete data collection and begin transcription of qualitative responses and quantitative analysis of categorical and scaled responses. The results of the analysis will be prepared as a manuscript by spring/summer 2014. The survey focuses on identification of key factors influencing the science-policy translation process (what influences the use of scientific results in decision making at various scales in the Canadian Arctic) with perspectives/perceptions from both scientists (health, natural, physical and social sciences) and Arctic decision makers / policy makers (Indigenous and non-Indigenous at local, regional, Territorial and Federal scale).

3b. Assessment and indicators of Arctic science impact

A significant amount of literature exists on this topic focused in other programs or countries around the world. It argues that the benefits of the investment in science are significantly greater than currently reported and discussed in the Canadian Arctic context. Benefits stem from the training and engagement of those conducting the work, the processes of scientific activities, the direct and also indirect outcomes from the knowledge generation process and then finally the direct and indirect (intended and unintended) uses or applications of this knowledge. Benefits are seen in the short, medium and long term in some cases. This project is reviewing this literature and providing recommendations for enhanced project reporting or program review and reporting that better captures the extent of benefits from investment in ArcticNet (and other Arctic) science to northern and Canadian society in general. It appears as though this will be one of the first attempts to suggest an extensive list of indicators specifically for consideration in the Canadian Arctic science context to date, or at least as reported in the primary literature. The report and manuscript are planned for completion in September / October 2013.

Discussion

The distributed nature of knowledge and policy-making is complex and the evidence from our project demonstrate that linkages are often elusive. The policy and/or social benefits arising from innovative research can be challenging to quantify. In the North, there are still gaps in publicly available data, incompatibility between databases and analysis tools, and difficulty including measures of traditional knowledge sources. Emerging sets of practices within networks place emphasis on managing partnerships, based on understanding that innovation is often serendipitous; that circular and complex knowledge models are the norm; recognition that no one entity can itself do most of the research; and finally that emphasis needs to be placed on defining benefits to society from the outset.

At one level we have focused on integration of results at a pan-ArcticNet scale. However, our case study approach to understanding the interface between ArcticNet research and policy has allowed us to see how this process operates where there are often closer connections between decision-makers and researchers. For example, the majority of biophysical studies focus on regional level changes and impacts, however community and local assessments of climate change impacts contribute towards improving understanding of future vulnerability, (e.g. Ford and Pearce 2010, for the ISR). The understanding we are gathering will be integrated into a more comprehensive understanding of the science-policy dynamics in northern Canada and in the formation of a new science-policy framework to help analyse and understand this decision making environment.

So far, our results suggest several ways that research can support the national, regional and local climate change adaptation policy and program interests of Canadian Inuit. It has been essential to consider how various stakeholders understand and communicate about the relationship between climate change, country foods, and health. Increasingly, researchers are seeking out Indigenous sources of knowledge about what adaptation strategies are best suited to a changing

northern environment. However, what is less clear is how findings from these Indigenous knowledge studies are integrated back into climate change policy-making. Several of our Case Studies (especially the work being conducted by Rachel Hirsch and Freja McGetrick) have contributed to developing a map prototype, in collaboration with participants, by identifying the knowledge network related to a climate change, food security, and health. The significance of various research inputs (including ArcticNet, AHRN-NU, IPY and others) will be measured through this process.

Theories of public participation in and support for climate change science often suggest that lack of support stems from a knowledge deficit. Noor Johnson's research points towards a much more complex situation in which different sources of knowledge, including science, influence local understanding and support for research and action on climate change. At the territorial and national levels, institutional silos and the lack of a clear mandate for engagement pose barriers to knowledge 'uptake' by decision-makers. This pattern has been recognized previously, but we are exploring ways to break down these barriers. At both the national and international level there is a need to build on recent integrative programs such as IPY and assessments such as the Arctic Human Development Report (e.g. Kraft Sloan and Hik 2008; Brock 2010).

