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

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Abstract

Ecological change, economic strain, cultural transformation and other factors are significant stressors 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 Inuit and all Canadians can benefit from policy decisions that contribute to sustainable development and the well-being of Arctic environments and peoples. This research project is comprised of a series of sub-projects or activities that examine aspects of the science-policy interface. The central focus is to enhance our understanding of the Arctic policy landscape and factors influencing the translation and transformation of research results into decision support at various levels. It aims to understand how ArcticNet science and IK/IQ (Inuit Knowledge) can, has and might better contribute to informing policies on critical issues such as climate and other forms of change in the future. It is expected that conclusions from the sub-projects will help ArcticNet address the most effective ways to use and translate its research results into 'action' or decision-making at the local, region, national or international levels. More generally, these results will contribute to the present knowledge on how to improve the use, translation and transformation of research results into sound policy or accessible and compelling information for informed decision making in the Arctic or elsewhere in Canada and beyond.

Key Messages

1. An a priori understanding of the science-policy process may facilitate the design of research that is most likely to be used beyond the science community that generated the knowledge. The analysis of IRIS 4 suggests that this outcome was achieved after the fact, which is another alternative, although perhaps less ideal.
2. Policy makers seem to rarely discuss science or science programs. For example, ArcticNet has limited visibility in Parliamentary records (Hansard) and Arctic research outcomes do not always make reference to ArcticNet as a source of funding or collaboration. In comparison, IPY was somewhat more visible.
3. The time-lag 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, regional, national and international levels.
4. There is a growing 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. We have developed an integrative model that also incorporates observations from our various regional case studies.
5. 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. Geographical Information Systems (GIS) can provide an effective tool for communicating both reserach and management options.
6. 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.

7. 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 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 have varying abilities to translate the knowledge often leads to confusion or misinterpretation (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.
8. 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, and science advisors to government and other agencies.
9. 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.
10. Institutions and departments at the territorial level often lack sufficient organizational infrastructure and support for knowledge 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

Our project objectives are broadly focused on obtaining an 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. ArcticNet research has direct and indirect influences on decision making and policy that may be perceived at several levels. We are conducting activities that are both integrative and specific. A variety of sub-projects are clustered into (1) a knowledge generation and process emphasis, and (2) a policy and decision-making emphasis (Figure 1; Table 1).

Tracing the flow of ArcticNet research outcomes into policy has been measured in several ways. We have examined the ways that ArcticNet has been recognized by federal and territorial governments that have responsibility for both decision-making and funding research. We have also focused on case studies where it is possible to improve understanding of how to improve the use, translation and transfer of scientific

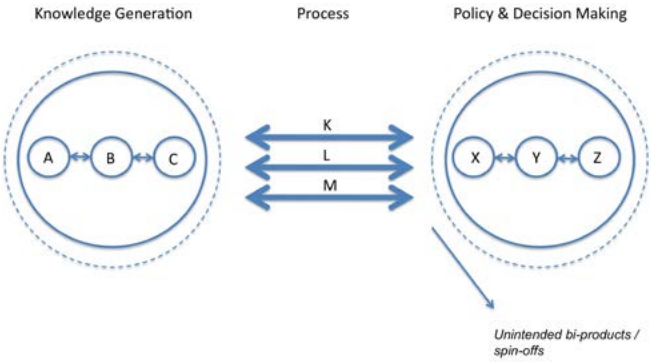

Figure 1. Conceptual linkages within and between Knowledge Generation and the Policy and Decision-Making Processes. A, B, C refer to various steps in the Knowledge Generation domain; X, Y, Z represent interactions among various players in the Policy & Decision-Making domain; and, K, L, M refer to examples of these processes, in our case derived from different case studies. The dotted line around the domains indicate that there is usually a larger context that influences these processes. Of particular interest, within our project are the unintended bi-products or spinoffs that arise at the interface of Knowledge Generation and Policy.

