Examining the Potential of Inuit Art and Artistic Processes to Facilitate Knowledge
System Bridging About Environmental Change

by

Kaitlyn Rathwell

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: See Statement of Contributions included in the thesis. This is a true cope of the thesis, including any required final revisions, as accepted by my examiners.

Statement of Contributions

In the School of Environment, Resources and Sustainability, two forms of presentation of the doctoral dissertation are permitted: (1) a standard dissertation monograph, and (2) a manuscript option centred on three or four published or publishable learned journal-type manuscripts on related matters, packaged with introductory and concluding chapters that integrate the purposes/research agenda and findings/implications, with the required result forming a conceptual whole. This thesis used the manuscript option. Specific requirements relating to the manuscript option, which have been met, are as follows:

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- In no case can a co-author serve as an external examiner for the thesis.

Findings from this dissertation are reported in three single- or co-authored manuscripts (Chapters 4, 5, and 6). Two of these chapters have been accepted for publication in refereed journals. Chapter 6 will be submitted for publication.
I testify that I am the primary author of the manuscripts in my dissertation, and that the work was dominated by my intellectual efforts.

Kaitlyn Rathwell (Student)

Co-authorship for D. Armitage (Advisor) on chapters Three and Four, and F. Berkes (Committee Member) on chapter Three, was determined based on meeting the following criteria:

- Substantive contributions to the conception and design of the work, and to interpretation of data;
- Contributing to editing and revising the work critically for important intellectual content;
- Final approval of the versions of the chapters that will be published as refereed journal articles;
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

I testify that Kaitlyn Rathwell is the primary author of the manuscripts in this dissertation, that the work was dominated by her intellectual efforts, and that I have met the four tests outlined above.

Derek Armitage (Advisor)   Fikret Berkes
University of Waterloo   University of Manitoba

Abstract

Art and artistic processes have an important role to play to bridge knowledge systems about environmental change and to inform governance action. Inuit and western knowledge systems contribute to understanding and governance of Arctic sea ice in Canada. Siku, sea ice in Inuktitut, connects to Inuit identity and well-being via multiple dimensions, including for example, food security, mythology and origin stories, travel and mental health. Increasingly complex and unprecedented changes in Arctic sea ice, driven by global climate change, presents challenges for local communities and their efforts to respond to those changes. Of utmost importance is to build bridges between Indigenous and scientific knowledge systems to enhance decision making about environmental change, such as Arctic sea ice change, as well as between generations of Indigenous knowledge holders to maintain social-ecological resilience.

Six months living in Pangnirtung and Cape Dorset, Nunavut, Canada enabled an embodied experience and the collection of rich qualitative data upon which this dissertation is based. Knowledge systems bridging is defined here as connecting two or more knowledge systems to arrive at novel insights about phenomena, and in ways that nurture the integrity of each participating knowledge system. In this dissertation, I demonstrate that art and artistic processes have an important role to play in the creation of compelling settings to respectfully bridge knowledge systems. In doing so, I provide a qualitative analysis that strengthens global understandings of *how* artistic approaches can enhance bridging diverse knowledge systems about environmental change and governance.

To study how artworks and artistic processes facilitate bridging knowledge systems, I used complementary data collection techniques. A systematic literature review provided the foundation for a typology of settings that are used in the environmental change governance literature to bridge indigenous and scientific knowledge systems. Semi-structured interviews with thirty professional Inuit artists, one-on-one sea ice drawing projects, and a collaborative mural process provide rich qualitative data on the role of art in Inuit communities as it relates to environmental change (e.g., sea ice change). A collaborative mural and sea ice drawing projects with

Inuit youth, artists and elders, helped narrow in on artistic interpretations of complex processes of environmental change. I outline below the three objectives that guided my research process, and I identify briefly how each of these objectives is addressed.

> *(1) To create a typology of settings used to bridge Indigenous and scientific knowledge systems about environmental change, and situate art and artistic processes within the typology.*

This objective was addressed using a meta synthesis approach to identify the various settings in which bridging of knowledge may occur based on an analysis of the literature, how those settings function, and how diverse settings can act in synergy (see Chapter 4). This 'typology of settings' to bridge knowledge systems is the first framework of its kind. I organize the typology as four broad settings – epistemology, methods and process, brokerage and networks, and institutions and governance - and discuss how they relate to each other in theory and practice.

The typology can be used as a touchstone for scholars and practitioners interested in knowledge co-production. In addition, two main insights are emphasized in this analysis: 1) the necessity of engagement with the philosophical dimensions of knowledge and knowledge systems (epistemology and ontology) when seeking to bridge knowledge systems; and, (2) consideration of how diverse settings can function to complement and/or contradict each other. Future efforts in the area of knowledge integration, or knowledge bridging for decision-making about the environment, must be cautious of settings chosen, especially since knowledge and power are related. The typology presented in this dissertation can help orient scholars towards the diversity of settings to bridge knowledge, and how to find synergies between them in ways that enhance research, governance and foster positive social interactions. One setting that stood out as potentially very robust, yet understudied, for bridging knowledge systems was art and artistic processes.

(2) To study the underlying mechanisms through which art and artistic processes may contribute to efforts to bridge knowledge systems about environmental change.

Participatory artistic methods are a novel 'setting' (See Chapter 4) to bridge knowledge systems. As an aesthetic boundary object in this space, artworks serve as a context in which to foster continuity between generations and as a shared reference point to connect different social worlds. I study *how* artistic approaches can enhance bridging of diverse knowledge systems about sea ice and climate change. To do this, I interviewed thirty professional Inuit artists, and facilitated three collaborative art projects (see Chapter 3). I identified six underlying mechanisms through which art and artistic processes support knowledge system bridging (see Chapter 5).

(3) To identify how artworks and the artists reflect both tangible and intangible dimensions of knowledge about climate and sea ice change (e.g., reflections of lived experience, elements of emotion, values), and the implications for knowledge bridging processes.

This objective was informed by a focused study of seven Inuit artists who created artworks specifically about sea ice and climate change (Chapter 6). Using a manual coding technique (see Chapter 3 for details), I examined how the artworks and artists use symbolism, metaphor and other aesthetic devices to convey messages about their lived experience of sea ice and climate change. Stories told by artists about their artworks emphasized the importance of adaptation and interconnectedness, and also embraced themes about transformation and renewal. The insights provided by the artists participating in this research are crucial in the context of bridging knowledge systems to enhance our understanding of, and potential responses to, environmental change. Connecting with the intangible aspects of knowledge systems is an ongoing challenge, yet accounting for these aspects of knowledge is a critical component of salient and legitimate environmental governance. Artists and their artworks can illuminate the less

tangible aspects of knowledge about change, and hence, have an important role to play at the interface of diverse knowledge systems.

   The recent history of Inuit people has been one of change imposed from the outside. Contact with non-Inuit, and the period of forced settlement and assimilation represent significant transformations in the Inuit experience as does rapid climate and sea ice change. Today's Inuit artists are telling stories of transformation while embedding elements of Inuit identity into artworks as a way to reflect social and emotional cohesion during these changes. Changes in sea ice and climate, the result of exogenous drivers that impact Indigenous communities, are similarly being captured in artworks. As with historical artefacts and other forms of expression, current artworks have the capacity to carry important narratives about environmental change and how to best approach environmental governance.

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Chapter 1: Introduction

1.0 Introduction

A small Inuit carving of mother and child was brought by Sheila Watt-Cloutier to the Inter-Government Negotiating Committee Toward a Global Convention on Persistent Organic Pollutants (POPs) meeting in Montreal 1998. Sheila Watt-Cloutier, then the Chair of the Inuit Circumpolar Council, presented the artwork as a gift. Her presentation of the carving was combined with a personal narrative about the meaning of Inuit knowledge and the impact of POP's on the culture and well-being of Inuit people. The artwork and its symbolism was a centerpiece for reflection and discussion throughout the meeting, and it is credited with having a transformative impact on meeting outcomes (Johnson 2014; Watt- Cloutier 2015). This particular work of art was 'mobile' enough to travel between two social worlds, from the local Inuit carver in Canada's Arctic, to an international decision making arena in Montreal. The Inuit artwork illuminated that humanity was at the heart of the POP issue, an issue that until that meeting had been viewed as largely a technical challenge.

This thesis engages with artworks and artistic processes, and examines how they create settings to bridge different understandings, experiences and knowledge across cultures and generations. In particular, I engage with Inuit art and artistic processes as a setting that reflects and communicates Inuit understandings, experiences and knowledge about particular forms of change in Canada's Arctic, and most notably changes in climate and sea ice. In this context, art communicates culture, and at a deeper level the humanity often missing in our efforts to understand and make sense of change, by triggering among 'viewers' or participants in the art experience, knowledge sharing, emotion and a sensory response (Cunsolo Willox et al. 2012; Shimamura and Palmer 2012, and see Chapters 5 and 6). Art and artistic processes can, as the example from the POPs experience illustrates, help to create a compelling and overarching narrative on issues or themes that affect people and their communities (see Lejano et al. 2013).

Climate change and related changes to Arctic sea ice and marine ecosystems, are having crucial and significant impacts on Inuit well-being. The rates of environmental

change occurring in the Artic are described as rapid in the environmental change literature and scholarly discourse. Inuit perspectives allude to this rapid change as well, describing that "…the earth is faster now…" (Krupnik & Jolly 2002, pp. 7). Climate change is described as occurring in the Arctic twice as fast as elsewhere in the world (AMAP 2011), with Arctic sea ice loss occurring at a rate faster than scientific models had projected (Stroeve et al. 2007), and there is scientific consensus that the Arctic will be ice free in summer months well within the century (AMAP 2011; Overpeck et al. 2005).

The narrative expressed in Inuit art reflects a rich culture and intimate knowledge of the environment and how it changes. Inuit artists continue to embed their knowledge and experiences into artworks with the intention of creating cultural continuity with the next generation. Moreover, Inuit artists have adapted to the introduction of commercial art making in their communities (Coward Wight 2012) and used it as an opportunity to embed traditional knowledge into aesthetic form (Vancouver art Gallery 2006, Komangapik et al. 2011) (see Chapter 2 and 5). At the same time, artists explore their current perspectives and experiences of the environmental change in artistic processes (see Chapters 5 and 6). In this regard, Inuit artists and their artworks have a potentially tremendous capacity to communicate Indigenous perspectives of Arctic sea ice and climate change.

1.1 Research goal and objectives

The goal of my dissertation is to examine the different approaches or settings in which different Indigenous and scientific knowledge systems can be bridged, and the specific functioning of artworks and artistic processes as one potentially novel setting to consider Inuit perspectives on sea ice change and climate change. Art and artistic processes are not tested explicitly as bridges between Indigenous and scientific knowledge systems. Rather, I investigate how and why artworks and artistic processes can enhance efforts to respectfully bridge Indigenous and scientific knowledge systems. In this regard, the importance of bridging knowledge systems crosses several dimensions: between Indigenous and scientific knowledge systems, from local to global decision making processes, as well as between generations (e.g., elders and youth). I used three

specific objectives to guide my research and to showcase three specific contributions to knowledge:

1. To create a typology of settings used to bridge Indigenous and scientific knowledge systems about environmental change, and situate art and artistic processes within the typology.
2. To study the underlying mechanisms through which art and artistic processes may contribute to efforts to bridge knowledge systems about environmental change.
3. To identify how artworks and the artists reflect both tangible and intangible dimensions of knowledge about climate and sea ice change (e.g., reflections of lived experience, elements of emotion, values), and the implications for knowledge bridging processes.

Understanding and responding to environmental change in the Arctic poses challenges. There is a well-established need for, and an opportunity to learn from, the expertise of Indigenous people, both for sense making about change, and for how to navigate change and uncertainty in ways that reflect cultural norms (Reidlinger and Berkes 2003; Laidler 2006; Leduc 2006). The reasons for doing so include, but also extend beyond, the requirements for decolonizing methodologies (Tuhiwai Smith 1999) and reconciliation of colonial policies and practices in decision making about the environment (Nadasdy 2003). As the Nuu-chah-nulth Hereditary Chief Richard Atleo has stated, "…These [non-Indigenous] visitors have made their gifts of science and technology evident and recognizable to all, while our gifts of relationality and *isaak* (respect for all life forms) have only now begun to emerge (pp. 134, Umeek 2004)". As delineated in my research, being open to artists and their artworks is one way to engage with the many gifts that come from Inuit knowledge. Artworks and the narratives artists tell about them, thus offer a potentially novel and robust setting to consider Inuit perspectives on environmental change, and the broader cultural and knowledge systems from which these perspectives emerge.

1.2 Research context

The Inuit of northern Canada are an Indigenous people with a unique culture, language and legacy. They are the descendants of the Thule prehistoric peoples who lived

in the North throughout the middle ages and the little ice age (Raghavan et al. 2014). Like their ancestors, Inuit have always used artworks and amulets for spiritual and ideological purposes such as rites of passage for youth or shamans healing rituals. As I explain in more detail in section 2.4 about Inuit art, the modern and contemporary carvings and prints that are considered Inuit art by western institutions were innovated into Inuit communities.

Inuit art has since provided an important cultural and economic mainstay in some Inuit communities, two of which are Cape Dorset and Pangnirtung, Nunavut. However, as is evident throughout this thesis, the vital connection Inuit people have to the Arctic landscape and ecosystems was not always respected by settler culture (see chapter 2). It was not until 1973 that the Inuit Tapirisat of Canada (ITC) - an organizational entity focused on the rights and well-being of Inuit – began a vocal study that formed a geographic basis of the Nunavut Territory. In 1980, ITC delegates unanimously passed a resolution to establish what is now known as Nunavut. Twelve years later, negotiations between Inuit representatives and the federal government led to the Nunavut Land Claims Agreement (1992). In this agreement were commitments to establish the territory of Nunavut as well as provisions to move toward self-government. The Nunavut Land Claims Agreement reflected an important shift in the relationships between the federal government and Inuit peoples. However, throughout this period of identity assertion, it is important to note that Inuit used artworks and artistic processes to maintain cultural knowledge (Tester and Kulchyski 1996; Government of Nunavut 2007).

Artworks and art making have a function to maintain traditional knowledge between generations of Inuit. As such artworks and art making may also serve as a form of non-violent resistance to colonialism and the negative impacts of forced cultural assimilation (Igloliorte 2014 and see Chapters 2 and 7). Inuit do this by carrying traditional knowledge in aesthetic form in artworks, storytelling and artmaking. Maintaining the resilience of traditional knowledge and Inuit Qaujimajatuqangit in light of ongoing pressures from ecological and social drivers of change is an important challenge (ACIA 2005; Arctic Council 2013).

Cape Dorset and Pangnirtung, Nunavut are two communities in Baffin Island and they provide the context for this study (Figure 1). Both communities are experiencing rapid social-ecological change from external drivers. Social and political drivers of change have included systematic oppression of Inuit people by settlers, dismissing of cultural truths during residential schooling, and assimilation orchestrated by the Canadian Government in the 1950's (Tester and Kulchyski 1999; see chapter 2). Economic drivers from global development are putting pressure on communities for resource development, extraction and tourism. Inuit youth are influenced by global youth culture since technology and media have reached the Arctic, and youth are reconciling a modern and Inuit identity. Finally, ecological drivers of change, such as sea ice loss from global climate change, impacts the connection between people and the environment (Gearheard et al. 2012; Krupnik and Jolly 2002). These drivers of change and social-ecological realities are present in all Arctic communities. Cape Dorset and Pangnirtung were chosen specifically because of the legacy and ongoing prominence of art making in these communities (Hessel and Hessel 1998).

Figure 1 Map of study region. Cape Dorset, Pangnirtung, and Iqaluit in Nunavut, Canada.

Canada

Arctic Ocean

Baffin Bay

Beaufort Sea

Pangnirtung

Iqaluit

Cape Dorset

0   185   370   740 Kilometers

Pangnirtung is a community of 1510 residents nestled on a fjord between Auyuittuq National Park and Cumberland Sound. Pangnirtung, first a trading post for the Hudson Bay Company, acquired municipal government status in 1973. The main livelihood activities in Pangnirtung are subsistence hunting, working at the fish plant, art and craft making, and municipal and territorial government services (e.g. water and sewage truck drivers, local nursing station, and Nunavut Health Services). People hunt a variety of marine mammals including beluga, narwhal, seal, and bowhead whale, as well as geese and ducks. Tourism is active in Pangnirtung, facilitated by the dramatic natural landscape, and coastal access. Textile arts, carving and graphic arts including printmaking and drawing are the prominent art forms practiced in Pangnirtung. Pangnirtung is famous for its weaving and has a state-of-art print shop and adjoined art co-op called 'The Uqqurmiut Center for the Arts' that facilitates sales of Inuit prints, drawings and carvings locally, nationally and internationally.

Cape Dorset, with a current population of about 1400 residents, was established as a trading post to service the Hudson Bay Company, and became a settlement in the 1950's. Art making is Cape Dorset's most important economic activity. The community calls itself 'The Capital of Inuit Art' with a reputation for artistic talent extending internationally (Hessel and Hessel 1998, Coward Wight 2012). Lithography, stone cut, stencil and etching are all techniques used for Cape Dorset prints. The annual Cape Dorset Print collection is an opportunity to showcase selected works to a global arts audience. Pencil crayons and large format paper are provided to graphic artists in the community so that both 'in house' artists and community artists can sell drawings to the Kinngait art co-op to be turned into prints or for direct shipment south. Carving with power tools is the other most prominent art form in the community. Plans are emerging for a world-class art center in Cape Dorset, which would provide many opportunities to foster the talent of individuals in this community.