In the context of a rapidly-changing Arctic, resource development in the Arctic presents new and enormous opportunities and challenges. There is a great deal at stake – economically, environmentally, socially and culturally. Policy development in this area, therefore, is urgent, and policy makers must do their job well and with a full knowledge base. For example, ICC future activities with regards to this case study will continue to move this policy issue forward. A major direct activity was the development of the Inuit Climate Change Call to Action which was prepared for the UNFCCC COP 15 in Copenhagen in 2009 and an updated version released for UNFCCC COP 16 in Cancun in 2010 and COP 17 in Durban. Using the

science-policy Matrix as developed at this time and an analysis of the science emanating from ArcticNet and others we felt this product was an example of a tool that was developed from the science to inform policy from an Inuit perspective. This is an example of the application of the matrix approach, and explicit mapping of these different perspectives will be applied to new issues in the future. It will also be possible to look at previous Inuit references to applications of science in the Arctic and see how the link between research and policy could have been improved (e.g. with reference to ICC's initial Arctic Policy (1978), the Utqiagvik Declaration in 2006 and the Nuuk Declaration in 2010, The ICC Inuit Leaders Declaration on Non-renewable Resource Development).

Interestingly, the discussions within ArcticNet concerning resource development in the Arctic mirrored the discussions within the Inuit leadership. How can the decisions made regarding oil and gas, mining and environmental assessment and the social implications of these activities be informed by knowledge (both western and traditional)? Of interest here is many aspects of the Matrix including varying levels of the same knowledge being used by various stakeholders, varying positions and interpretations of the same science. This has culminated with an Inuit Leaders Summit to be held Feb 23-24, 2011 on Resource Development. This Summit brought together the very best knowledge on the issue of offshore drilling and exploration, mining and environmental and social impacts assessments. The result of this Summit was a Declaration and is a direct application of the science policy interface upon which we may analyze the pathways of knowledge transfer and the development of decision paths.

With regards to mercury there has been a great deal of research undertaken through ArcticNet which has helped inform ICC's position within the Global mercury negotiations. ArcticNet as well as the Northern Contaminant program provide critical funds to undertake the baseline research to understand the

issue of mercury in the Arctic. ICC approach to the Global Hg Negotiations have used Arctic and NCP science as a foundation to conclude that emissions of anthropogenic mercury are increasing in the Arctic and coming mainly from Asian (China and India) sources. Through a NSERC grant ICC has also been investigating the distribution of Hg isotopes through archived ice cores. Critical research to determine increase in deposition to establish Hg sources.

Bridging the Science-Policy Gap

The gap between science and policy-making and policy-implementation is well recognized but probably not well understood (e.g. Saner 2007, Hik 2009). The essence of the gap is between the process of social learning (knowledge creation and transmission) and the process of social action, where knowledge is filtered through competing belief systems and other social constraints (Bradshaw and Borchers 2000). While scientists tend to be comfortable with uncertainty, the public and policy makers often seek certainty and deterministic solutions. The reconciliation of these different perspectives may be achieved through adopting a science policy that recognizes the need for better mechanisms to link science and policy through adaptive management of both perspectives. One of the outcomes of our research will be an assessment of mechanisms and processes need to be put in place which bring researchers and policy-makers together from the earliest stages of project development. This aspect is being explored explicitly by analyzing the role of science advisors in the North, and their role in helping researchers to better understand policy-making needs and provide policy-makers with a context in which they can contribute to the development of project outcomes that will be directly useful.

Based on the results from our integrative activities, the overall impression so far is that:

- The communication pathways and dynamics are not public/transparent;

- Information transfer may depend on personal contacts and relationships;
- There is often little or no documentation of these interactions.