Table 1. Geographic scale of sub-projects

Sub-Project Activity	Regional	Territorial	National	International
IRIS Case Study	X			
Science-Policy Survey			X	X
Indigenous Knowledge and Policy	X			
Impact of GIS on Policy		X		X
Community Adaptation Planning		X		
Research Knowledge Tracking		X	X	
Role of Science Policy Advisors		X	X	
Science Impact Framework and Indicators			X	X
Hansard Analysis		X	X	
ICC oil and Gas Declarations				X

research results and TK/IQ into sound policy in a variety of different Arctic science-policy interface environments, primarily at local scales. Finally, we are in the process of surveying decision-makers about how they integrate research into decision-making and policy.

Introduction

There is increasing interest in Canada and around the world in finding ways to ensure that investments in research have a larger impact on social, environmental and economic conditions. ArcticNet has often articulated a need to identify critical policy connections or decision making relationships that will contribute to the development and dissemination of 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 (e.g. ArcticNet Strategic Vision, 2006). The policy relevance of Arctic science is being highlighted and queried by other users, and ArcticNet provides a critically relevant context within which to increase our collective understanding of how to make these linkages more effective and meaningful (ArcticNet Strategic Vision, 2006; Hik 2009).

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, region, national or international levels remains limited. It is argued that it requires many of these same elements (e.g. the generation of leading edge science) 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 important for ArcticNet, as a program, to contribute to and develop a critical understanding of this process in order to make the best use of the knowledge generated under the scientific activities of the program and ultimately, 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 includes activities that are both integrative and specific. The integrative scale that examines the overall science-policy landscape in the context of ArcticNet contributions, while the Case Study scale examines specific and often local impacts of research can be linked to decision-making and policy. The various sub-projects are clustered into 1) a knowledge generation and process emphasis, and 2) a policy and decision-making emphasis (Table 1; Figure 1). We have also attempted to examine these processes a scales that extend from circumpolar to regional (see Table 1).

In each case, we are studying how 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. This project is not acting as an evaluation of the relevance or effectiveness of any approach, but rather provides an framework for understanding which steps and factors in the knowledge translation process are most important or influential for this area of science to policy translation. It is taking advantage of the opportunity the ArcticNet program has created to study the intersections among communities, and to enhance the abilities of both

scientists and decision makers to improve knowledge exchange and utilization in the future.

Below, we focus on activities conducted during 2013-14, however much of the research is cumulative and linked to previously reported work.

Activities

In 2013-14, considerable progress was made on each of the 10 sub-projects individually, and the integrative framework for the entire project. We are now in the process of synthesizing and bringing together the findings of these 10 studies in order to provide a thorough understanding of the knowledge-policy landscape in the Arctic. The research activities for each of the 10 case studies or sub-projectsI are summarized here.

1. ArcticNet's IRIS Process as a Science-Policy Mechanism: A Case Study of IRIS 4 in Nunavik and Nunatsiavut (Furgal, Hik, Nickels, Buckham, Kelley, Moss-Davies, Braithwaite)

- Participant list generation, participant recruitment, and phone/in person (at the ArcticNet ASM) interviews conducted with lead chapter authors, organizers and regional policy makers involved in IRIS 4 (n=11) (October/ November/December 2013)
- Interview audio recordings transcribed and sent to participants for verification (December/ January 2014)
- Participant list generation, participant recruitment, and phone interviews with decision/ policy makers who are intended recipients and end-users of the IRIS 4 outputs (n=15) (January/ February 2014)

2. Understanding Scientist and Decision Maker Perspectives on the Arctic Science-Policy Landscape (Furgal, Buckham, Hik, Nickels, Moss-Davies, Braithwaite)

- Development of a 31 question survey for researchers, policy makers and employees at intermediary organizations who are working at the science-policy interface in the Arctic (August/ September 2013)
- Piloted the survey with various researchers and policy makers at ArcticNet's 2013 Annual Scientific Meeting (December 2013)
- Feedback generated from the survey pilot was used to improve/finalize the survey for international distribution (January 2014)
- Survey uploaded to Qualtrics, an online survey platform (January 2014) and internationally distributed in February 2014

3. Barriers and Facilitators to Indigenous Knowledge Incorporation in Policy-Making: The Nunatsiavut Case (Buckham, Furgal, Sheldon)

- Completion and defense of Master's thesis (September 2013)
- Development and distribution of a final results and policy recommendations document to the Nunatsiavut Government and project participants (January 2014)
- Drafting of two journal articles (Fall 2013), with plans to submit to journals in Spring 2014