Like in Pangnirtung, residents of Cape Dorset have close connections to the land for subsistence and identity formation. Hunters and their families enjoy boating while they hunt marine mammals. A good hunter in both Pangnirtung and Cape Dorset will share his catch upon returning to the community.

1.3 Navigating my research journey

A research project involving indigenous peoples requires scholars to be particularly reflective and sensitive to issues of privilege and identity. I am a gender queer individual; although I largely identify as 'femme' female, I also morph into an androgynous state of appearance wearing bulky masculine clothing, no makeup and hiding my hair under a baseball cap. Likewise, having an assertive personality and focus on career and education are considered masculine attributes. Not being hyper-feminine in appearance was a conscious decision I made while in the communities. This is because I already received some unwanted attention as a white female and did not want to exacerbate any issues. Part of engaging respectfully is being educated and aware, and another part is being adaptive and open. My experience in the Arctic was a gendered one. I was able to connect more easily and deeply with other females. This was in part due to our natural connection and also due to unspoken social conventions.

My ancestry includes French, German, English, Irish and Indigenous. I am 1/16 Ojibway, but I approached this research from my position as a white settler. An acute awareness of the history between settlers and Indigenous peoples in Canada helped me to approach my research from a sensitive and empathetic place, while maintaining a commitment to rigorous research.

My doctoral dissertation draws on my engagement with the theoretical literature regarding Indigenous and Inuit knowledge, knowledge system bridging (particularly in an environmental change context), the role art and artistic processes to bridge knowledge systems, Inuit art and the history of Inuit art. These topics are further explored in my lived, and empirical research experience in two communities in Nunavut, Canada (see Chapters 2, 5, 6, and 7).

I had the opportunity to live in Pangnirtung and Cape Dorset for five consecutive months during 2013, and I also had a return field visit in 2015. During this time, I held many roles, foremost as a researcher, but also as a musician, eventually as a friend to many, and even a *panik* (Inuktitut for daughter) to one elder. My confidence in these different roles, ways of engaging with the world and sharing experiences with people, influenced my research process and the outcomes that are reflected in this thesis.

I lived in Pangnirtung for the first five weeks as part of a field school program offered by the University of Manitoba. During the organized university program, I was taught rudimentary Inuktitut, and was further exposed to cultural and political studies, as well as the ecology of the Arctic via western scientific and traditional sources. Accommodation for the first two months (June – August) involved camping in a location just outside of Pangnirtung. However, by September there was snow, and I was invited to stay at a municipally owned house. Following the Field school program, I navigated life in Pangnirtung, and subsequently Cape Dorset, as a scholar and more importantly as a guest in these communities. As such, I spent afternoons and evenings with new Inuit friends, making house visits, or hosting visitors at my place.

During my third month in Pangnirtung I was given a puppy, and named her Nanook after her mother's reputation as a polar bear hunting dog. I nurtured this small animal throughout my time in the Arctic. Upon reflection, I believe that adopting this 'Arctic animal', and having her with me played a role in helping individuals to connect and accept me in their communities. Nanook brings much joy to my family and she is a living connection I have in my daily life to the communities where we lived.

A personal highlight during my time in the Nunavut, and an experience that facilitated my own research, was being invited as a guest on the land with hunters and their families. As we boated past icebergs, hunters described how climate change is impacting their hunting practices. Despite the time I spent on the land with this group, I could not help but feel that so much of the hunter's knowledge about climate and sea ice change was not communicated to me during our brief discussions in English. However, as I began engaging artistically with my hosts and others in the communities, I started to learn more deeply the profound implications and experiences of sea ice and climate change that people are experiencing in many parts of the Arctic (see Chapter 6).

I first engaged artistically with my hosts by singing. As a non-Inuit I wanted to connect with my Inuit hosts, and without many material resources to offer, I used my singing voice as a way to reach out to people. In doing so, I was reminded of how the late ethnographer and linguist Knud Rasmussen sang for his Inuit hosts during the Fifth Thule Expedition of 1921-1924 (Kunuk and Cohn 2008). He is described as having a bellowing,

operatic voice, and Rasmussen's songs provided his Inuit hosts with the evidence they needed to continue a relationship with him, and to share their cultural and spiritual artefacts and practices with him.

Connecting to people through my music helped me to build the kinds of relationships needed for the participatory art projects with Inuit artist's elders and youth in which I was engaged (see Chapter 3). The music I composed during the process of this dissertation also contributes to my knowledge mobilization strategy, and the power of art to connect people and their cultures was a crucial aspect of my lived experience in the Canadian Arctic.

And yet, while I 'lived' the evidence that engagement with art and artists is potentially powerful context in which to bridge different understandings, experiences and knowledge across cultures and generations, there also exists an inherent tension in using art and Indigenous artworks as a focus of my doctoral research. A question never far from my mind was how could I legitimately examine Indigenous art and Inuit knowledge in an academic context without jeopardizing the relationality, and wholeness of the knowledge that I sought to illuminate? This central concern has influenced my choice of methodology, analysis and presentation of findings and insights (see Chapter 3 and 7). I am indebted to my teachers, both Inuit and non-Inuit, inside and outside of the academy, for their patience and insights for how to navigate this challenge.

Indeed, I learned how songs in Inuit tradition take on a value, much like food or clothing, and could be traded for such items. As Martin (2012, pg. 9) has stated, "Inuit songs are occasionally decontextualized and even exported to serve as tools and trade items: they might then take on a spiritual power, function symbolically to evoke a particular place or ideology." Much like songs, the artworks and stories that artists and elders shared about them, flow through this thesis. They bring with them an ideology and sense of place, yet there is a risk that they are become decontextualized, and considered through a narrow prism required to fit the confines of a doctoral dissertation. This is an ongoing tension in my dissertation, and one I hope I have navigated successfully. I take inspiration from the carving of mother and child that was taken from its local context in order to travel to the POP meeting in Montreal, and yet it was contextualized by the

narrative used by Sheila Watt Cloutier as she presented the artwork. That carving acted as a powerful symbol and served to evoke the meanings and experiences of a specific place. As a result, the carving had an impact on the decisions that took place during the meetings by requiring participants to engage with the emotional dimensions of the POPs issue.

My concern in this dissertation has been to qualitatively examine the contexts in which knowledge bridging can occur, generally, and more specifically how art can be simultaneously valued in its own right, and used as setting to communicate the human experience of change. In the section below, I outline the remaining chapters in my dissertation, with each reflecting a different point along my research journey.

1.4 Organization of thesis

This doctoral thesis is organized into six additional chapters following this introduction. Chapters 4, 5 and 6 have been prepared as articles that have been, or will be, submitted to different academic journals as jointly- (Chapters 4 and 5) or sole-authored (Chapter 6) publications. These chapters are intended as 'stand-alone' papers, and as a result, there is some repetition with regard to framing, empirical context, and methodological approach. At the same time, the papers are complementary and they seek to build upon each other and map out a comprehensive understanding of the challenges of bridging knowledge in the context of change, and the potential role of art and artistic processes as one novel setting in which that bridging process may be supported. I summarize each chapter below.

In Chapter 2, I elaborate on the history of Inuit art, and the specifics of art making as it was introduced and expanded into commercial production in Cape Dorset and Pangnirtung, Nunavut. I reflect on Inuit knowledge as a distinct form of Indigenous knowledge, and Inuit Qaujimajatuqangit (IQ) as the way Inuit describe and reflect their principals for how to engage with the world. I expand on the diverse, and sometimes complementary, roles of art and artistic processes as a setting in which to bridge different understandings, experiences and knowledge. These roles include bridging knowledge across cultures (e.g., Inuit, non-Inuit) and generations (e.g., elders and youth), as well as an income generator for individuals and communities, and as a context for emotional

therapy. I use also Chapter 2 as a way to further position myself as a researcher (also see section 1.3 above and Chapter 7) in the sensitive and specialized context of Indigenous knowledge and Inuit art.

In Chapter 3, I articulate my overarching methodology and corresponding methods. The purpose of this chapter is to highlight the philosophical foundations of my research, describe the interconnected methods I used to engage with Inuit communities and collect data, and summarize the strategies I used analyze my data. I also describe the ethics clearance and research license I obtained to undertake research in two northern communities (Pangnirtung and Cape Dorset, Nunavut), and how I endeavoured to approach my research ethically. Chapters 4, 5 and 6 also contain specific methods sections, as is required for peer-reviewed scientific publications.

In Chapter 4, I elaborate in particular on settings used to bridge Indigenous and scientific knowledge systems in the context of environmental decision-making. Using a meta-synthesis approach we identified four broad categories, or settings, through which knowledge bridging may occur: Epistemological arenas; methods and processes; brokerage; and, institutions/ governance. This is the first typology of its kind. These settings can function in synergy, or complement each other to produce 'bundles' of settings. We discuss how scholars and practitioners can leverage our typology to enhance practice and policy related to Indigenous and scientific knowledge systems. Of importance, we identify how art and artistic processes emerge as one particularly novel setting to bridge knowledge in ways that can complement other settings and methods (e.g. interviews, on the land trips, bridging organizations), and how artworks and artistic processes open windows to various dimensions of knowledge, such as beliefs and values, emotions, and felt experience.

Art and artistic processes are identified as a particularly robust setting to bridge Indigenous and scientific knowledge systems in Chapter 4. In Chapter 5 my co-author and I draw on empirical data from thirty professional Inuit artists and a collaborative mural making project with Inuit elders, artists and youth. We examine the mechanisms through which art and artistic processes can contribute to knowledge system bridging about Arctic sea ice change and how to navigate it. Six primary mechanisms through

which art and artistic processes support bridging knowledge systems are identified in this paper: 1) embedding knowledge-practice-belief into art objects, 2) sharing knowledge using the 'special language' that is art, 3) art making skills shared in practice, 4) monitoring social-ecological change and anomaly, 5) maintaining continuity over time in art and art making, and 6) knowledge co-production / creation of hybrid knowledge. Findings from this empirical work are discussed in relation to a broader literature on the role of art in helping society build and maintain social-ecological resilience in the context of environmental change and uncertainty.

In Chapter 6, I examine in-depth the knowledge, perspectives and narratives about climate and sea ice change in the artworks of seven leading Inuit artists. Through drawing projects and interviews with these artists, I analyze how artists and their artworks reflect both the tangible and intangible aspects of their knowledge and experience relating to climate and sea ice change. Inuit artists have created works that illuminate factual knowledge about climate and sea ice change, and at the same time, also convey crucially important elements of emotion, values and beliefs, and their sensory experience relating to this environmental change. The less tangible aspects of knowledge (e.g., emotion, belief) are at the core of respectful and meaningful bridges between knowledge systems. For example, the Inuit artists I spoke with helped to portray the emotion and values associated with adaptation, the importance of patience and staying connected (e.g., to each other, to the land), and the importance of 'keeping one's chin up' despite the tremendous changes occurring with sea ice and climate. Transformation is a theme evident in Inuit art about climate and sea ice change, but the artworks and the ways those artworks were communicated transformation is also embraced as a form of renewal. In this chapter I show how art and the artist can enhance knowledge system bridging between cultures and generations, and that further opportunities to incorporate art and artistic processes into decision making about the environment is warranted.

I summarize in the final chapter six core findings associated with my doctoral research, and that reflect the totality of insights across the three empirical chapters (Chapters 4, 5 and 6). In brief, these findings include: (1) The many settings used to bridge knowledge systems can be conceptualized in four categories: Epistemological arenas; methods and processes; brokerage; and, institutions/ governance; (2) Art supports

knowledge system bridging via six mechanisms; (3) Artists and their artworks enhance knowledge system bridging by illuminating knowledge as fact, emotion, belief, values and sensory experience; (4) Inuit artworks about sea ice and climate change embrace transformation, interconnection and adaptation as central themes; (5) Knowledge co-production via artistic processes creates opportunities for innovation and empowerment; (6) Art and artistic processes can make important contributes to environmental change governance. I reiterate in Chapter 7 how my findings suggest that art and artistic processes can make significant contributions to bridging knowledge systems about change.

I take an opportunity to discuss some additional insights that reflect the breadth of my research, including:

a) The role of art in Inuit communities; I discuss how there's always been Inuit art but that now it's a commodity, and what that means, why that's important and/or problematic.

b) How Inuit people leveraged the introduction of commercial art making as a way to embed and maintain knowledge and culture - despite structural subjugation.

I seek also to explicitly connect the findings from my doctoral research to the context of linked social and ecological sustainability, the focus of my doctoral program in the School of Environment, Resources and Sustainability. Finally, I discuss my knowledge mobilization strategy and the tangible recommendations I can make based on my research.

1.5. Conclusions

In this chapter, I have outlined the objectives, context and scope of my doctoral dissertation. I have introduced the idea of art and artistic processes as a way to bridge knowledge systems using the compelling story of an Inuit carving that impacted international environmental decision-making. I have described my entrée into the Arctic communities of Pangnirtung and Cape Dorset. I made explicit the personal connections I have with the communities where I worked, and how my background and experiences have positioned me as both a scholar and guest in a northern Indigenous context. I have

further reflected on the tension inherent in considering art and artistic processes as they create a setting in which to bridge different understandings, experiences and knowledge, and the challenges of engaging with Inuit artists in a holistic way while meeting the requirements for doctoral research.

Chapter 2: Inuit knowledge, Inuit art and the challenge of bridging knowledge systems

2.0 Introduction

Hunter Paul Quassa is filmed holding a small 100-year-old ivory comb on which a whale hunt is engraved. After describing the artwork of the whale hunt engraving on the comb, he explains that the carving functions as a reflection of his culture by mirroring knowledge, practice, tradition and history (Kunuk 1998). Quassa (as filmed in Kunuk 1998) says: "What [the comb] is saying in this engraving is that Inuit have always hunted bowhead. It may not be in words, but these pictures tell us who we are".

Quassa speaks about this engraving on the ivory comb in response to the legal controversy regarding the bowhead whale hunt that occurred between a group of Inuit hunters and the Canadian government in 1994 (Kunuk 1998). The group of hunters had caught an injured bowhead whale while boating in response to the dying wish of a respected elder. The community members explain in the film that elders crave bowhead whale meat since it has been forbidden to catch it for forty years by international law (Kunuk 1998). To end one's life with a craving for bowhead is not how Inuit want to leave their elders. But, the bowhead was added to the endangered species list after the expansion of the baleen and blubber market in Europe caused the population to reach record low levels.

In response to the controversy Inuit hunter Quassa shares the engraved comb as evidence of the Inuit right to hunt whale. He asserts that the artwork on the comb functions as a historical 'document', just as western legal documentation and written words are considered as legitimate. Artworks, such as the comb, reflect Indigenous knowledge, and therefore, can provide important settings to understand and legitimize Indigenous knowledge and practice (Koutouki et al. 2015). The imagery engraved on the comb, along with other testimony and evidence contributed to Inuit hunters winning the legal right to hunt bowhead whale in 1996.

In this chapter, I establish a foundation of concepts and themes, and a context for this dissertation. Working with Indigenous knowledge and Indigenous knowledge holders requires a sensitive approach, and an understanding of historical and ongoing issues of

power (Tuhiwai Smith 1999; Wilson 2008). I seek to reflect an understanding of Indigenous knowledge, and more specifically, Inuit Qaujimajatuqangit which "…embraces all aspects of traditional Inuit culture, including values, world-view, language, social organization, knowledge, life skills, perceptions and expectations (Nunavut Social Development Council 1999).

I identify the challenges of bridging knowledge systems and the importance of doing so in an Arctic environmental change context. I then unpack, from a broad literature, the different ways art and artistic processes create a compelling setting to bridge knowledge systems. In particular, I describe how artworks and artistic processes have been important for Inuit people and their ancestors. In doing so, I review the tumultuous social-political history during which traditional Inuit art was expanded into the Canadian and international market economy. I stress the way Inuit artists leveraged, and continue to leverage, art making to support their families, and to simultaneously maintain and honour their Indigenous knowledge in aesthetic form. My intent in this review is also to reflect the challenges and politics of defining and studying knowledge systems and the role of Inuit art as a setting in which to bridge knowledge systems.

2.1 Inuit knowledge or Inuit Qaujimajatuqangit (IQ)

Although traditional practice and culture is embedded into carvings, Indigenous knowledge systems are far from 'static' in time and space (Nader 1996). Indigenous knowledge, in fact, embraces dynamism and adaptiveness while maintaining continuity, and identity (Agrawal 2002; Wilson 2008). Scholars are now sensitive to the idea that Indigenous knowledge systems are not 'ancient', but rather that they have unique elements, such as how knowledge is shared between individuals over time, and in how knowledge, practices and beliefs are integrated (Wilson 2008; Berkes 2012).