In general, there does not generally appear to be a central person or group responsible for these information transactions. Who should this be? Possibilities include science advisors or chief scientists as motivators, facilitators, or coordinators, but other models or processes might work even better. There is some evidence that participation alone is not sufficient to ensure that multiple stakeholders are equitably involved in research and policy, and that when coherence is missing between different publics, policy formation and implementation become difficult (e.g. May et al. 2005; Mertens et al. 2005). Bridging this 'Science-Policy Gap' will require enhancing public understanding through better communication of science and its implications. This public knowledge dissemination has been an explicit and perhaps successful aspect of ArcticNet and the International Polar Year. It may be helpful to increase confidence in research by accelerating the pace of scientific confirmation and dissemination of results, however, science will remain complex and scientists may not be able to decrease uncertainty sufficiently to allow more precise estimations of risk for policy makers or the public. Consequently, it may be necessary for scientific uncertainty to be regarded in the policy arena as it is in scientific circles: as information for hypothesis building, experimentation, and decision-making (e.g. Hik 2009).

One important role of science and research is to assist governments in effectively discharging their responsibilities and mandates. In the Arctic, these mandates are necessarily far reaching, diverse and include a broad range of disciplines, from the natural sciences, the human behavioral, social and historical sciences, medical sciences, engineering and applied sciences, and research in the managerial, economic, and legal fields. Advanced technological knowledge and fundamental or theoretical research

must be combined with the holistic observations and knowledge of Indigenous northern peoples (Furgal et al. 2006). Various Case Studies and examination of the IRIS process within ArcticNet can provide some very specific examples about how the needs of policy makers can be more closely linked to the scientific process, adding value for all interested parties. Application of these lessons beyond ArcticNet regions will also demonstrate the wider impact of ArcticNet outcomes.

Overall, most of our original objectives are close to being met. We have benefited from reviewer comments that have encouraged us to restructure the organization of this project to emphasize the integrative activities, and to more explicitly utilize the different Case Studies to emphasize specific aspects of the science-policy nexus. ArcticNet research is both directly or indirectly, and sometimes not obviously, utilized in decision making by various groups and for various purposes. Being able to track these influences is a critical step in making science more useful for formulating policy, and for other societal benefits at local, regional, national and international levels, and for planning future research activities in the Arctic.

Conclusion

We are able to utilize new and existing conceptual frameworks for understanding, and possibly improving and facilitating the science-to-policy process in the Arctic. Research outcomes that are timely, clearly communicated, and can be related to policy objectives will have the greatest probability of having impact on policy and decision makers, at local, regional, national and international levels.

We can identify a distinct lag between the events that generate media interest in Arctic research initiatives (such as ArcticNet and IPY), the publication and dissemination of results, and incorporation of these results into science policy. The evidence to track the influence of Arctic science into policy needs to be

considered in terms of a decade, not years.

There appear to be three distinct ‘pulses’ where ArcticNet and other Arctic science programs (e.g. IPY) might have an influence on policy. The first is related to the high profile events (funding announcements, conferences, other events with high media interest). The second follows the publication of results in primary literature and associated media coverage. And the third is associated with sometimes unrelated policy discussions, including budgets, international events, or other political announcements. Tracking the influence of ArcticNet and Arctic science into policy decisions is difficult, however some evidence is emerging that earlier activities will affect subsequent decision making. However, in the absence of a clear national policy, new initiatives are often motivated by other factors, often identified at a more local level.

Our ongoing integration of project activities and goals provides an opportunity to directly document how and where ArcticNet science contributes to informing policy in a variety of sectors. A new set of research activities will contribute to a strategic analysis of the Arctic policy landscape and how the ArcticNet science program contributes to informed policy decisions in Canada and globally. This will be accomplished through ongoing quantitative and qualitative analysis of the influence of ArcticNet science on various realms of Arctic policy development. More significantly, we anticipate providing new information that will help ArcticNet science products become more commonly used in policy and decision making.

Building on work underway (and various pieces to be completed by end of 2013-2014), we will examine a series of ‘next steps’ to learn how ArcticNet can address the most effective ways to use and translate ArcticNet research results on urgent issues such as climate change. Aspects of the project will fill some key gaps identified in our current work, and will focus on summarizing recommendations for improving the use, translation and transfer of research results into sound policy in the circumpolar north.

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