4. Role of GIS in Health Impact Assessment Processes for Natural Resource Development in the Canadian Arctic (McGetrick, Hik, Bubela)

- Participant list generation and recruitment and in person/phone interviews (in Yellowknife and Bechoko, Northwest Territories) with stakeholders in the environmental assessment for the proposed Nico mining project (n=13) (June 2013-October 2013)
- Automated content analysis of transcripts from public hearing transcripts (March-May 2013)
- Interview audio recordings transcribed and sent to participants for verification (July-November 2013)

- Analysis of verified interview transcripts (December 2013-present)
- Manuscript preparation (January-February 2014)

5. Community Adaptation Planning in Nunavut (Johnson, Meakin, Furgal)

- Most work completed prior to this year, although some additional publications in progress

6. Sharing Research Findings in the Canadian Arctic: Assessing the Integration of Community-Based Knowledge in Policy Communications about Climate Change Related Food Insecurity (Hirsch, Furgal)

- Most work completed prior to this year, although some additional publications in progress

7. The Role of Science Advisors in Facilitating Science-Policy Linkages (Hik, Morris)

- Meta-analysis of science advisor roles using descriptions of these offices in Canada and internationally (May-September 2013)
- Review of positions providing this function in Canada (federal, provincial, territorial) (ongoing)
- Preparation of manuscript.(October 2013 – January 2014)

8. Assessment and Indicators of Arctic Science Impact (Furgal, Hik, Braithwaite, Meakin, Nickels, Moss-Davies, Durkalec, Buckham)

- Literature review and analysis completed
- Proposed framework developed which is a composite of others however adapted to Arctic impact assessment interests including the need for indicators that capture various aspects of society, inputs, process and outcomes of the science process, and various scales of impacts of science at the community, regional, Territorial, and National levels.
- Poster presented at ArcticNet ASM and peer reviewed paper in preparation to submit in Spring 2014.

9. Quantitative Analysis of Linkages between Policy and Knowledge during the first cycle of ArcticNet Using Analysis of Parliamentary Hansard (Hik, Morris, Bubela, Bieber)

- Analysis and summary of the Arctic Institute of North America databases – Canadian IPY and ArcticNet Publications (May 2013)
- Keyword list generation and preliminary searches of the Hansard databases – House of Commons, Senate, Yukon, Northwest Territories and Nunavut (for example, the terms ArcticNet and International Polar Year - see Figure 2) (May-September 2013)
- Keyword searches of the LexisNexis – Academic and Canadian Newsstand Daily Majors online databases (June-August 2013)
- Analysis of ArcticNet Media Archive (July - August 2013)
- Presentation of poster at ASM (December 2013)
- Draft report preparation (September 2013 – January 2014)

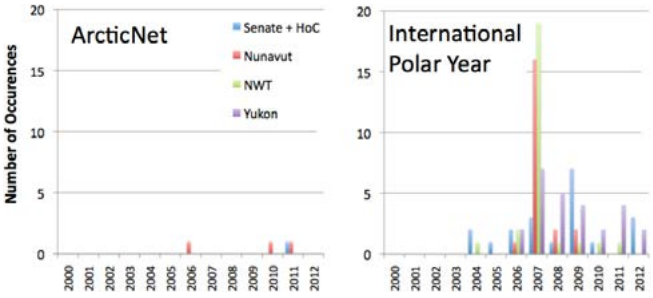

Figure 2. There are a few references to either ArcticNet or International Polar Year (IPY) in legislative debates, as recorded in Hansard, although IPY was more common in the territories.

10. ICC Consideration and Development of a Position on Oil and Gas in the Arctic (Meakin, Moss-Davies, Hik, Furgal, McGetrick)

- Comparative review of other Arctic indigenous Oil and Gas statements (specifically Nenets region in Russia) (December 2013 – January 2014)
- Outline of manuscript based on this comparative analysis (January 2014)

Results

Overview

We are working at various geographical and jurisdictional scales in order to learn about the various aspects of the science-policy interface (Table 1 for list of sub-projects and geographic foci). We have learned from each of the sub-projects and results stemming from this year's research activities have been organized around: i) aspects of the research-interface that the results address; and, ii) cross-cutting and common themes that emanate from the sub-projects.