Various definitions of Indigenous knowledge, traditional ecological knowledge (TEK), and local knowledge are outlined in Table 1. Over the past twenty-five years, the definitions of Indigenous knowledge have evolved to be increasingly culturally sensitive and respectful. For example, The World Bank (1991:pg 1) defined Indigenous knowledge '…an important resource', reducing it to fit within a western capitalist way of seeing the world. More nuanced definitions are provided by social scientists (e.g.,

anthropologists, political scientists) and interdisciplinary environmental scholars (see Table 3). Berkes' (2012) conceptualization of Indigenous knowledge as a 'knowledge-practice-belief' complex has been helpful for western-trained scholars to frame the complexities and interconnectedness of Indigenous knowledge. As such, this framing has gained traction in the natural resource management, environmental governance and resilience thinking literatures. Yet, some scholars have cautioned against silos of 'knowledge', 'practice' and 'belief' being used to describe complexities of Indigenous knowledge (see for example, Forbes & Stammler 2009, pp. 32).

Table 1: Selected definitions of Indigenous knowledge (IK), traditional ecological knowledge (IEK) and local knowledge

Concept	Group	Definition	Implications
Indigenous Knowledge (IK)	World Bank (Development Organization)	"Indigenous knowledge is an important natural resource" (Agrawal 1995 pp. 416; citing Warren 1991: 1).	• Viewed through the prism of a western capitalist value system • Knowledge described as one dimensional • Knowledge implied to be 'static'
	Davis (2006) cites Howden 2001, pp. 60	"Indigenous knowledge is a living system of information management which has its roots in ancient traditions. It relates to culture and artistic expression and to physical survival and environmental management. It controls individual behavior, as it does community conduct..."	• Gives IK agency and legacy • IK is dynamic • Explicit emphasis on culture and artistic expression
Traditional Ecological Knowledge (TEK)	Berkes 2008, pp. 7	"Cumulative body of knowledge, practice and beliefs, evolving by adaptive processes and handed down through generation by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment."	• TEK is dynamic • Transmission is necessarily cultural and social • Knowledge tightly coupled with practice and belief
	Huntington 2000	The knowledge and insights acquired through extensive observation of an area or a species	• Experience based • Locally rooted

	Davis 2006 (pp. 154) cites Winona LaDuke (1994, pp. 127)	" Traditional ecological knowledge is the culturally and spiritually based way in which Indigenous peoples relate to their ecosystems" "this knowledge is founded on spiritual-cultural instructions from 'time immemorial' and on generations of careful observation within an ecosystem of continuous residence".	• Culturally and spiritually coupled with knowledge • Locally based • From 'time immemorial'
Local Knowledge	Tengö and Belfrage 2004 refer to Olsson and Folke (2001)	Knowledge held by a specific group of people about their local ecosystems	• Group specific • Ecosystem specific
	Fabricus et al. (2006)	"… is embedded in local customs, belief systems, and learning" with characteristics such as : • Constantly evolving • Tacit • Everyday knowledge for day-to-day challenges • The backbone of local social institutions".	• Linked with institutions • Dynamic
Inuit Qaujimajatu qangit (IQ)	Nunavut Social Development Council 1999 In Nunavut Department of Education 2007 pg. 22	Inuit Qaujimajatuqangit embraces all aspects of traditional Inuit culture, including values, world-view, language, social organization, knowledge, life skills, perceptions and expectations	• Holistic • All encompassing
	Following Leduc 2006, pg. 4	"Practical common sense; teachings and experiences passed through generations; knowing the country; being rooted in spiritual	• All encompassing • Defined as a mixture of behaviors, values and obligations

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		health; a way of life; an authority system of rules for resource use; respect; obligation to share; wisdom in using knowledge; using heart and head together."	• Spiritual, emotional and practical elements are emphasized
Inuit Ecological Knowledge	Wenzel 1999, pp. 114	"The dynamic interactions that occur among all the elements, cultural as well as biophysical, within the Northern ecosystem."	• Dynamic • Human and non-human elements •
	Thorpe 2000, pp. 17	"An accumulated and evolving body of knowledge that comprises the intergenerational survival skills, beliefs, practices, wisdom and experiences of Inuit as people who demonstrate an acute awareness of dynamic interactions between people, lands and resources."	• Dynamic • Spiritual, emotional and practical

In the context of Nunavut, the broader terminology to communicate Inuit knowledge and worldview is *Inuit Qaujimajatuqangit* (IQ). The eight guiding principles of IQ, as articulated by the Nunavut Government (2004) are (Source: Laidler 2007):

1. Respecting others, relationships, and caring for people

2. Fostering good spirit by being open, welcoming and inclusive

3. Serving and providing for family and/or community

4. Decision making through discussion and consensus

5. Developing skills through practice, effort, and action

6. Working together for a common cause

7. Being innovative and resourceful in seeking solutions

8. Respecting and caring for the land, animals and environment

The term IQ was created in 1998 to clarify central guiding principles for governance of the newly emerged political entity of Nunavut (post-Nunavut Land Claims Agreement) (Wenzel 2004; Laidler 2007). IQ frames general principles or cultural values (see Box 4) that dictate Inuit conduct toward each other and non-humans. For example, Wenzel (2004) describes accompanying a Clyde River hunter on a hunting trip. The hunter accidentally shot a dog, mistaking it for a seal. Based on codes of behaviour and orally transmitted Inuit values, the hunter made sure to move the dog carcass from the ice, for not to do so would offend the seals, resulting in bad seal hunting. Investing the effort into transporting the dog carcass to land is a way to show respect to all animals (Wenzel 2004, pp. 246).

Inuit ecological knowledge (IEK) is described as embedded within IQ, just as traditional ecological knowledge can be thought of as embedded within traditional knowledge (Berkes 2012; Leduc 2011; Wenzel 2004). This means that IEK cannot be separated from the broader knowledge system in which it is embedded. Thus, efforts to engage with IEK or TEK to gain insights into environmental change may miss important cultural nuances if an understanding of the wider traditional knowledge or IQ framing is ignored (Wenzel 2004; Cruikshank 2005; Leduc 2011). To expand on the above example,

IEK is the knowledge that allows the Clyde hunter to navigate the land, his expertise to understand seal behaviour for hunting, and his practice in how to successfully hunt. IEK is also the guiding principles of how to treat and relate to animals that motivated this Clyde hunter to take the time to move the dog carcass off the ice. Insight about IQ or traditional knowledge can help scholars and the environmental change literature to contextualize the contributions of Indigenous knowledge holders (Cruikshank 2005; Martin 2012).

Disregard for the complexity and nuance of Indigenous knowledge is resulting in maladaptive responses to change and the perpetuation of mistrust between and among Indigenous peoples, governments and scientists (Nadasdy 2003; Castleden et al. 2012). These kind of processes can lead to poor science, incomplete results and have the potential to inappropriately inform policy and decision making. This is one of the main reasons why my work is important – it can help to support better science, contribute to better decisions, and forge stronger relationships and partnerships across cultures. There is a significant literature on the challenges and limitations of initiatives to 'integrate' Indigenous knowledge or IQ into decision-making processes (Bohensky and Maru 2011; Gomez- Baggethum et al. 2013; Tengö et al. 2014; Dokis 2015). Novel strategies to bridge knowledge systems are needed.

2.2 Bridging knowledge systems

Knowledge systems are defined here as the lens through which people see the world. That lens influences individual and collective perceptions of environmental change, personal identity, social and personal values, how to use the senses, and one's role in relation to life and the cosmos (Carolan 2005; Godfrey-Smith 2003; Midgley 2000; Tuhiwai Smith 1999). Knowledge systems are co-constructed and adapt over time by people as they relate to each other and their environment (Burchell et al. 1991; Dryzek 2005; Reid et al. 2006). For example, the language, assumptions and narratives to describe change in the Arctic frame the actions, attitudes and decisions that are considered legitimate responses to that change (see Foucault 1991; Forsyth 2003; Robbins 2012; Dryzek 2005). Given the implications for action, it is important that diverse views, perspectives and narratives are reflected in framings of social and

ecological change (Leach et al. 2010). In particular, political ecologists have shown how local and Indigenous narratives may be incongruent with the dominant discourse on environmental change (Fairhead and Leach 1995; Robbins 2012). Local and Indigenous perspectives can, therefore, contribute to broadening what is considered a legitimate response to environmental change (Batterbury 1997).

In Canada's Arctic, efforts to make sense of climate and sea ice change should reflect both Inuit and western scientific perspectives. Western scientists, through observation and data collection, seek to empirically document changes in sea ice extent and quality, whereas Inuit are experiencing and adapting to changes in sea ice through travel and the practice of hunting. Thus, the ways of knowing sea ice driven by very different initial conditions. As Laidler (2006) describes, Inuit and western science embark on very different processes for understanding and acting upon changes in Arctic sea ice. For instance, scientists may use satellite imagery and analyze changes at a desk with a computer; Inuit utilize their understanding of changing hunting conditions (e.g., movement of wildlife) and discuss experienced changes amongst themselves to verify observations (Laidler 2006; Laidler et al. 2011). Further, these two knowledge systems are positioned differently in their capacity to have their knowledge articulated and legitimized in global environmental discourse (Ford et al. 2009; Laidler 2007; Smith & Sharp 2012). Yet, scholars have made clear the practical and moral importance of both these knowledge systems for collective sense making and decision making (Agrawal 1995; Bohensky & Mauro 2011; Fazey et al. 2012; Reid et al. 2006; Reed et al. 2011).

Indigenous knowledge can make valuable contributions to understanding environmental change and fostering responses to that change beyond the local level. However, finding robust and respectful ways to bridge Indigenous and scientific knowledge continues to be a challenge (Tengö et al. 2014). Superficial engagement with knowledge systems, or processes dominated by only one knowledge system, are repeatedly critiqued for their detrimental outcomes (Booth and Skelton 2011; Weiss et al. 2013; Gratani 2014). Settings to bridge knowledge systems in ways that respect diverse knowledge systems and the many tangible (experiences, facts) and intangible (emotions, beliefs, values) aspects of knowledge remains a critical challenge. Responding to this challenge is the focus of the systematic review in Chapter 4, and in that context I clarify

how different settings (e.g., processes and methods, institutional settings) can facilitate knowledge system bridging, and how these opportunities to bridge knowledge systems act in synergy across multiple levels. One potentially novel setting and entrée to facilitate knowledge bridging opportunities is through art and artistic processes.

2.3 The different ways art and artistic processes create a compelling setting to bridge knowledge systems.

Art and artistic processes may offer a robust mechanism to connect ways of knowing, such as Indigenous and scientific knowledge systems (Zurba and Berkes 2014; Heras and Tabàra 2015). My empirical research (Chapter 5 and 6) provides an opportunity to test and reflect on if and how art and artistic processes are a robust setting to bridge knowledge, and draws on experiences in two Inuit communities in Nunavut (see Chapter 3). I have identified in the literature several broad insights on the role of art and artistic process in knowledge bridging. These insights from the literature facilitate my analysis and help me to situate my empirical work (see also Chapters 5 and 6).

For example, the sort of hybrid knowledge sought in knowledge bridging processes is that which stimulates a new way of seeing the world. This way of seeing the world should, ideally, be different from that held by individuals and groups at the initiation of a knowledge sharing process (Elgin 2002). In this regard, art is unique in its ability to evoke imagery that challenges people's perspectives and values, offering a new way of seeing the world through by the mutual experience of art and the artistic process (Marcuse 1979). For instance, Goldstein (2008) uses theater to connect heterosexual and homosexual ways of experiencing the world. Her research as an ethnographer investigates homophobia and gender discrimination in high schools, but she communicates her ethnographic findings in the form of plays and uses the process of enacting these plays as a means to stimulate a discourse toward gender consciousness (Goldstein 2008). Through theatre, Goldstein (2008) illustrates the possibility of engaging in a collective creative process to stimulate epistemological re-framing and shifts in values.

The arts are argued to be crucial for imagining and the building of plausible futures, and in ways that require a 'stretching' of current epistemologies to create

alternative visions of the future (Davies and Sarpong 2013). Similarly, in the context of art and science collaborations, there have been a number of examples of demonstrated and positive outcomes when enhancing and advancing both scientific and artistic insights (Elgin 2012; Scheffer et al. 2015; Rathwell and Westley *in review*). In a recent study on this theme (Rathwell and Westley *in review*), participating scientists describe how working with artists has helped them to ask novel questions and to look at their research in a new way. Artists likewise articulate the benefits they accrue from the factual knowledge and expertise of scientists which they use to strengthen the knowledge foundation for their artworks.

Beyond the domain of science, art and aesthetic objects have helped whole societies and populations to stretch their ideas about how the world works, and what should be valued. Iconic images, such as the earth from space, are aesthetic ideas that re-orient the perspective of humans place in the world and the cosmos (Folke et al. *unpublished manuscript)*. On a smaller scale, Elgin (2002) has described how Picasso could paint portraits in ways that highlight previously unimagined characteristics of individuals: "[b]y painting a picture of Stein that highlights certain hitherto unnoticed or emphasized features, Picasso enabled us to see her differently" (pp. 15). Similarly, Indigenous stories and oral histories show tremendous ability to stretch our epistemological foundations. For instance, the life stories of Athapaskan and Tlingit elders depict a reality where glaciers are sentient beings that interact with humans (Cruikshank 2005; 2012). These stories broaden our epistemological foundations by asking us to consider a reality where geological entities, such as glaciers, have agency and demonstrate affect to human actions.

Art and artistic processes also have the potential to contribute to knowledge bridging by nurturing the creation of artistic, or aesthetic, boundary objects. Artistic mediums themselves function as a 'boundary object' by connecting multiple epistemologies in an artistic process, or acting as a mutual point of reference (Star and Griesmeir 1989; Singh 2011). In this way, contemporary aesthetic objects, such as visual artworks, can travel through social networks and impact agents and social processes (e.g., decision making initiatives). This was the case with an Inuit carving that functioned as an aesthetic boundary object when it was brought to an international meeting on Persistent

Organic Pollutants (POPs) in Montreal. The carving of an Inuit mother and child served as an object around which participants connected symbolically with the people who are being impacted by POPs contamination (see Chapter 1). This Inuit carving is just one example. The multiple aesthetic roles of video screens as boundary objects have also been studied in the context of perception and the experience of the audience in participatory art (Lee 2009). Artworks have been found useful as boundary objects in participatory research to understand the perspectives of marginalized youth in India about mobile technology (Singh 2011). Finally, artworks resulting from a collaborative mural projects have been framed as a boundary object at the interface of Indigenous and settler knowledge systems (Zurba and Berkes 2014; Zurba and Friezen 2015).

Artistic processes and artworks (as boundary objects) offer space for multiple *languages* of expression. Different ways of expressing the human condition can stimulate emotive, sensory and knowledge centers in the brain (Shimamura and Palmer 2012). This is important because scholars have argued that bridging knowledge systems can be aided by allowing the holders of different knowledge systems to express themselves in mediums that best reflect their culture. As Maffie (2009) suggests, when attempting to bridge knowledge systems "[w]e should place as few restrictions as possible upon the manner in which alternative knowledge's present themselves. Poetry, song, dance, music, proverbs, narrative, pictures, plastic art, and ritual and ceremonial performance [can] exist alongside discursive argument and scientific experiment" (Maffie 2009, pp. 62). Calls for diversifying forms of sharing knowledge are also echoed in literature about knowledge co-production (Armitage et al. 2014).

An informative example is provided by Leduc's (2010) description of the naiveté when equating the Inuit word *Sila* with the English word *weather* while engaging with Inuit understandings of climate change. Simple translation of the word *'Sila'* into weather masks the depth of meaning and ancestral wisdom also attached to *Sila*. Indeed, *Sila* represents wisdom, interconnection between elements of the world and the weather currently being experienced. Sila also represents relationality, reciprocity, and protocols for connecting beyond the human world. Leduc (2010) submits that such shallow interpretations of Inuit perspectives reinforce power imbalances between science and Indigenous ways of knowing. Instead, scientists could learn much from engaging with

the artistic forms of oral history, and thus, the meaning *attached* to the concept and story of *Sila*. This example shows that the oral history surrounding *Sila* provides a very different perspective on how Inuit understand the weather – for Inuit, *Sila* also embodies their relationship to their ancestors, nature, animals and the cosmos.

The importance of *language of expression* is also reflected in research by Nayak and Berkes (2010), in which they discuss marginalization of fisher people in the Chilika Lagoon, India. They engage with local metaphors as "an alternate way to understand marginalization from the fisher's point of view" (Nayak and Berkes 2010, pp. 555). By including the study of metaphor in their methodology, they were able to capture additional insights on the meaning of marginalization. For example, 'Mother Chilika is crying' is a metaphor used by fisher people in the lagoon to describe a changing lagoon ecosystem. This metaphor situates people in relation to their changing environment (*'mother'*) and also evokes the emotional effect of environmental degradation on local people (*'is crying'*). By incorporating local metaphor into their research, Nayak and Berkes (2010) were better equipped to appreciate and articulate just how local experience of lagoon degradation is different from the formal government reports on the status of the lagoon fishery.

During periods of rapid, unexpected environmental and/or social change, art and artistic processes help to maintain emotional and social cohesion by acting as a stable aesthetic objects, or serve to create shared reference points that connect conditions before and after periods of rapid change. For example, sculpture in Haida Gwaii totemic art has enabled a social sense of coherence during periods of crisis and rapid change – creating a knowledge bridge between generations. Jim Hart, Hereditary Leader of the Saangga.ahl Clan and also an artist, reflects on carved totem poles:

> *"Our people, when they carved these pieces, they were survivors from the old sicknesses that were going around. We have pieces in collections today that are older then those days, and then when the sicknesses came around…The carvers that survived that – how they got together and worked on pieces to help record our history, and for us today to look at, to hang on to, to study, to talk about, because all that knowledge is in there. We look at [a piece], and study it,*

and talk to each other about it. If we're lucky, we have relatives that recognize the pieces and also know its history, even more so, and tell us the stories behind it. For us to have been able to learn from that, and to carry on from that…the amount of history that's in those things where you stand there and hang on to it, you're hanging onto all your history, your past histories. It's so important, the strength that comes through that. And the person that's standing there is the extension of all that history" – Jim Hart as quoted in Raven Travelling (Vancouver Art Gallery, 2006).

As Hart expresses, the totem poles offer the Haida people an opportunity to remain connected to their sociocultural past as they navigate social-ecological change (e.g., shifting forestry governance in the 1980s, disease epidemics). In this way, the totem art supports Haida people to maintain meaning and identity during periods of change, and that art creates a temporal bridge between their ancestors' wisdom and themselves. Just as the Haida totem art reflects a culture, Inuit graphical and sculptural art offers an entrée to better understand Inuit perspectives on Arctic sea ice and climate change.

2.4 Inuit art

The word for 'art' does not exist in Inuktitut. It is translated as "isumanivi" which means "your own thoughts", or as "sanaugaq", meaning "things made by hand", "from the imagination", or "making an object". Each of these descriptions focus on the action of art making as it was introduced to the Inuit. This linguistic nuance foreshadows the history of art making in the Arctic. The institution of art making for economic gain is a western model of production introduced into Inuit communities. But cultural practices of creating and using aesthetic objects such as intricately carved tools songs and stories have been part of the Inuit heritage for millennia. Inuk, Minni Freeman describes when art was taken 'seriously':

"Inuit made amulets, decorations for the body or hunting equipment, and replicas of everyday objects to attach to their clothing. A lot of traditional art was made for burial purposes. Those objects were taken seriously. To qallunaat [non Inuit], some Inuit use of charms may not some sound very serious. A lot of traditional art was used to "shoo away" bad spirits, to bring good luck when an

event took place, to encourage a young person to bravery, and also to escort the dead to the good spirits rather than have their spirits floating around nowhere. Very often a charm would be made for a newborn child. Some charms were made to bond closer a very special relationship. Some of these uses are still common today, especially for the bonding of special relationships. It was only when qallunaat saw this traditional art that it became "art" (Freeman 1995, 15-16).

In seeking to understand the evolving purpose of art making, I found myself asking numerous questions: What happens when commodification of art is the main motivating factor in its production? Can the role of art and artistic processes be reduced to one dimension (e.g., economic)? My research is undertaken with the recognition that there is a danger inherent in the commodification of art and artistic processes for external audiences, yet also with the recognition of the synergistic capacity of the arts to both provide economic security *and* emotional wellness, opportunities for knowledge sharing and the maintenance of Indigenous identities.

2.4.1 A historical perspective on the Inuit art industry

Nomadic hunters that travel across extensive land and ice, as in the case of the Inuit, cannot carry with them artworks and art making materials. Instead, practical items take on an aesthetic appeal. The early peoples that inhabited what is now the Canadian Arctic (e.g., Dorset and subsequently the Thule peoples) where hunters, artists and warriors and were practical with regards to aesthetic objects (Coward Wight et al. 2012). Tools, clothing and weapons were all crafted from local materials: stone, ivory, animal hides and antlers were all used. The cultural and artistic practices of both Dorset and Thule people may have contributed to the knowledge and creative practices of today's Inuit (Freeman 1995). Moreover, it is important to situate an understanding Inuit art in its broader historical context.

Several interacting factors stripped away the ability of Inuit hunters and their families to continue a self-sufficient hunting and/or nomadic lifestyle. Fur traders, missionaries and explorers have all influenced people and environments in the Arctic and catalyzed a "…complex process of cultural transformation" (Martin 2012:8). More

recently, social programs (e.g., residential schooling), resource development, and a military presence reached the Canadian Arctic by the 1950's, and significantly transformed the way Inuit could live their life and embody their culture (see Croteau 2010; Brody 2012; Truth and Reconciliation Commission of Canada 2015; Watt-Cloutier 2015).

As Inuit peoples engaged with the market economy by selling furs and sealskins, they became more dependent on a receiving market for these goods (Tester and Kulchuyski 1994). Guns and ammunition for hunting, instead of traditional tools, needed to be purchased from the Hudson's Bay Company. The more hunters used these efficient tools, the more dependent they became on the south to provide the tools (Tester and Kulchuyski 1994; Watt- Cloutier 2015). When the international fur economy was stable, sealskins could be sold to international markets, while the Inuit used the rest of the animal for subsistence. Families could make eighteen thousand dollars each year in revenue from selling these skins (Brody 2012; Watt- Cloutier 2015), with which people could purchase supplementary food, clothing and more hunting tools. However, animal rights activists successfully eliminated the sale of sealskins in America in 1972 (*Marine Mammal Protection Act*) and Europe by the 1970's. Without income from the sale of sealskins, many Inuit families suffered and even starved (Watt- Cloutier 2015).

The Canadian Government acknowledged the severity of the crisis and introduced the 'Family Allowances Act' to provide Inuit with basic income to survive in the market economy (Watt- Cloutier 2015). However, this much needed relief came with conditions. First, families must have a postal address, but this was only possible by moving into the community settlements and living in the 'matchbox' houses (without water or electricity) offered by the government. Second, children were forced to attend school. In some cases, schools were built in communities, but in other cases children were sent far away from their families for a southern education (Truth and Reconciliation Commission of Canada 2015; Watt-Cloutier 2015).

The trauma of residential schooling stemmed from many interacting factors. Some important elements are the separation of children from their families, forced assimilation that included the loss of language and culture – and in turn, a loss of sense of

self - for many children. Further, many Inuit children were physically, emotionally and sexually abused during their time in the residential school system. The reality of this trauma is only now being revealed openly (Truth and Reconciliation Commission of Canada 2015). Residential schooling exacerbated loss of cultural knowledge; children no longer had skills of how to hunt and/or sew, or how to speak their language. When these children returned to their families, many could not even communicate with their mother and father without a translator (Watt-Cloutier 2015).

Having Inuit parents living in settlements in the north, while acknowledged to be part of a social assistance program, also acted as part of a military strategy used by the Canadian Government to assert rights over the vast Arctic landscape – and potential natural resources (Tester and Kulchuyski 1994). This incentive is more obvious when one considers the Inuit families who were forced to move from Arctic Quebec to the High Arctic – where light, land and weather were significantly different, and where the social isolation weighed heavy on the mental state of many (Watt-Cloutier 2015).

Post-colonial scholars describe how the government's actions were a part of a broader social-political strategy to assimilate and control Indigenous people (Tester and Kulchyski 1994). Effectively controlling nomadic, self-reliant and resilient people is challenging if not impossible. But severing Inuit hunters from their dog teams was one way to do it – and that is exactly what the Canadian government mandated the RCMP to do. Hunters in communities spanning the entire Canadian Arctic witnessed the brutal slaughter of their precious sled dogs (Croteau 2010, Qikiqtani Inuit Association 2013). This tragic context was identified by some hunters as a precursor for art making in Inuit communities during the dialogues I had with artists. For example, when asked broadly about the role of art in their community, some artists described art making as one of few options to make money after forced settlement.

Art making for economic gain did not emerge in Nunavut out of a bubble. The quotations below were not used as part of my dissertation analysis but are provided here to exemplify the very tumultuous context in which Inuit art making for profit began. Secondly, artists and hunters have maintained a strong symbolic connection to dog teams via their artworks. Miniature dog team carvings made by talented carvers mimic the

traditional harnessing and movement of the team, and by doing so, maintains a connection to dog teams and knowledge of how to maintain them. The relationship between the Inuit art industry and colonial trauma regarding the loss of the sled dogs is explored in more detail elsewhere (Rathwell 2016). As one artist in my study remembered when sitting with me and Nanook (my adopted Arctic Pup):

"Nanook, quannuippi (how are you in Inuktitut). [Directing me] Female or male? You are going to have a dog team of huskies!?

I used to have a dog team and huskies too. But umm… the RCMP was going to kill them off; so my dad told me I have to do it myself. I didn't want the RCMP to kill them off. My dad told me that you have to kill them off because it's the rules… I was crying. I shot my dogs. There were six of them, every time I shot them I cried. I cried, I shot them, I cried. That's why my dad doesn't want me to do the dog team anymore the RCMP they are going to kill them all. I was so sad. If I saw the RCMP look at them I'd go yell at them or something like that, I got to do it myself.

KR: Were they healthy?

Yep, very healthy dogs; fat huskies, yep… I was starting with a dog team at that time … that was so sad. Well, it's been done a long time ago [laughs as I am tearing up].

KR: That is a sad story.

Ya, I know. I was crying when I was shooting. It was right over there [points out the window]. So it is all gone now. We have to fight it to; get the government for our huskies - they killed them off (Identity of participant kept anonymous, Oct 2013).

Not all hunters took it upon themselves to shoot their own dogs. The far less humane descriptions exist of RCMP officers shooting whole dog teams tied to their sleds. The

animals were piled into masses and burned. Some hunters then had no means to return to their families at outpost camps (Watt-Cloutier 2015).

Some artists in this study identified the loss of their dogs as the chronological start to their carving because they could no longer travel in the winter and hunt for food. As a result, they needed money and carving was the only option:

> "I grew up on the land. I didn't come to [Pangnirtung] until all those dogsled teams got slaughtered. I was around 33 when I moved here to [Pangnirtung]…Only after I came to the settlement did I start to carve. I learned carving by myself, nobody taught me. I started wanting to do carvings when I started noticing people making carvings and making a bit of money at the same time…Wintertime if you don't have dog teams, it seemed like there was never going to be anything to do. That's how the carving started. Summertime was not as bad because one could go out on a boat… [Art is] really important in my life, given that there are hardly ever jobs to go around and everything now a day in this world runs on money. Everything costs money" (Identity of participant kept anonymous pers. comm. August 2013).

Without their dog team's hunters could not travel, hunt, nor provide for their families. Dog teams were vital to Inuit life and culture. Well-trained dogs could lead hunters home through blizzards, and sniff out the hunt while also helping with the attack of large prey such as polar bears (Fox Gearheard et al. 2013). Further, hunting dogs in Inuit culture have intimate psychological, emotional and social connections to Inuit (Laugrand and Oosten 2015; Watt- Cloutier 2015). Dogs are the only animals in Inuit culture to be given human namesakes. This symbolizes the inextricable relationship between human and dog (Laugrand and Oosten 2015). Having a dog team meant that a boy could be a great hunter and provide for his family and community. The identity of Inuit men as proud hunters and providers was disabled when the dogs were shot. Fear and shame from this event even kept many silent about what happened to their animal counterparts for decades after (Watt Cloutier 2015).

The situation that occurred with the Inuit sled dogs is emphasized here because it is the context in which Inuit adapted to new circumstances by making artworks to sell.

Further, it foreshadows the importance of bridging knowledge systems in ways that account for the values and knowledge of local people. In the case of the sled dogs, a policy created in a non-Inuit context was imposed in a culturally inappropriate manner and it demonstrated the brutality imposed on Inuit people by outside groups. Finally, art making then became more than a means to subsistence for Inuit people after their precious companions were killed. It was also a way to preserve their culture and knowledge in aesthetic form. In that sense, creating and selling artworks to preserve cultural knowledge and identity can be thought of as a form of peaceful resistance to colonialism and for understanding and healing.

2.4.2 The innovation of 'Inuit art' as an economic commodity

In the 1950's, the Canadian government, in collaboration with the Hudson's Bay Company and the Montreal Arts Guild, identified an opportunity to create an art market as a component of the broader 'social development programming' across Canada's North. A few northern communities in particular, including Pangnirtung and Cape Dorset, were identified as particularly promising locations for the development of an Inuit art industry (Coward Wight 2012). As noted above, artworks had long been part of the culture and heritage of Inuit people, but the emergence of art as a commodity was novel.

The emergence of art as a commodity was also catalyzed when a young artist and adventurer named James Houston travelled on a rare medical flight to the Canadian Arctic in 1948 (Coward Wight 2012). Passionate about drawing, he spent time sketching his first Arctic experience. During this time, one unnamed Inuit onlooker presented Houston with a small carving. Houston expressed great pleasure with the carving. Throughout the following week he was presented with several more carvings. Proudly displaying his gifts to the Montreal Handicrafts Guild, upon his return, he proposed returning to the Arctic to focus on making purchases of carvings for the Guild (Coward Wight 2012). During a second trip to the Canadian Arctic in 1949, Houston purchased approximately 1000 art objects from the Inuit (Coward Wight et al. 2012). In less than ten years, sculpture from Inuit communities was in high demand and being showcased in prestigious galleries across Canada and internationally.

In addition to purchasing the art and bringing it south for sale, Houston also worked with intellectuals, art collectors and galleries across Canada to create a suitable narrative with which to describe Inuit aesthetic works (Coward Wight 2012). He and his young wife, Alma, used their charisma and charm to travel and market the Inuit artworks. They appeared on radio shows and wrote magazine and newspaper articles, 'branding' what was becoming 'Inuit art' (Coward Wight 2012). Using the rhetoric of "modern art" linked to "primitivism" and "national culture", Houston provided meaningful terms for audience to create a personal connection to Inuit art (Vorano 2012).

Throughout the 1950's, 1960's and 1970's well-marketed gala openings for sales of Inuit art in galleries across Canada continued to build intrigue and accessibility amongst the southern population. At the same time, the southern market started to dictate the form that Inuit artworks would take. Inuit carvers where taught early on to respond to the market demands of the south. For example, one Guild official is documented in 1950 as having requested Houston to focus on: "…large stone pieces [as they are] are very popular and the more [the Inuit] can make big pieces of good quality the better" (Coward Wight 2012 pp. 24). In stark contrast to the small mobile aesthetic objects created and historically used by Inuit, the carvers now created large stone pieces for sale in the south. Yet, the ingenuity of Inuit knowledge has prevailed. While still adapting to southern tastes, artworks and artists have shared and preserved their knowledge and culture in an aesthetic form, at a time in history when that knowledge and culture was under threat (Igloliorte 2014).

Inuit art exists today as a respected genre. Concerned stakeholders including art collectors, the Canadian government and northern cultural workers established an Inuit Art Foundation. Governed entirely by Inuit artists and cultural workers in the Inuit Art Foundation is mandated to support the development and maintenance of Inuit art in Canada (EPMRBAES 2011). Galleries all across Canada have permanent and travelling exhibitions of Inuit artworks. For example, the National Art Gallery of Canada has a permanent Inuit art wing and curators that specialize in Inuit art. High-end art retailers sell Inuit art in boutique stores in large cities in Canada USA and Europe. Isuma TV, launched in 2008, is an online platform that supports the Inuit artistic voice, and the development and promotion of Inuit multi-media art, such as film (see website,

http://www.isuma.tv). Atanarjuat (The Fast Runner) is an Inuit film directed by Zacharias Kunuk of Isuma TV that has garnered international acclaim and won the Camera d'Or at Cannes Film Festival in 2001. This film is one example of how art and artistic processes, supported by platforms such as IsumaTV, can bring Inuit culture and perspectives to the fore of international arts culture.

Despite a tumultuous history, Inuit artists and their artwork have had a broad and lasting impact on the national and international art scene. However, the contributions that come from engagement with Inuit art exist beyond the public arts domain. The capacity for art and artistic processes to support efforts to bridge knowledge systems, and to promote Inuit Qaujimajatuqangit across cultures and generations, are also significant but largely understudied. These potential roles are explored further in this PhD dissertation.

2.5 Summary

Inuit knowledge is a distinct form of Indigenous knowledge, and Inuit Qaujimajatuqangit (IQ) is the way Inuit describe and reflect their principles for how to engage with the world. I have summarized key aspects of Indigenous and Inuit knowledge as relevant to my own research. I have situated this understanding in a tumultuous social-political history of Nunavut during which Inuit art was integrated into the Canadian and international market economy. It is within this context that my PhD research examines the role of art and artistic processes to bridge knowledge systems. As a result, I have identified the diverse capacities and roles of art and artistic processes in an Indigenous context. My dissertation research provides an opportunity to connect insights from the literature about art and art making at the interface of knowledge systems and generations (see Chapter 4), with the specific experience of the individuals that participated in this study (see Chapters 5 and 6). In doing so, I contribute novel insights at the intersection of art, Indigenous knowledge and environmental change.

Chapter 3: Methodology and methods

3.0 Introduction

In this chapter, I describe my research approach in terms of: a) key philosophical research pillars that framed my work; b) the ethics and ethical protocols followed when designing and conducting this research; c) the methods of data collection; d) the analytical and reflective processes I used to interpret and synthesise the data I collected; and, e) revisiting my positionality in light of my methodology and methods.