Aspects of the Research-Policy Interface

Results indicate that there are four distinct aspects or elements of the research-policy interface that assist us in understanding the movement of research into policy. These four elements or aspects are summarized graphically (Figure 1) and include:

1. Knowledge Generation
2. Processes Linking Research and Policy
3. Policy/Decision-Making Products
4. Roles and Responsibilities of Actors at the Interface

For a summary of which sub-projects address these four elements please see Table 2. For each aspect we provide a summary of results emanating from each of the sub-projects.

Table 2. Content focus of sub-projects

Sub-Project Activity	Aspects of the Knowledge-Policy Interface											
	Knowledge Generation			Processes linking Knowledge-Policy				Policy/Decision Making Products				Role of Actors
	C	KG	KP	A	S	PM	F	C	P	Acc	Par	*
IRIS Case Study		**X**	**X**		X	**X**		X				X
Science-Policy Survey				X			**X**	**X**	**X**			X
Indigenous Knowledge and Policy	X	X		X		**X**	X	**X**			X	X
Impact of GIS on Policy		**X**	X	**X**	X					X	X	X
Community Adaptation Planning	X				**X**			X		X	X	
Research Knowledge Tracking			X	**X**	X	**X**						X
Role of Science Policy Advisors			X	X		X	X	X	**X**	X	X	**X**
Science Impact Framework and Indicators		X	X		**X**	X			**X**			
Hansard Analysis									X			**X**
ICC oil and Gas Declarations									X	**X**	X	

X = aspect covered in sub-project
X = aspect a particular emphasis in the sub-project

Knowledge Generation
C – Context
KG – Knowledge Generation Process
KP – Knowledge Products

Process Linking Knowledge and Policy
A – Actors
S – Scale
PM – Pathways/Mechanisms
F – Factors Influencing

Policy/Decision Making Products
C – Context
P – Product
Acc – Access
Par – Participation

Role of Actors
This aspect applies to all 3 stages of the knowledge-policy process

1. Knowledge Generation

- Researchers involved in IRIS 4 indicated that their increase contact and relationships with northern communities was not something that the IRIS process necessarily facilitated – rather this was already happening prior to ArcticNet and is indicative of larger research methodology trends (IRIS Case Study)
- Dispossession impacts indigenous peoples relationally, as a co-constitutive structural barrier between indigenous peoples, the state, and the resources of society; interventions to address this factor require engaging indigenous peoples and state institutions in a process of mutual transformation. For example, discourse analysis shows that indigenous and community voices are often expressing very different issues compared to government or industry in environmental assessment processes (see Figure 3) (GIS Impact on Policy)

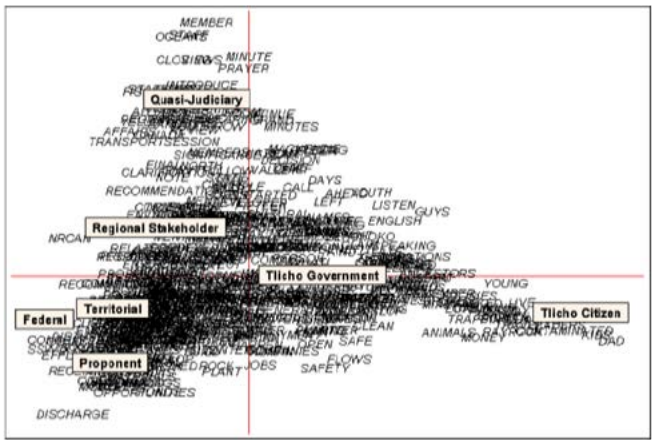

Figure 3. Summary analysis of multi-stakeholder dialogue from the public record for the Nico mine development environmental assessment conducted under the Mackenzie Valley Resource Management Act. Figure shows proximal similarity according to Jaccard's coefficient showing axial terms coded from documents. There is a clear separation of actor perspectives (stakeholders), with the largest separation being the indigenous and local voices. (Source: Freja, McGetrick, preliminary MSc results)

- Researchers participating in IRIS 4 from the natural sciences generally welcomed the experience to connect with policy makers, but on the whole prefer to focus on their science and research (Indigenous Knowledge and Policy)