3.1 Philosophical foundations

Three philosophical perspectives have helped to frame my research: 1) a critical realist perspective; 2) a post-structural perspective; and, 3) a transdisciplinary perspective. For example, critical realism (Forsyth 2003; Robbins 2005; Carolan 2005) is an appropriate conceptual foundation for my work because it accounts for changes that occur in the environment (e.g., changes in sea ice and the weather), but allows for multiple narratives to exist about those changes. The recognition that we socially construct meaning encourages the scholar to be *critical* of how reality is interpreted by any one individual or social system (Foucoult 1991). Critical realism also acknowledges value in the process of adapting, innovating and co-producing knowledge via critical inquiry, testing and learning (Carolan 2005).

Post-structuralism, like a critical realism, is a humanistic approach (Edgar and Sedwick 1999). Post-structuralists draw attention to the nuance in social systems and reject binary understandings of the world. Like critical realism, post-structuralism as a philosophical foundation acknowledges that many truths can exist simultaneously (Peters and Burbules 2004). An understanding of the 'truths' and the narratives that contain them contribute to illuminating the cultural elements of expression, and the cultural experiences of a person or group (Edgar and Sedwick 1999). Post-structuralism as a scientific philosophy stresses that power and knowledge go hand in hand, and that the social, cultural and economic narratives that dominate today's society cannot alone be accepted as a universal 'truth'. Critical realism and post-structuralism as philosophies of science have, therefore, prepared me to acknowledge the nuance and 'truths' of multiple

and diverse knowledge systems upon which we draw to understand change and its implications. Engaging in meaningful ways with individuals and communities experiencing change in different ways, using diverse methods to seek out different perspectives and knowledge, and acknowledging the contributions from different knowledge systems and diverse academic disciplines, are also tenants of transdisciplinary research – the third philosophical approach informing my PhD dissertation research.

Transdisciplinarity is explained as an approach that:

"... By transgressing disciplinary paradigms and surpassing the practical problems of single actors, transdisciplinary research is challenged by the following requirements: to grasp the complexity of the problems, to take into account the diversity of scientific and societal views of the problems, to link abstract and case specific knowledge, and to constitute knowledge with a focus on problem solving for what is perceived to be the common good (Hirsch Hadorn et al., 2008, pg., 19).

Transdisciplinary approaches encourage the integration and/or participation of stakeholders within the context of applied research, and reflect the notion that the real world concerns of individuals and communities be addressed via culturally respectful processes (Pohl and Hirsch Hadorn 2008; Pohl 2010).

Transdisciplinary research should, therefore, reflect the diverse narratives and metanarratives of stakeholders in the project design and implementation. This is consistent with a post-structural perspective outlined above. For example, in describing challenges encountered with regards to sea ice and climate change, stakeholders in my study area identified the need to connect youth and elders so their knowledge, perspectives and narratives about environmental and climate changes and uncertainty could be better shared. My qualitative and participatory approach sought to reflect these lessons and principles of transdisciplinary research. However, I also recognize that transdisciplinary research requires significant time, resources and a broad number of perspectives. Given the time and resource constraints I faced, my investigation of the significance of art and artistic processes to bridge knowledge systems (e.g., between cultures and generations) cannot be fully characterized as transdisciplinary. Still, the

principles and intent of transdisciplinary approaches were at the core of my interactions with individuals and communities during my time in Pangnirtung and Cape Dorset.

3.2 Ethics

Ethics are an important and sensitive topic for all research, and especially when working with Indigenous communities and community members. Canada has a history that includes the abuse and systematic subjugation of Inuit people by white people. Power asymmetries and colonialism in the Arctic is ongoing (Truth and Reconciliation Commission 2015), and scholars are participants in these processes (Agrawal 2002, Nadasdy 2003). As noted above, I sought to engage in meaningful ways with individuals and communities where I undertook my research. In this regard, obtaining consent to undertake this research was an important principal (Tri-Council 2010).

As a foundation of ethical research, I only engaged with willing participants and asked for written or verbal consent prior to all research interviews and participatory art projects. Consent forms, available in English and Inuktitut were signed prior to any interviews or participation in the art workshops. Participants had an option to provide consent for their name to be used, and/or for direct quotations to be used in publications coming from this research. Not all participants were comfortable with having their interviews audio recorded and in these cases no recording was made.

Information and protocols provided by Canada's Tri-council Policy Statement (2010) helped to shape the quality of my interaction with individuals with whom I interacted. In this regard, the policy statement describes the importance of freedom of expression and consent:

> First Nations, Inuit and Métis persons, whether or not they identify as members of an Aboriginal community, enjoy freedom of expression, as does any citizen. They are free to consent and to participate in research projects that they consider to be of personal or social benefit. If the project is unlikely to affect the welfare of the individuals' communities, local community engagement is not required under this Policy. The necessity or desirability of engaging regional or national representatives of Aboriginal communities in policy research may, however, be determined by other considerations" (Tri-Council 2010, pg. 113).

Second, to verify the desirability of and gain support for my research in Pangnirtung and Cape Dorset, I received guidance from local officials (i.e. the senior administrative officer of Pangnirtung and Cape Dorset). These interactions with local officials and others helped me to better link my research interests with community priorities. For example, once in Pangnirtung for about one month, the Director of the community youth center communicated a desire to engage youth in a mural project for the building. I saw an opportunity to contribute to this community desire in the context of my research. In doing so, I was guided to obtain a supplementary ethics clearance from the University of Waterloo ORE so as to include youth in the collaborative art project. Being able to engage youth in our project significantly enhanced this research, and importantly, also contributed to the community.

I obtained consent for this research through formal research licensing process. I received a research licence from the Nunavut Research Institute (NRI). The NRI is responsible for administering Nunavut's *Scientists Act*. I completed a 'Scientific Research Licence Application for Social Science and Traditional Knowledge Research'. Once my application was approved, I was provided with Nunavut Research Institute License (# 01027 13N-M). The research liaison representing NRI was available to provide recommendations and advice for how to conduct ethical research in Inuit communities. I obtained a research licence extension in 2015 to follow up with participants in both Pangnirtung and Cape Dorset during a report back and verification trip (see below).

The follow-up trip to Pangnirtung and Cape Dorset in July-August 2015 was an important way for me to report back to those whom participated in my research, and to contribute to the communities. Additional time in Pangnirtung and Cape Dorset during the data analysis and writing stages of this thesis would have been desirable but proved logistically difficult. When I did have the opportunity to return, my report and feedback was well received by elders, artists and local change makers, such as the mayor of Cape Dorset, and the art co-op manager in Pangnirtung. My report was featured on the Government of Nunavut's climate change portal (link: http://climatechangenunavut.ca/en/node/3805).

3.3 Language

The issue of language and translation is an important concern in cross-cultural research. In an Indigenous context demonstrating respect for native language is crucial to legitimate research. For this PhD dissertation I took an introductory course in Inuktitut. I also used opportunities to learn and practice speaking Inuktitut when living in Pangnirtung and Cape Dorset. That said, my Inuktitut language speaking were not sufficient to allow me to collect qualitative data directly. Local translators where hired to help me introduce the research project on local radio, make house visits, conduct interviews and facilitate workshops. Of thirty interviews done with professional artists, 15 were conducted in Inuktitut and 15 were conducted primarily in English with some Inuktitut when necessary. Sea ice drawing projects were done in the language of preference for participants. I used a translator for workshops with youth, artists and elders. Materials used in this thesis were translated into Inuktitut and participants were all provided a copy of materials for their own records.

Language barriers between participants and myself were a study limitation. Information may have been lost during translation between English and Inuktitut. This could have occurred during interviews or collaborative art projects, or it may have occurred during my everyday engagement with people in communities. I made a conscious effort to remedy this limitation by hiring competent translators, learning and using some local language skills, preparing myself with ethnographic texts about the Inuit culture, and being open minded about what to expect from my field research more generally (e.g. Golde 1986; Brody 2000; Martin 2012).

The interview questions I posed to professional Inuit artists where pretested with Leena Gilday, a Dene musician whom I met in Ottawa during the Northern Lights Festival for preliminary research in 2013. At this event, a high concentration of Inuit artists from all genres had gathered, and I had the opportunity to absorb their arts and speak with many to take the temperature of the relevance for my research pursuits. In preparation for the interviews, I had a professional translation service, suggested by the Nunavut Research Institute, translate the interview questions into the south Baffin dialect of Inuktitut (syllabics). After living in Pangnirtung for about one month, I asked some

community members to read the interview questions and provide feedback. In Cape Dorset, Omalluk Oshultsaq took the time to review each question with me and make sure she understood what we were trying to achieve in asking the questions.

I also identify engagement with art and artistic processes as one strategy to expand beyond the use of language (and/or translation) in cross cultural interactions. As I argue in section 2.3, artworks foster emotional and sensory knowledge sometimes before language is used. Hence, working with art and artistic processes is itself one creative strategy to buffer the complex issues emerging from translation.

3.4 Qualitative methods

Complementary data collection techniques were used for my research. Systematic literature review provided data for the meta-synthesis. Participant observation created a foundational understanding of my field research communities (DeWalt and DeWalt 2011; Bryman et al. 2012). Semi-structured interviews (n = 30) with professional Inuit artists and participants of the collaborative mural process provide rich data. Collaborative artistic processes were also used as a data collection method. For example, the collaborative mural and sea ice drawing projects with youth, artists and elders, helped narrow in on artistic interpretations of complex environmental change.

Qualitative methods were deemed most suitable for working across cultures, and in ways that promote inclusiveness and cultural nuance, and were the primary manner in which I collected data. In addition to using several standard qualitative methods such as semi-structured interviews, participant observation, I also engaged in participatory art making that involved: (a) two Participatory Art Workshops involving storytelling and sketching with Inuit youth and elders; (b) a Collaborative Mural Project that used sketches from the workshops to create a large formal mural over several months; and (c) two Sea Ice Drawing Projects. Elisapee Ishulutaq created two drawings of sea ice past and two of sea ice present. Shuvinai Ashoona drew a broad interpretation of sea ice. Finally, I also undertook a systematic literature review and meta-synthesis of the literature on knowledge bridging. I provide more details on each of these methods below.

In terms of the timing of the methods used, I conducted the systematic literature review first while living in Waterloo, Canada. During this time, I also initiated contact

with research licencing administrators and local community administrators to obtain their feedback and advice during the development of my research proposal. The systematic literature review provided insights I used in the design and application of subsequent methods and approaches prior to my arrival in Pangnirtung and Cape Dorset. Implementation of my subsequent research methods occurred simultaneously during my time in Pangnirtung and Cape Dorset. However, the collaborative mural effort continued over a time span of four months. During that period, I also conducted interviews, transcribed interview data and notes, and participated as a guest in the community by making house visits, hosting and attending events.

3. 4.1 Systematic literature review

A systematic literature review helped to identify the explicit contributions that my research could make to the field of knowledge bridging. I was guided by the question: *What settings are discussed that support bridging Indigenous and scientific knowledge systems*? The resulting 429 papers from the database search and literature lists were culled down to n=30 informative research, review and/or perspective pieces. The large sum of search results reflects the broad scope of our initial search. I culled the large initial sum of papers by examining abstracts to identify which papers addressed bridging Indigenous and scientific knowledge systems.

The systematic review is process is explained in more depth in Chapter 4, and also in the section below on data analysis. However, of importance here is that the systematic review provides the first empirical assessment of the settings in which knowledge bridging occurs. As such, the review provided an important method that allowed me to further refine and focus my subsequent research and can be a contribution to the academy in and of itself.

3.4.2 Semi structured interviews

Semi-structured interviews were a main method in my data collection process, and they are a frequently used method for data collection in social science research (May

2001). Semi-structured interviews are an approach that "...allows people to answer more on their own terms than the standardized interview permits, but to still provide a greater structure for comparability other that of the focused interview" (May 2001, pg. 213). A set of guiding questions used with individuals can yield a great deal of information. Limitations with a semi-structured approach exist, however, if questions are misleading, or asked in an inappropriate setting. For example, early on in my research I wanted to understand if and/or how elders considered future projections, much like natural scientists may take their observations and use them to project future conditions. However, I learned quickly that asking some elders about the distant future was not deemed appropriate and that it could cause them discomfort. I adapted my approach accordingly.

In the case of Inuit Qaujimajatuqangit about sea ice, semi-structured interviews are a challenging form of data collection to use, and one must be sensitive to cultural protocols. For example, Indigenous knowledge is shared through practice, learning by doing and observations while being on the 'land' (Oosten and Laugrand 1999; Martin 2012). While my time on the land was limited to a certain extent (although see below), I did engage with artworks and art making. Similar to being on the land, art making is an approach that allowed me 'learn while doing' about experiences via individual's symbolic representation. Most Inuit are used to interacting with researchers and other 'qallunaat' (non- Inuit) and have adapted to answering questions in diverse ways. However, blending art and artistic processes with semi-structured created novel opportunities for me to engage with people.

Another challenge when using a semi-structured interview approach is having space for the breadth of narratives and stories through which Inuit elders (and many of the other individuals I spoke with) share their knowledge. I had flexibility enough with the semi-structured interview to listen to whole stories and narratives. Sometimes at the time I might not know their precise relevance. I found opportunities to work with elders in different ways and some settings provided opportunities for more stories. For example, a workshop with youth, artists and elders focused on elder stories of being on the ice. Knowledge in an Inuit context may not be shared or learned if the receiver is not ready. Elders use narrative and rhetoric in complex ways; information embedded with puzzles and metaphor can easily be lost in translation or on ignorant ears (Leduc 2006).

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These are some of the reasons why I coupled interviews with several other methods, including participatory art and storytelling, to create a robust picture of my research phenomena.

Participatory art, on the land trips and community engagement are part of my broader methodology and helped to situate the interviews with other research methods. When introducing my work and myself to elders and interviewees I made clear that they did not have to answer or discuss anything that felt uncomfortable. I took time to gain trust of individuals and to hire respected and capable local research assistants to relieve some of the tension that could arise from interviews as a research technique in an Indigenous context. In taking these precautions, I was able to benefit from the semi structured interviews that provided valuable data for this research, while being sensitive to the cultural context in which my research occurs.

Semi-structured interviews were undertaken with selected and interested professional Inuit artists from Pangnirtung and Cape Dorset. Individuals receiving at least a significant proportion of their income generation from art making and selling their works, in this case, defines 'professional' artist. A list of potential artists for my study was made in Pangnirtung and Cape Dorset with the advice from municipal authorities (e.g. manager of art co-op), art books and local research assistants. Artists were approached and asked if they would like to participant. In some cases, these artists are well known internationally and have works in museums across Canada. Other artists are well known in the community for their miniature ivory earrings that locals wear. Interviews ran between half an hour and two hours. Participants were given a $100CAD honorarium for their time, as is consistent with research protocol and NRI. All but one of the interviews was recorded (with consent). Detailed notes were taken during all the interviews. Interview recordings were transcribed verbatim. The translator provided an opportunity for clarification both during the interview, and afterwards during transcription. Transcriptions were done the morning following an afternoon of interviews. In some cases, follow up interviews were undertaken to clarify issues and ideas. During interviews, artists were asked questions in three broad thematic areas:

(1) The role of art in their life and in their community;

(2) The artist's perspectives on environmental change, sea ice change and climate change; and

(3) If/how the artist explores environmental change, sea ice change and climate change in their artworks.

I approached Inuit art about sea ice and climate change by asking first about changes experienced by the artist, and then asking if they explore these changes in their artistic process.

Learning about perspectives on sea ice and climate change through artwork provided an opportunity to study how the artist and her works can enhance bridging knowledge systems. When artists described the role of art in their lives there was an opportunity to unpack how they leverage art and art making for different outcomes (e.g. income, bridging knowledge between elders and youth). The semi structured interview protocol template is available in Appendix A.

Semi-structured interviews were also undertaken with participants from the participatory art workshops, collaborative mural project, and sea ice drawing projects (described above). These interviews focused on the participant's experience of the participatory art engagement, and the impact the process had on them. Much of the data and insight from these interviews is presented in Chapter Five – where I explore mechanisms through which art and artistic processes bridging knowledge systems.

3.4.3 Participatory art projects

Participatory art making is considered a robust method of data collection because it can enhance participants experience, and act to balance power disparities between participants (Stringler 1999; Zurba and Friesen 2014; Heras and Tabàra 2014). For my research, participatory art projects enabled a study of content, perspective, and knowledge, during art process and through the use of aesthetic boundary objects (Pink 2001; Singh 2011). Participatory artistic engagement is an emerging method to engage with stakeholders about environmental change (Kunuk and Mauro 2010; Cunsolo Willox et al. 2012) and its implications (Zurba and Berkes 2014). For example, these authors

suggest that engaging with art making provides additional opportunities to learn about the participants *affect* and experience toward changing environments (Consolo Willox et al. 2012).

I initiated two main participatory art projects as part of my research project: 1) a collaborative mural project; and, 2) sea ice drawing projects. Outcomes associated with the collaborative mural project are presented primarily in Chapter Five. The outcomes of the sea ice drawing presented primarily in Chapter Six. A brief overview of each is provided below.

Collaborative mural project

Collaborative mural projects can be one form of participatory artistic methods in the context of scientific research (Pink 2001; Somerville 2013; Zurba and Berkes 2014). In my research, I engaged in a collaborative mural project in Pangnirtung that involved people over three months (see Chapter 5). The objective of the mural project was to create an opportunity to engage collaboratively with elders, artists and youth in a participatory art project and to study the underlying mechanisms through which art and artistic processes may contribute to efforts to bridge knowledge systems about change (e.g., Inuit and scientific; elder and youth).

We started the project with games as a way to 'break the ice' and make people feel comfortable. Then on a card we all wrote something 'old' and on another card something 'new'. We then engaged in telling stories about those topics and drawing sketches during storytelling. This method of multi-form engagement (listening and drawing what you hear) is a valuable strategy to facilitate learning. We felt this was a way for participants to feel validated, that is by having others actively listening and even sketching vignettes of their stories. Within several hours, we had a series of images that we arranged into groups based on content and theme. We discussed shared themes and ideas that had continuity through all the stories.

During a second workshop we followed similar activities. In this case, elders were storytellers, describing experiences on the sea ice, while participating youth sketched the

stories. We then discussed the stories and drawings all together. The workshop was conducted in Inuktitut with a simultaneous translator to help with English.

Over several days and months, the mural took form. We engaged in several different processes and activities during this time, including print-making workshops, printing on the canvas mural, sewing with elders, and seal skin stretching techniques with elders. These processes and activities offered opportunities to combine other techniques of data collection, such as participant observation (discussed below). The mural project was featured by a regional newspaper for its capacity to connect elders and youth.

The mural itself, and the processes leading up to the mural, is key data sources for my work (see Chapter 5). However, it should be noted that these insights are formalized primarily through the reflections of project participants during follow up interviews. Participant observation and field notes were also helpful to reflect on different components of our process and their importance for bridging knowledge systems. For example, carrying the mural around town to elder's homes for help with the sewing was something I wrote about in my field notes.

Sea ice drawing projects

Sea ice drawing projects were undertaken with Elisapee Ishulutaq and Shuvinai Ashoona. Both Elisapee Ishulutaq and Shuvinai Ashoona are high profile Canadian artists. Elisapee Ishulutaq is a graphic artist based in Pangnirtung, Nunavut. She grew up living a traditional lifestyle with her family. She was recently awarded an Order of Canada for her artistic contributions to her community and Canada. Shuvinai Ashoona, also a graphic artist, is emerging as a powerful female voice in Inuit art; her works have been presented in prestigious galleries throughout Canada (e.g., National Art Gallery of Canada) and around the world (e.g., Basel Switzerland). She is the topic of books and movies (Sinclair 2004). Shuvinai lives in Cape Dorset and works full time drawing at the art co-op.

Sea ice drawing projects with Elisapee Ishulutaq and Shuvinai Ashoona offered me an opportunity to work one-on-one with the artist during her artistic process, and to

engage in in-depth discussion about the core themes of their artworks as they relate to this dissertation. In both cases, artistic materials were provided to the individuals to facilitate this process (i.e., materials that were brought with me to the communities). The artists were approached about the project only after relationships of trust had been established (see Castleden et al. 2012). I asked if they would like to participate in the project and explained what would be involved. I provided financial compensation for their time working on the commissioned pieces, and left the artworks to the artist to keep or sell at their discretion. Both artists had full agency over what was drawn and what they wanted to describe.

Once the imagery had been started, we engaged in discussion about the drawing(s). The artworks themselves offered a robust tool to enhance discussion of the artist's perspectives on sea ice and how it is changing. Elisapee Ishulutaq was very enthusiastic and prepared a series of sea ice drawings. Two of these drawings of sea ice focused on the past and are titled, *'It's a beautiful day, it's a wonderful day'*, and '*Spring hunting party'*. Two additional drawings focused on the present and were titled, '*The sea ice is dangerous today'* and *'Camping scene'*. She was uncomfortable drawing depictions of sea ice in the future. Shuvinai Ashoona made one drawing with a sea ice theme. Ashoona refers to her sea ice drawing as, 'Transformation'. In this drawing, the central character is falling through the ice, and is simultaneously transforming into fish flippers (the individual's legs) and into the Northern Lights (the individual's arm).

In both cases, the narratives described by the artists about their artworks - either directly, or through simultaneous translation as in my interactions with Elisapee Ishulutaq, - were recorded and transcribed for later analysis (see section below on data analysis). These art pieces and the outcomes of my analysis of them are presented in Chapter Six.

3.3.4 Participant observation

Participant observation is a method of research whereby the scholar engages with the community of interest while also taking detailed notes that provide data on the empirical case (Golden-Biddle and Locke 1993, DeWalt and Dewalt 2011). Participant observation requires that one be socially accepted to some degree in order to engage

meaningfully or in ways that provide robust observation opportunities (May 2001). Spending five months in Pangnirtung and Cape Dorset (as well as brief periods in Iqaluit) provided an opportunity for participant observation. Indeed, the first five weeks in the field involved solely participant observation. During this time, I participated in local events and festivals (e.g. bowhead whale hunt), and I also made regular home visits to elders in the community. Throughout the duration I was in Nunavut I maintained detailed field notes, and also practiced reflective journaling and song writing. The details from my participant observation notes are used throughout the dissertation to provide context and discussion around results and methods. Participant observation requires that one be socially accepted to some degree (May 2001). I spent most of my time in Pangnirtung camping in a small tent just outside of the community. I was welcomed into a family to store my things, shower, cook and spend time. These relationships have value far beyond being a source of data collection. However, they do provide the opportunity for participant observation (Golden-Biddle and Locke 1993, Dewalt and Dewalt 2011). For example, trust between myself and Elisapee Ishulutaq, built over the period of my stay in the communities allowed for her to elaborate on her drawings sharing stories of her past that she may not have been comfortable telling a stranger.

In Cape Dorset, camping arrangements were not easy to establish. I therefore spent the first 10 days in local accommodation before being invited to stay at the guest apartment of the art co-op for one month. I spent time making house visits for interviews, talking with artists informally, and volunteering in the high school art class.

While in Pangnirtung and Cape Dorset I continuously engaged in local activities. Adapting to another way of engaging in the world helped me to better understand local perspectives (Elgin 2012). For example, timetables and deadlines that I brought with me from the south can be irrelevant when daily life in an Inuit community takes an "in the moment" or adaptive approach. I learned to be adaptive myself, and to take the process of research at a slower pace than my initial timeline dictated. For example, I was invited to go on a 10-day hunting trip with a group of families. During the trip I spent many hours on hunting boats, playing music with others by a fire, and contributing to communal tasks such as fetching water, cooking and cleaning. These activities created a foundation for legitimate research (see Casteden et al. 2012).

3.4 Data analysis

Data collection techniques described above yielded a robust evidence base for my doctoral research. I will describe each of the data analysis techniques used for this thesis and the links among my data analysis activities. For example, a meta synthesis technique was used to analyze the data coming out of the systematic literature review. Interview transcripts were manually coded using open, axial and selective coding techniques (Bryman et al. 2012; May 2001). Data was coded for themes about bridging knowledge systems that emerged in part from, and was consistent with, the systematic review process. For example, many of the Inuit artists interviewed (n=30) spoke of embedding traditional wisdom and knowledge into their artworks. That became a theme or mechanism to bridge knowledge systems, because the knowledge can be shared across cultures or generations via engagement with the artwork. I recognize that when engaging with Indigenous perspectives, data analysis itself becomes a political process. For example, data analysis as required by the academy for a doctoral dissertation requires a sort of unpacking and intellectual prism that may not be the intended use for Indigenous knowledge. I am reminded of a scene in the Fifth Thule expedition (Kunuk and Cohen 2005) when Rasmussen is asking questions about spirituality, ideology and so on and his Inuit hosts reminded him that "… our gods get angry if we think too hard about such things".

To balance the tension between scientific rigour and maintaining the voice of participants, I used a qualitative ethnographic approach that left space for large verbatim quotations to be left intact (Doubleday 1993) and/or artworks to be shown and described on their own terms (Igloliorte 2014). I took a methodological approach that could at the same time benefit the local context via community engagement that was adaptive to participant's priorities and timelines.

3.4.1 Meta synthesis

As outlined above, the first data analysis stage in my thesis occurred in the context of the systematic review. A qualitative approach was taken (rather than a quantitative approach, as would be the case with meta-analysis (see Fazey et al. 2014). Here, my aim was to analyse the literature in a way that encouraged a holistic and

reflective perspective on the broader challenge of bridging knowledge systems. This 'meta synthesis' process is described in methods textbooks as an analytical strategy to take "...the insights developed to a new level of awareness and creates the possibility of stronger, more complete, or more theoretically responsible ways of understanding or interpretation" (Paterson et al. 2001, 122). A new level of awareness emerges from synthesizing the literature in different ways (e.g. such as creating a typology – see Chapter 4). In this way, the meta-synthesis process involves stages of contemplation, creation, and theorization (Paterson et al. 2001). I leveraged meta synthesis here to study the settings discussed in the environmental change governance literature, such as those that have emerged to support efforts to bridge Indigenous and scientific knowledge systems. The meta synthesis allowed me to conceptualize how diverse settings (e.g. methods and processes, governance structures and institutions) can be considered in isolation as well as in conjunction with regards to their role in bridging Indigenous and scientific knowledge systems (see Chapter 4). However, this initial data analysis process also helped me to frame subsequent data analysis efforts. For example, one of the outcomes of the data analysis was a recognition of different settings that can contribute to bridging knowledge systems, one of which was art and artistic processes.

3.4.2 Manual coding

The transcripts from all interviews (i.e., semi-structured interviews with artists, interviews associated with participatory art projects) were coded manually, and using a combination of *open, axial* and *selective* coding for analysis. The literature review yielded certain expected themes in the data, such as the role of art for intergenerational continuity. At other times, the data brought our attention to new themes, such as environmental change being mirrored in artworks (Bryman et al. 2012).

Open codes were written by hand alongside each paragraph. Open codes were combined with copied and pasted long quotations from interview transcripts into a large data matrix using Microsoft excel. I kept quotations as long as necessary to have the artist's full thoughts transparent in my data. The first column of the data matrix organized the open codes (e.g., embedding knowledge into artworks). Each artist or interview was given an adjacent column, and the rows were populated with quotations and passages

from the transcripts of varying length. Because the interviews with artists followed a semi-structured interview protocol, the responses were organized initially around research themes. These themes provided initial *axial codes* to organize the experience and insights from each interview:

a) 'The role of art in lives of people';

b) 'Experiences of environmental change'; and,

c) 'Art about environmental change'.

Using open codes, I organized quotations from artists based on these three themes. To do so, I identified relationships among the open codes. For example, twelve different open codes were initially identified relating to 'the role of art in the lives of people'. I was able to identify diverse roles that art plays, as described by artists. The role of art for bridging knowledge systems was a theme of particular interest to this research project. Thus, open codes were arranged for how they related to this theme.

Artist's descriptions of artworks about environmental change, sea ice change and/or climate change were coded openly. Discussions with Elisapee Ishulutaq and Shuvinai Ashoona about their sea ice drawings were all openly coded. Axial codes related to beliefs, facts, values, emotions and sensory experiences were related to open codes and quotations. Further, when describing artworks about environmental change, I coded also for *diverse forms of expression,* meaning that I took notation of when artists used sounds, colour, metaphor and symbol as aesthetic and rhetorical devices to share their perspective. After noting the presence of themes of transformation and interconnectedness in Inuit artworks about environmental change, I used *selective coding* to re-consider all transcripts in light of these topics.

Follow-up interviews with participants of the collaborative mural project were also manual coded to facilitate analysis. Open coding was performed on all transcripts. Then axial codes about the role of art for bridging knowledge systems were related to the open codes. I also used axial themes of youth empowerment and opportunities for learning as they related to art making and bridging of youth, artist and elders in Inuit communities.

The exploratory nature of my work, with a focus on creative and artistic processes, made manual coding most appropriate for my research. Specifically, manual coding was preferred over the use of NVivo or other coding software for several reasons. For example, coding material translated from another language is problematic. I was concerned that computer software would make the analytical process too mechanical (Bryman et al. 2012). The richness of the Inuit language is already being diminished in translation into English. As well, the total number of interviews is rather small, allowing for manual analysis to be undertaken in a reasonable time frame. Finally, the use of metaphor, symbol and aesthetic descriptions often communicated by artists are difficult, if not impossible, to capture with computer software. Because computer software only captures researcher's instructions, the creative wordplay involved in symbol and metaphor cannot easily be accounted for. These nuances are important to my research and the human eye and mind are more sensitive to them. I discussed research results and had reflective moments with participants, artists and my interpreters.

3.5 Study limitations

Like any dissertation, my research reflects some limitations and a number of trade-offs. I aimed to strike a balance among personal ambitions, institutional protocols, Inuit priorities, and resource support, to design and implement a robust research project. In addition to the specific obstacles addressed in the section on language (3.3 above), there were other limits to my project. For example, I placed boundaries around my dissertation process to make it more manageable (e.g. within five years, producing three publishable manuscripts). These boundaries (and financial realities as discussed below) also meant that I had to constrain the total amount of time I had available in each community, and the activities I emphasized while in the communities. Financial realities also created study limitations. Northern research (i.e., travel, food and accommodation, honoraria) is very expensive. Follow-up trips are also needed and add to the financial costs of northern research. In this regard, I tried to balance the goals of research and community engagement with a limited research budget. This is a reality for any research, but is specifically challenging in the north. Material resources for participatory art projects were also limited by the research projects budget, and the inaccessibility of art making materials to the public in the communities.

3.6 Revisiting my positionality

I described the initiation of my journey in the north in Chapter 1. Here, I discuss how the methodological approach and methods I chose for my research project have an influence on my positionality during community engagement. I first arrived in the Inuit communities of Cape Dorset and Pangnirtung as a student participating in the University of Manitoba's field school program. Because the field course has been conducted in Pangnirtung for over fifteen years, the community was familiar with the position of students in relation to their community. For example, local artists would often come to show us the small carvings and handmade jewellery they wanted to sell. Once the other students left (after completion of the program) I navigated the communities alone as a scholar. My methodology and methods had an impact on how I engaged with the community and how the community perceived me.

The philosophical pillars of critical realism, post-structuralism and trans-disciplinary engagement each helped me to be conscious and reflective during my research. I was open to the many possible ways that local participants are experiencing climate and sea ice change. I took all responses as legitimate and valuable sources of data. My role as a scholar allowed me to pay local research assistants and artist participants for their time. By giving $100 to each artist for participating in interviews, and being able to hire local assistants during the project, my positionality shifted, as did how I was perceived. While this is a research protocol as advised by Nunavut Research Institute, it also created the illusion that I was very rich and created a power asymmetry because of my new position as employer and 'giver of cash' following interviews.

Following ethics and consent protocols may have also impacted how I was perceived by community members, in turn influencing my positionality. Knowing that I was conducting my research in an ethical way helped me have confidence in my protocols. Yet, having to ask for formal consent to speak to people in some cases changed how I was perceived, or changed the context of our conversation from a more casual exchange to a formal one.

Using a participatory artistic approach and music as a way to engage with community members impacted my positionality (see also Chapter 1). Sharing my own

music required me to be vulnerable by exposing my own thoughts, feelings and values. I became close to participants precisely because I allowed myself to be open and honest as a person as well as being a scholar. Furthermore, in light of reciprocity I always took time to help out community members and elders when I could, including for example, making tea and cleaning up when I was visiting elder's in their homes. Having friendships develop with community members strengthened my position from simply researcher to researcher and friend, and in one case even adopted daughter.

3.7 Conclusions

In this chapter, I have outlined the key philosophical research pillars of my research, the ethical protocols and procedures I followed, and the methods of data gathering and analysis used to support my research. Critical realism, post-structuralism and transdisciplinary perspectives provided a philosophical foundation for my research. Ethics guidelines and research license approvals were followed, and my approach to research was consistent with principles for research in northern communities (ACUNS 2003; Tri-Council 2010). I used several qualitative methods and participatory art projects to collect data. Specifically, a systematic review of the literature and meta synthesis, semi-structured interviews with Inuit artists, a collaborative mural project with elders, artists and youth, and two sea ice drawing projects, provide a rich data set to investigate the significance of art and art making to bridge knowledge systems. These results are presented in the three chapters that follow.

Chapter 4: A typology of settings to bridge knowledge systems and enhance governance of environmental commons

4. 0 Abstract

We offer a typology of settings to bridge scientific and Indigenous knowledge systems and to enhance governance of the environmental commons in contexts of change. We contribute to a need for further clarity on how to incorporate diverse knowledge systems and in ways that contribute to planning, management, monitoring and assessment from local to global levels. We ask, *what settings are discussed in the resource and environmental governance literature to support efforts to bridge Indigenous and scientific knowledge systems?* The objectives are: 1) to offer a typology that organizes various settings to bridge knowledge systems; and 2) to elaborate on how these settings function independently and in concert, using examples from a diverse literature in addition to field research experience. Our focus is on Indigenous and scientific knowledge, but the typology offers lessons to bridge diverse knowledge systems more generally, and in ways that are sensitive to a moral, political and process-based approach. The typology includes specific methods and processes, brokering strategies, governance and institutional contexts, and the arena of epistemology. We describe each setting in the typology, and provide examples to reflect on the function and potential outcomes of different settings. Insights from our synthesis can inform policy and participatory action[1].