2. Processes Linking Research and Policy-Makers

- The IRIS process in Nunavik and Nunatsiavut has overall been perceived to positively promote/support science impact on policy by researchers and policy makers involved in the process
- The process was celebrated in bringing together government actors from Nunavik and Nunatsiavut – described as a historic event in relationship building between the two jurisdictions (IRIS Case Study)
- Transformation of social practices around arctic resource developments requires responsible engagement at various spatial and temporal scales by multiple stakeholders, including industry, regulators, government, researchers, and communities (GIS Impact on Policy)
- Opportunities for Indigenous Knowledge (IK) incorporation in policy and decision-making occurs in three main ways:
- Governance and Institutions (formal policy making structures and processes)
- Community Participation and Engagement (formal avenues and processes that provide Indigenous peoples access to and opportunities to influence policy making)
- IK Research and Support Programs (avenues and sources of IK that effect how IK is accessed and if IK is available to decision and policy makers)
- For each of these three thematic areas, a list of elements (n=54) that have been found to aid IK incorporation into policy was developed (Indigenous Knowledge and Policy)

3. Policy/Decision Making Products

- Science advisors play a key role in decision-making and policy, and can be a primary conduit for bring science and knowledge into the process of decision-making (Role of Science Advisors)
- Non-governmental organizations like ICC can play a central role by developing consensus documents or products such as the Oil and Gas Declaration (ICC)

4. Roles and Responsibilities at the Interface

- Participants involved in IRIS 4 processes perceive it to be the role/responsibility of social science researchers to bridge the gap between research and policy (IRIS Case Study)
- Science advisors play a key role in decision-making and policy, and can be a primary conduit for bring science and knowledge into the process of decision-making (Role of Science Advisors)
- Science advisors have defined but flexible roles that allow them to be key integrators of science and policy or decision-making, by getting key participants the right information at the right time (Role of Science Advisors)

- The role of politicians in bridging the science-policy interface is less clear as there is not much discourse in Parliamentary records or announcements of policy. While some of this bridging takes place in committee work, the evidence is difficult to quantify (Hansard)

Thematic Categories

Our results elucidate that there are common elements and themes that undercut several sub-projects. By characterizing and understanding what those common elements are among cases we further our understanding of how to bridge the research-policy gap. We found that across cases, the following five themes underpinned numerous cases (see Table 3):

1. Differences in Actor Perspectives
2. Spatial Scale
3. Consensus of Approaches
4. Drivers of Research-Policy
5. Asymmetries in level and forms of information

Table 3. Major Themes emanating from cross-project analysis

Sub-Project Activity	Themes				
	Difference in Actor Perspectives	Spatial Scale	Consensus of Approaches	Drivers	Asymmetry in Info
IRIS Case Study	X				X
Science-Policy Survey	**X**				
Indigenous Knowledge and Policy	X		**X**		
Impact of GIS on Policy		X			**X**
Community Adaptation Planning	**X**				
Research Knowledge Tracking		**X**			
Role of Science Policy Advisors			**X**		
Science Impact Framework and Indicators		X			
Hansard Analysis				**X**	
ICC oil and Gas Declarations	**X**		X		

X = aspect covered in sub-project
X = aspect a particular emphasis in the sub-project

1. Differences in Actor Perspectives

- The role of various actors was the dominant influence on science-policy linkages, based on our comparison, of all subprojects and case studies
- Defining the role of actors early in the process may be beneficial for improving the quality of knowledge generation and knowledge translation and application
- This pattern emerged clearly in initial Survey results, and was locally evident in various aspects of Community Adaptation Planning

2. Spatial Scale

- Evidence that spatial scale was a central theme emerged primarily from the work conducted by Rachel Hirch on Research Knowledge Tracking
- The results of this study illustrated that who receives, transmits and acts upon the Qaujigiartiit Health Research Centre's message about climate change and health in Nunavut
- Visualization of policy networks is a useful participatory evaluation tool because it easily facilitates an interactive experience where, for example, structural changes can be observed in the overall network simply by adding or removing actors
- This means that assessments are made at both the system and individual levels, which operate at different spatial scales

3. Consensus of Approaches

- This IK-policy framework created was useful in identifying areas of strength and current challenges/ recommended areas for future policy development in the Nunatsiavut case related to the incorporation of Inuit Knowledge, values, and principles in to policies
- Particular areas of strength include: Political Autonomy; Recognition of IK and Customary Laws; Ownership of Research
- Current challenges/areas of future policy development include: Documentation and Storage of IK; Indigenous Representation; Indigenous Worldview Represented in Governance Processes; Targeting Stakeholders

- However, consensus on how to approach these ideals is not clear from the literature and from the case (Indigenous Knowledge and Policy)

4. Drivers of Research-Policy

Our approach did not provide extensive information about drivers of the research-policy interaction, but the analysis of Hansard transcripts suggests that more needs to be do to bring key science results to the attention of decision making bodies at the high levels (e.g. Figure 2 indicates little visibility at political level, based on Hansard). While science advisors have a role to play in facilitating this exchange, we don't see them as being drivers of this thematic engagement. (Hansard Analysis)

5. Asymmetries in level and forms of information

- Addressing asymmetries of evidence by employing technological platforms in development forums reflects earlier stages of knowledge generation in communities' definition of research issues, access to technology and training, and community-level data collection, stewardship, and analysis (Impact of GIS on Policy)

Table 4. Critical elements of IK incorporation in policy

How is IK Incorporated?	Critical Element of IK Incorporation	What Aids IK Incorporation?
Governance and Institutions	Political Autonomy	Legal recognition of an Indigenous group's rights to and jurisdiction over its lands, territories and resources.
	Recognition of IK and Customary Laws	Institutions recognize and enshrine IK and Customary Laws. Evidence of guidelines for IK implementation in government processes.
	Indigenous Representation	Rules ensuring that decision-makers and civil servants are Indigenous. Evidence of employment strategies to attract and train Indigenous employees.
	Indigenous Worldview Reflected in Governance Processes	Process reflects Indigenous culture. Evidenced by use of traditional languages and decision-making processes, role of Elders.
Community Participation and Engagement	Community Power and Influence Over Decisions and Outcomes	Communities perceive that policy makers have the political will to include their perspectives, are given more than an advisory role, and are involved early and throughout the process
	Capacity and Ability to Engage and Contribute to the Policy Process	Community members are permitted to communicate in the language or medium (oral, video, story, written) of their choice. There are efforts to limit the use of technical jargon.
	Targeting Stakeholders	Elders and IK holders are identified as stakeholders, and are participating in the process
IK Research and Support Programs	Documentation and Storage	Evidence of a program for collecting, storing, and organizing IK for ease of access for decision-makers that is under the control of the Indigenous group.
	Ownership over Research	Indigenous group has control over research and approval of projects and conducting/participating in research.
	Health of Local/Informal Institutions	Evidence of IK and Customary Laws being practiced and applied. Existence of programming between Elders and youth.

With respect to the critical elements that facilitate or inhibit the incorporation of IK into policy, we have summarized several key considerations in Table 4. These have emerged from our summary of key documents, and provide a set of benchmark criteria for determining how IK is incorporated into policy. Most of our case studies have informed this analysis. Rather than emphasize regional differences, we have tried to examine emergent similarities.

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 set 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.

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 have provided 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.

The central objective of ArcticNet, as stated in the original proposal to the Network Centres of Excellence Program and as stated in the ArcticNet Strategic Plan (2006) is to contribute 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. For example, Furgal et al. (2003) identify a series of factors were associated with the NCP'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 actors and publics.

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 ofter 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 (see Table 4). 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.

Overall, 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.

Conclusion

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 learning, 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 societial benefits at local, regional, national and international levels, and for planning future research activities in the Arctic.

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.

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, upon the completion of this project and reporting we anticipate providing new information that will help ArcticNet science products become more commonly used in policy and decision making. There are many relevant studies addressing various aspects of the knowledge to policy nexus (e.g. Bradshaw and Borchers 2000; Caine and Krogman 2010; Lemos and Morehouse 2005; Noble and Bronson 2005; Walker et al. 2009; among many others). We think the strength of our work, which has emerged over the past several years, is the connection between processes that occur across the entire matrix. Completing this analysis will be the focus of our final efforts over the next few months.

Building on work underway (and various pieces to be completed by end of 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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