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[1] This chapter has been published as a scientific journal article in the *International Journal of the Commons* (see Rathwell et al. 2015).

4.1 Introduction

Navigating environmental change and sustaining environmental commons (e.g. the climate system, wildlife, freshwater) will depend, in a large part, on coordinated action across levels (local, regional, global) and knowledge systems (Reid et al. 2006; Armitage 2008; Berkes 2012). While knowledge systems are themselves a kind of 'commons' (Hess and Ostrom, 2006), our emphasis in this paper is on environmental commons and the ways of knowing (or knowledge systems) associated with them. Diverse social actors who have specialized (although not independent) forms and types of knowledge (e.g., Indigenous and western knowledge) often share environmental commons. Identifying opportunities to bridge different knowledge systems has been a key theme in commons governance for some time (Ostrom et al. 2002; Reid et al. 2006), although getting clarity on the appropriate settings in which to do so remains a challenge.

Diverse types and sources of knowledge can make important contributions towards understanding and governance of environmental commons (Tuhiwai Smith 1999; Wilson 2008; Bohensky and Maru 2011). Despite the potential of individuals with different knowledge systems to contribute experiential and tacit knowledge about their environments (Batterbury et al. 1997; Dryzek 2005; Fairhead and Leach 1995; Forsyth 2003; Njaya et al. 2012; Robbins 2012), scientific knowledge has emerged as a dominant lens through which humanity makes sense of, and decisions about, environmental change (Ellis 2005; Smith and Sharp 2012; Partidaro and Sheate 2013). However, major international research initiatives to understand and govern environmental change (e.g. the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES); Arctic Resilience Interim Report) are seeking new ways to incorporate diverse knowledge systems. Clarifying how different settings can facilitate knowledge system bridging, and how these opportunities to bridge knowledge systems act in synergy across multiple levels, requires more research (Weiss et al. 2013; Fleischman et al. 2014). Effective governance responses to multi-scale challenges must align action with values of social justice and democracy, and must validate the legitimacy of diverse knowledge systems in both sense making about environmental change and the strategies used to navigate impacts of environmental changes (Mitchell et al. 2003; Armitage 2008; Henry and Dietz 2011). We contribute to this growing need and emphasize the moral/political and

practical motivations to connect diverse knowledge systems at the Indigenous and scientific knowledge interface.

We use a meta-synthesis procedure and ask; *What settings are discussed in the resource and environmental governance literature to support efforts to bridge Indigenous and scientific knowledge systems?* A meta-synthesis approach (discussed below) helps to develop a typology of settings for bridging knowledge systems. We elaborate on how these settings function independently and in concert. The typology of opportunities includes specific methods and processes, brokering strategies, governance and institutional contexts, and the arena of epistemology. We describe each setting and provide selected empirical examples to reflect on the function and potential outcomes of different opportunities. Outcomes from our synthesis can inform policy and participatory action, as well as identify areas for future research in efforts to bridge knowledge systems in a wide-range of contexts. In doing so, we contribute to the growing need for clarity on how diverse knowledge systems contribute to environmental planning, management, monitoring and assessment, from local to global levels.

We conceptualize the interface of Indigenous and scientific knowledge systems as *bridging* (Reid et al. 2006). We define bridging knowledge systems as maintaining the integrity of each knowledge system while creating settings for two-way exchange of understanding for mutual learning. This definition acknowledges the role of both a parallel approach to knowledge systems, as well as mutual learning and evolution/innovation of the shared knowledge base. For some knowledge systems, connection to a specific place or landscape is necessary to maintain the integrity of knowledge - learning occurs embedded in places. Throughout our discussion, issues of *power* are always near the surface and warrant careful attention (see Clement 2012). However, having a typology as elaborated in this paper can help those engaged in knowledge bridging processes to be reflective about the role of power via the choice of settings and contexts that are used.

Our geographic scope for this analysis is global, but we have a particular emphasis on the Arctic for several reasons. The Arctic is a "canary in the coal mine" for environmental changes, and considered particularly susceptible to abrupt and unexpected

change in environmental conditions and commons resources (i.e. changes in sea ice, impacts on marine mammals) (Lenton 2012; Arctic Council 2013). The Arctic is also a region where traditional knowledge and local observations have been contributing to an understanding of the social-ecological system in significant ways (Krupnik and Jolly 2002; Laidler 2006; Krupnik et al. 2010). Arctic peoples are the first to be affected by changes, and taking their insights about change and their impacts seriously has required a moral, political and process-based approach.

4.1.1 Contributions of Indigenous Knowledge to Understanding Environmental Change

Differences among knowledge systems are sometimes blurry. Use of discrete categories of 'scientific' and 'Indigenous' to describe 'types' of knowledge is a simplification. For example, Indigenous people can be versed in the scientific method and participate in scientific knowledge development (Weiss et al. 2013). Yet, there are real distinctions in how holders of scientific and Indigenous knowledge see the world (Brody 2001; Cruikshank 2012). Neglecting to acknowledge the similarities and differences among types of knowledge and how they each make sense of, and contribute to governance of, changing environmental commons can perpetuate power asymmetries (Wilson 2008). It may also exacerbate superficiality in what participants of different knowledge systems can contribute to understanding and managing the commons (Weiss et al. 2013). Differences in how people from different knowledge systems perceive and address environmental change are sometimes framed as complementary (Riedlinger and Berkes 2001; Laidler 2006). Complementarities, however, can only emerge when diverse knowledge systems are valued and invited into discourse about changing commons.

Contributions of Indigenous knowledge in the Arctic, for example, have enhanced overall understandings of changing environmental commons *and* the governance processes used to navigate that change through: (1) cross-scale and/or multi-level perspectives and data for decision making; (2) place-based narratives; (3) expanded forms of expression (e.g., oral history); (4) alternative epistemological traditions; (5) enhanced perceived credibility and legitimacy of 'other' knowledge systems. Each of these contributions is outlined below.

First, scientific data about Arctic sea ice change, assessed using evidence from regional and global levels (e.g. satellite imagery and models), has been complemented with place-based observations and understandings of Inuit who live with sea ice (Reidlinger and Berkes 2001; Laidler 2006). Policy decisions that benefit from multi-level monitoring (Jasanoff and Martello 2004) have the capacity to respond to local nuances of environmental change because local data are available to direct local initiatives. Further, policy that takes into account local expertise is considered more legitimate, increasing local compliance (Sillitoe and Marzano 2009; Reed et al. 2011; Mitchell et al. 2006). For example, hunters in Nunavut are experimenting with Geographical Positioning Systems (GPS) as a way to both navigate and document changing and dangerous sea ice conditions (Laidler et al. 2012). Hunters also speak on community radios to discuss local nuances in ice conditions and implications for local safely (Pers. comm., Pangnirtung elders, August 2013).

Second, local resource users maintain place-based narratives about the environmental changes they experience. These local narratives have been found to challenge dominant narratives (Adger et al. 2001; Batterbury 1997; Fairhead and Leach 1995). In the Canadian Arctic, Inuit elders have observed the increased effect of the *refraction* occurring in the Arctic. The process of documentary film making (Kunuk and Mauro 2010) invited elders to reflect on their observations of climate change in their own language and on their own terms. Mauro noted that:

> "By linking different ways of knowing, we discovered that a warming atmosphere is actually changing the refraction index of the sky, which dramatically alters the visual landscape of the Arctic" (SSHRC 2010).

In this context, the optical illusion of a changing position of the sun shed light on how greenhouse gases are altering the perceived angle and intensity of the sun (Manitoba Eco Network 2011ab; Isuma TV 2010). This is a good example of a complementary process where the holistic nature and place-based perspectives of Indigenous knowledge can create novel hypotheses that challenge the causal framing of western science (see also Berkes and Kislalioglu Berkes 2009).

Third, Indigenous knowledge is communicated in socially and culturally embedded mediums such as oral history and art (e.g., carving). Legitimizing these means of expression in the global climate change discourse concurrently offers more flexibility to participants in terms of how they choose to use their 'voice'. Indigenous knowledge can occur in a complex narrative format that communicates both content and cultural context, such as information about environmental change *and* how that is connected to culture/worldview (Leduc 2006; 2011; Cunsolo Willox et al. 2012). Creative forms of expression can often engage human senses more intensively than do 'rational' formulations of science (Anderson 1996). Indigenous perspectives should not be *coerced* to communicate in written English, because this in itself is an act of power (Raik et al. 2008; Foucoult 1991).

A fourth and related argument is that openness to multiple epistemologies and different ways of seeing the world prepares communities to navigate change. Having one's current epistemology challenged by attempting to grasp how someone else sees the world confronts the idea that there is only one possible way to experience the world (Miller et al. 2008). Hence, openness to alternative epistemologies creates a space for envisioning a future that is different from the present. Cruikshank (2005; 2012) expresses this sentiment by exploring oral histories about glacial change told by Tlingit elders. Her book, '*Do Glaciers Listen?'*, provocatively implies that for some knowledge systems, indeed glaciers listen. The agency, sentience and connection to human spirituality of glaciers communicated by oral histories creates an alternative view of sentient and non-sentient beings, reflects dynamic time/space scales, and engenders more diverse ontological and epistemological framings for how the world works.

Fifth, the process of finding parallels between Indigenous and scientific knowledge systems can act to enhance the perceived credibility and legitimacy of both (Berkes and Davidson-Hunt 2008; Moller et al. 2004). Tools used by science to track environmental change (e.g. anomalies) (Hanson et al. 2006) and to anticipate regime shifts (e.g. skewness, variability) (Scheffer et al. 2009; Dakos et al. 2011) may be paralleled in metaphors, observations and narratives connected to Indigenous knowledge of environmental change (Nayak and Berkes 2010). For example, climate change scientists measure changes in global average temperature using the phenomenon of

anomalies (i.e. the differential between observed global temperature averages and a baseline of global average temperature, usually from years 1951-1980) (Jones and Wigley 2010). Inuit also describe changes in their local environment in the form of anomalies. However, their 'baseline' is orally communicated wisdom about how to predict the weather, and anomalies rest in the extent to which elders cannot predict the weather as they used to (Krupnik and Jolly 2002; Krupnik et al. 2010).

4.1.2 Bridging Knowledge Systems

Diverse literatures have sought to unpack the meaning of 'knowledge systems'. For example, the philosophy of science is concerned with questions such as 'what constitutes knowledge' (Carolan 2005; Godfrey-Smith 2003; Midgley 2000)? Political philosophers have helped us understand the role of *power* in the construction, maintenance and deconstruction of knowledge, and they are also concerned with questions about 'whose knowledge?' and the political processes by which knowledge is created, confirmed or denied (Burchell, Gordon and Miller 1991; Foucault 1991). Political ecologists build on political philosophy in the specific context of the environment to study the narratives of different knowledge systems about environmental change, examining how dominant knowledge systems reflect the power of dominant groups, potentially subverting the insights of marginalized people (Batterbury et al. 1997; Dryzek 2005; Fairhead and Leach 1995; Forsyth 2003; Njaya et al. 2012; Robbins 2012).

Increasingly, interdisciplinary scholars are investigating how different knowledge systems can be brought together in applied forms to collectively navigate environmental change and contribute to processes of governance (Reed et al. 2011; Fazey et al. 2012; 2014; Gomez-Baggethun et al. 2013). However, incorporating Indigenous knowledge into collaborative processes for decision making and maintaining the integrity and agency of the knowledge holders is not easy. Some scholars argue that Indigenous knowledge cannot be combined with western science because to do so would displace Indigenous knowledge from its context or place-based significance (Cruikshank 2005). In this regard, Nadasdy (2003; 2007) has scrutinized co-management boards in Northern Canada for narrowing management practices in favour of western paradigms. These critiques are helpful because they broaden the discourse and shed light on important epistemological oversights, including for instance, the assumption that numerical data are more valid than

narrative data. Yet, the demands of navigating rapid and complex environmental change, such as that occurring with Arctic sea ice, requires accommodating multiple perspectives and openness to hybrid solutions. Further, Indigenous people, in this case the Inuit of Northern Canada, are quite capable of adapting their Indigenous knowledge to modern circumstances and their capacity to do so should not be overlooked (Berkes and Armitage 2010).

In a shift away from the language of knowledge 'integration', Fazey et al. (2012) have emphasized *knowledge exchange* in the context of environmental management. They examine how knowledge can be exchanged between actors and across scales, and by doing so, implicitly conceptualize knowledge and information together as *something* that can be "moved". Likewise, Reed et al. (2011) highlight the importance of *managing knowledge* to improve land degradation and assessment. These conceptualizations are technical and perhaps apolitical, yet pragmatic in their attempts to help societies navigate environmental change. Other scholars have previously advocated a parallel approach that views Indigenous and western/scientific knowledge as parallel. For example, the two-row Wampum concept takes a beaded Indigenous belt with a two-row pattern to symbolize Indigenous and western knowledge moving in parallel and enriching one another but not interfering with each other (Doubleday 1993; Berkes 2012). In a similar vein, Tengö et al. (2014) have developed the idea of a 'multiple evidence base' where evidence from different knowledge systems are brought beside each other and evaluated in relation to criteria developed in the context of that knowledge system. In another strand of thinking, knowledge co-production describes processes that leverage expertise of different knowledge systems to create novel and hybrid understandings of environmental change and adaptation strategies (Armitage et al. 2011). What is less clear in these various approaches are the specific settings/contexts or opportunities in which exchange, management, co-production and validation of knowledge might occur, and in which bridging of knowledge can be facilitated. Here we map out a typology of settings to do so, and their relationships to each other, by examining the literature and by reflecting on our own experiences.

4.2 Methods

We developed the typology using a meta-synthesis approach to interpret groups of qualitative empirical research findings, perspective and review articles, and to generate novel insights about phenomena (Walsh and Downe 2004; Carpenter et al. 2009). The goal of a meta-synthetic approach is to strive for a holistic and reflective perspective on a particular issue or problem. Meta-synthesis techniques from health sciences were used to inform our process (Thorne et al. 2004). Meta-synthesis is different from meta-analysis in that the latter uses a largely quantitative approach to understand a body of literature (see Fazey et al. 2014). We sourced literature from:

1) Expert advised reading lists on the three broad themes of (1) knowledge systems; (2) Indigenous/traditional knowledge systems; and, (3) resource and environmental governance;

2) Systematic literature review based on keyword search in two Scopus research database: following search protocol: ("Indigenous" OR "traditional") AND "knowledge" AND ("integrat*" OR "link*" OR "bridg*" OR "connect*" OR "evaluat*" OR "manage*" OR "exchange") AND "environment*"

We followed an inductive process that involved: 1) reviewing expert advised reading lists on the topic of Indigenous knowledge in environmental governance to discover how authors describe and apply bridging knowledge; 2) based on this initial process, we developed the overarching question - *what settings are discussed in the resource and environmental governance literature to support efforts to bridge Indigenous and scientific knowledge systems?* This question was used to guide the systematic literature review; and 3) creating the typology to conceptualize how insights from the literature fit together, and to help further refine current thinking on the different ways that knowledge systems can be bridged.

Based on the preliminary literature review of the expert advised reading list, we found that scholars from various disciplines and working in different areas of the world were focusing on different types of knowledge 'bridging' processes (e.g. formal institutions like co-management boards, informal collaborations with NGOs in social networks). However they were doing so without the guidance of a meta-framework to

consider how their approach fit or related to other mechanisms, institutional support structures or political philosophies about bridging Indigenous and scientific knowledge. Therefore, we identified an opportunity to clarify the diversity of settings in which to bridge Indigenous and scientific knowledge systems, reflect on how these settings can be conceptualized as multi-level, and to consider how bridging settings can work in synergy (within and between levels) to create more robust understanding for governance of the commons in the context of change.

Teasing out settings that support bridging of knowledge system is a subjective process. Moreover, we wanted to capture elements from an interdisciplinary literature that inform environmental governance and management. This includes anthropology, political science, environmental management, environmental sciences, organizational science, global change governance, and Indigenous studies, to name a few. We felt it important to capture settings that have both structural elements (e.g. network structures, formal governance arrangements) and process elements (e.g. map making, in-situ interactions through trips on the land). We considered it vital to emphasize the epistemological component of bridging knowledge systems. We were also mindful of the multi-scale, multi-level dimensions of our settings. For example, brokerage as a dimension of bridging (see Cash et al. 2006) can occur at multiple levels from local to global.

We started organizing settings based on initial categories: structure, process and epistemology. The subsequent review/synthesis confirmed the validity of these categories, but also drew our attention to additional settings and additional examples of how settings function in isolation, or in concert, to bridge knowledge systems. We therefore modified the initial categories based on results of the keyword database search which included n=30 papers culled from 429 papers. The large size of the initial output resulted from the intentionally broad parameter to account for different nomenclature used for the concept of connecting Indigenous and scientific knowledge (i.e. linking, managing, exchange). We culled the large initial sum by examining the titles and abstracts of the selection. We also used filters to identify articles specific to environmental change and the environmental commons (e.g. climate change). We kept only case examples (empirical papers), grounded reviews and perspective pieces on

Indigenous and scientific knowledge bridging for learning about and/or management/governance of environmental commons. We subsequently focused our analysis on a small subset of papers (n= 30) that dealt explicitly with connecting Indigenous (or called traditional) knowledge with scientific knowledge in the context of environmental commons, such as Arctic sea ice. This literature was used for cross checking themes, confirming settings and identifying examples to emphasize each setting in the typology.

4.3. Results and discussion

Four categories of settings were ultimately determined: a) epistemological arena b) methods and processes; c) brokerage mechanisms; and d) governance/institutional arrangements. In Table 2, we also identify a selection of sub-categories within each setting category. We explain each setting, provide an example, and list a few key literature sources. In the text below, we elaborate on the key aspects of each category, the evidence from the literature demonstrating the capacity of that setting, and the tangible and intangible outcomes that can result from successful engagement with that setting.

Table 2 Settings for bridging knowledge systems

	Setting	Explanation	Example	How is this setting is helpful for bridging?	Selected Sources
Epistemological Arena	**Epistemological Pluralism**	To conceptualize and motivate transdisciplinary research by accounting for knowledge pluralism in research process. This means prioritizing different ways of knowing by valuing the epistemological foundations of different participants in processes and discussions	Authors provide examples from urban ecology and Arctic biodiversity demonstrating traps that occur when epistemological framing is not taken seriously. No example of using epistemological pluralism to guide a successful empirical process.	Guides process of social and scientific inquiry wherein a) multiple epistemologies are valued; b) values, aims, and parameters governing the validity of knowledge are continually negotiated in an iterative science cycle.	Miller et al. 2008
	Polycentric global epistemologies	A variety of dialogues with epistemological 'others' to allow sharing, borrowing, learning and collaborative projects; knowledge practice in the service of human well-being. These dialogues will expand the number of epistemologies accommodated in decision-making processes.	No example provided by author, no example of engaging with approach in an empirical example. Therefore the contribution remains theoretical and should be tested for its added value.	"A creative process of aesthetic ordering. Participants function as artists who create new knowledge practices from the ingredients of existing ones" (p. 63). Aesthetic rather than rational. Participants can learn about each others worldview as a precondition to knowledge bridging and decision making.	Maffie 2009
Methods and Processes	**Mapping**	Practical spatial processes to understand place based perspectives on ecological systems.	Inuit elders map changing ice extent and flow edge patterns -facilitated by Laidler (2006) and her dissertation research on connecting scientific and Inuit sea ice knowledge.	Provides spatially explicit information about ecological features and perception of ecological space. Mapping can be performed collaboratively with scientists and Indigenous peoples both participating. Demonstrates local expertise.	Krupnik and Jolly 2002; Laidler 2006; 2007; Turnbull 2007 Krupnik et al. 2010

	Monitoring	Procedures and processes embedded in local management, co-management, adaptive co-management or adaptive governance arrangements to account for ecological attributes and changes.	The Igliniit project (Gearheard et al. 2011) Inuit hunters document life on the trail to map and monitor arctic change.	Monitoring processes can be embarked on collaboratively in the field or participants can monitor while on the land (local, Indigenous), or in the lab (scientific), and report to each other.	Kofinas 2002; Armitage et al. 2008; Krupnik et al. 2010; Gearheard et al. 2011
	Artistic processes	Creative collaboration, space for symbol, culture and tradition.	Kunuk and Mauro (2010) collaboratively created the documentary film 'Inuit Knowledge and Climate change.	Visual or performing arts can allow for culturally embedded knowledge sharing, emergent ideas, simulations and storytelling.	Kunuk and Mauro 2010; Zurba and Berkes 2014
	Scenario Planning	As a tool to collectively envision and navigate change in social-ecological systems.	Engaging with qualitative scenarios helped Wesche and Armitage (2013) identify local perspectives on the impacts of climate change and resource development for community vulnerability and adaptation.	Discourse, imagery, experience and data can all inform scenario planning. Stakeholder groups create plausible storylines about changing social-ecological systems. These efforts direct continued dialogue and potential steering of social-ecological change.	Bennett and Zurek 2006; Peterson 2007; MA 2005; Wesche and Armitage 2013
	'Out on the land' together	As a way of sharing embodied experience.	In her PhD thesis Laidler (2006) describes the importance of her time on the land with Inuit elders for enhanced bridging of scientific and Inuit knowledge on Arctic sea ice change.	Setting where scientists are dependent on Inuk land skills for security, this can help shift power disparity. Inuit are more comfortable explaining environmental knowledge in context and this means spending time 'on the land'.	Brody 2001; Laidler 2006; 2007
Brokerage	**Boundary Objects**	As a tool for linking communities of practice.	Zurba and Berkes (2014) use participatory art as a boundary object to help communicate Indigenous knowledge and values in coastal resource and management.	Objects that are valued on both sides of the boundary and provide a site for cooperation, debate, evaluation, review and accountability e.g. models, forecasts, newsletters, reports (Cash and Moser 2000, p. 115). The objects	Star and Griesemer 1989; Cash and Moser 2000; Gearheard et al. 2011;

				then act at the interface of knowledge systems and can help to bridge questions and ideas.	Zurba and Berkes 2014
	Boundary Organizations	In the context of sustainability science; organization with specific role of linking science with policy.	The project 'Nilliajut Inuit perspectives on Arctic Security' initiated by the Inuit Knowledge Center branch of Inuit Tapiriit Kanatami, has documented the perspectives of Inuit on the ever-increasing topic of security in the Arctic (Inuit Qaujisarvingat. 2013).	Institutions that straddle and mediate the divide between science and policy. They "serve to mediate between scientists and decision-makers on the one hand, and between these actors at different scales on the other" p. 114.	Cash and Moser 2000; Cash; 2001; Cash et al. 2006; Inuit Qaujisarvingat. 2013
	Bridging Organizations	Within governance or management networks bridging organizations create connectivity between groups, locations and worldviews	Rathwell and Peterson (2012) discuss the critical role of bridging organizations for connecting different actor groups to address water quality in polluted Canadian watersheds.	"Facilitates bringing together science and local knowledge and provide an arena for knowledge co-production, trust building, sense making, learning, vertical and horizontal collaboration and conflict resolution" (Berkes 2009, p. 1695).	Folke et al. 2005; Cash et al. 2006; Berkes 2009; Rathwell and Peterson 2012
	Networks (bridging and bonding ties)	As a structural arrangement between individuals or organizations.	Weiss et al. (2012) examine knowledge exchange and policy influence of a diverse network of actors in a fisheries context.	Structural bridge in social network arrangement	Granovetter 1983; Coleman 1988; Burt 2001; Bodin and Crona 2009; Weiss et al. 2012
Institutional/ Governance	**Adaptive co-management**	Combination of co-management with adaptive management practices.	Armitage et al. (2011) discuss the process of linking Indigenous and scientific knowledge in three cases Arctic marine co-management.	a) Sharing of management power and responsibility through multiple institutional linages that may involve government agencies, NGO's and other communities; and, b) Feedback learning and building of mutual trust among the partners	Olsson et al. 2004; Berkes 2004; 2009; Armitage, Berkes and Doubleday 2007; Armitage et al. 2011

Adaptive Governance	To govern ecosystems with multiple nested centers of decision making power, connected by polycentric institutional arrangements and capable of adapting to novel circumstances.	Olsson et al. (2007) discuss the importance of adaptive governance to address multi-level and dynamic issues in the context of natural resource management.	Actor groups and organizations involved in governance arrangements interact for iterative sense-making and decision-making.	Folke et al. 2005; Armitage, Berkes and Doubleday 2007; Olsson et al. 2007; Armitage 2008
Project driven Environmental Assessment	To assess environmental conditions (e.g. local, regional scales), often in the context of resource development.	Many environmental assessment processes are required (often legally) to include Indigenous knowledge and perspectives in understandings of the environment and impacts of local resource development.	Project based environmental assessments are a platform to bridge scientific and Indigenous knowledge systems about local environmental conditions. Concerns exist in the literature that environmental assessment is too rigid to respectfully accommodate diverse worldviews.	Stevenson 1996; Usher 2000; Sinclair and Diduck 2001
Global Environmental Assessment	To synthesize environmental conditions (regional or global scales) and/or social-ecological conditions in changing environments.	The MA (2005) sought input from multiple knowledge systems to assess the state of ecosystems at the global scale. The process required elaborate local, regional and global assessments.	A global perspective of environmental change requires inclusion of many knowledge systems. Global environmental assessments have the added challenge of bridging knowledge systems across many localities to understand ecological change *and* to scale up findings, such that results are compatible amongst regions to create a coherent global picture of environmental conditions.	MA 2005; Tengö et al. 2014; Nakamura 2014

4.3.1 Epistemological arena

Epistemology "deals with questions involving the nature of knowledge, the justification of beliefs, and rationality" (Godfrey-Smith 2003, p. 235). By epistemological approach we mean the philosophical framings that identify the relationships between knowledge systems, and how to approach knowledge system bridging, philosophically and ethically. An epistemological approach reflects issues of power, legitimacy and saliency in knowledge bridging – elements that may be overlooked if not explicitly addressed (Brugnach and Ingram 2012). Indeed, the epistemological arena that guides knowledge system bridging is perhaps the most important and least discussed setting in the literature. However, actors committed to bridging knowledge systems must attend to the philosophical and epistemological dimensions of knowledge. Epistemology serves as a setting because actors engaged in knowledge systems must step back into the 'setting of epistemology' and reflect critically on their own views, and the extent to which their epistemology is filtering 'valid' from 'invalid' evidence.

In a focused study of bridging Indigenous and scientific knowledge's in Australia, Weiss and colleagues (2014) identify a major challenge to coastal marine governance as being a lack in the depth of understanding of epistemology, resulting in only superficial interactions between Indigenous and scientific knowledge holders. They find that patterns of superficial engagement perpetuate power struggles and can stunt collaborative efforts (Weiss et al. 2013). Increased effort to clarify our epistemological starting points remains an important need (Ellis 2005; Fazey et al. 2014) pointing out that "the way knowledge is exchanged is strongly influenced by the way knowledge exchange is conceptualized" (Fazey et al. 2014, p. 206). We highlight two examples in which philosophical and conceptual settings for bridging knowledge systems are explicitly made.

In the first example Miller et al. (2008), present the idea of epistemological pluralism as a way to consider how each individual may 'hold' multiple epistemologies. Epistemological pluralism as a setting requires commitment to open discourse and negotiation from which might emerge novel insights. Miller et al. (2008) only

hypothesize how 'epistemological pluralism' as an arena might improve multidisciplinary work related to environmental commons. They don't provide empirical examples, but the importance of epistemological pluralism as a foundational setting to bridge knowledge systems is clearly articulated.

In a second example, Maffie (2009) proposes the concept of polycentric global epistemologies' (PGE) philosophical approach to bridge Indigenous and scientific knowledge's. Respectful conduct between knowledge systems is of utmost importance in this epistemological arena, with "a necessary prerequisite of [PGE] as well as its first and foremost goal...the survival and self-determination of Indigenous peoples and their knowledge's" (Maffie 2009, p. 60). Maffie (2009, p. 63) asserts, "PGE promotes greater self-awareness and self-criticism regarding the unstated limitations of participants' philosophical horizons", and clearly acknowledge the political and moral attributes of knowledge system bridging. As with the concept of epistemological pluralism, the rigorous ideals of PGE as an epistemological setting have yet to be fully tested with an empirical case. Engaging with epistemology (and multiple epistemologies) will change how environmental commons are managed. Being aware of the underlying values and beliefs of another culture can clarify why and how particular resources can be managed to build rather than burn bridges between scientific and Indigenous cultures.

4.3.2 Methods and processes

Methods and processes serve as the tangible settings to bridge Indigenous and scientific knowledge. Methods and processes that bridge knowledge systems have been directed toward resource management tasks, for example, by monitoring the environment (e.g., sea-ice change) (Nichols et al. 2004; Gearheard et al. 2011), setting quotas for wildlife catch (Armitage et al. 2011; Dale and Armitage 2011), or modeling changing environments (Giordano et al. 2010). Alternatively, processes can be 'soft' and exploratory, grounding participants in local context and epistemology through, for example, anthropological inquiry that includes storytelling (Cruikshank 2005; 2014; Brody 2001), artistic processes (Kunuk and Mauro 2010; Petheram et al. 2011; Zurba and

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Berkes 2014), role-play (Castella 2012) and participating in local cultural events (Castleden et al. 2012).

As illustrated through the meta-synthesis, research engaged in knowledge system bridging can embrace a bundled approach with regards to methods. Scenario planning is an example of a method that engages with multiple processes such as interviews, monitoring, mapping, workshops and creation of imagery (Peterson et al. 2003; Peterson 2007; Wesche and Armitage 2014). Bundling methods and processes is a robust way to connect knowledge systems Being part of a hunting party provides insights about how hunters work together in practice over space and how Inuit worldview guides hunting practice (Wenzel 2002). Laidler's (2006) work on Baffin Island to map Arctic sea-ice change provides a good example. Working in collaboration with elders and other community partners, she has undertaken rigorous systematic spatial mapping of the changing ice by drawing on expertise from Inuit hunters to complement scientific understandings (Laidler 2006). Outcomes from this mutual process are maps indicating the extent of sea-ice change. Balancing the scientific approach of map-making with openness to local culture, Laidler (2006) speaks about the importance of being 'out on the land' with the Inuit. A scientist willing to participate in explorative methods to bridge knowledge systems demonstrates respect for the way Indigenous peoples have accumulated their expertise (Laidler 2006; 2007; Laidler et al. 2011). Trust and respect between knowledge systems, mutual experience and the sharing of place embedded stories about sea-ice and how it is changing are all fruitful outcomes of collaborative fieldwork as a bridging process. These outcomes have direct impact on how environmental commons are managed. For example, respect and trust emerging from engagement in diverse methods and processes for bridging knowledge systems, will create improved learning and collective compliance regarding governance of environmental commons (Mitchell et al. 2006; Armitage et al. 2011).

Methods and processes are important to bridge Indigenous and scientific knowledge in space and time, but these techniques alone remain insufficient. Methods and processes must be embedded within organizational (governance, institutional) structures to support a 'scaling-up' of insights and experience from these processes, to allow bridging to occur beyond the local, and to be sustained over time to allow for

learning to occur. Methods and processes are the building blocks of management of environmental commons. Expanding and diversifying the methods and processes used for environmental commons management and understanding that different methods have different capacities for bridging knowledge systems will allow resource managers to better accommodate the multiple knowledge systems sharing environmental commons.

4.3.3 Brokerage and networks

The structure of organizations, actors/actor groups, and objects interacting with each other about a particular issue can be thought of as a social network (Granovetter 1983; Burt 2001). Formal and informal networks influence the information, connectivity, activities and decision-making power of actor groups in an environmental change context (Bodin and Crona 2008; Rathwell and Peterson 2012). Thus, one can think structurally about how knowledge systems are connected in social networks and the implications of structural settings for bridging Indigenous and scientific knowledge systems.

Particular network configurations impact if and how knowledge systems are connected to each other to govern commons (Bodin and Crona 2009). Robust social networks include both strong and weak connections (ties) between entities (Granovetter 1983; Coleman 1988; Burt 2001). Strong connections (bonding ties) enable trust and shared values, while weak ties (bridging ties) provide sources of new information/insight and can challenge stale assumptions held by otherwise isolated actors. Both bridging and bonding ties can help facilitate bridging of knowledge systems to make sense of complex environmental change and identify solutions. For example, Inuit actors can hold bonding ties with other hunters to reinforce their local knowledge (often confirming observations through informal networks) and at the same time have weak ties (bridging ties) with scientific parties in the form of co-management boards where results from scientific studies can provide additional insights into environmental change (Nichols et al. 2004).

A structural perspective about how actor groups understand and navigate environmental change points to particular entities, organizations and/or 'objects' embedded within social networks that can facilitate or impede the bridging of knowledge systems (Cash 2001; Rathwell and Peterson 2012). Boundary organizations have been

highlighted for their capacity to link science with policy, often across levels (Cash and Moser 2000; Cash 2001; Cash et al 2006). Inuit Tapiriit Kanatami (ITK), a political advocacy organization, is a boundary organization that seeks to bridge Inuit knowledge and scientific knowledge to direct Canadian policy. For example, the project 'Nilliajut Inuit perspectives on Arctic Security' initiated by the Inuit Knowledge Center branch of ITK, has documented the perspectives of Inuit on this emerging topic (Inuit Qaujisarvingat 2013). For Inuit, the concept of 'security' involves a focus on food, shelter and a healthy environment. In contrast the southern discourse on security is focused on projecting military strength (Inuit Qaujisarvingat 2013).

Boundary objects connect organizations or actors in social networks by functioning as a mutually beneficial tool for learning and adaptation. Boundary objects act as a mutual reference point for different knowledge systems (Star and Griesemer 1989). Boundary objects themselves can adapt over time. For example, Inuit hunters and geomatics engineering students co-created an integrated GPS/PDA mobile weather station technology that can be utilized by scientists and hunters for observing and monitoring a changing Arctic environment (Gearheard et al. 2011). This technology acts as a boundary object in that both its creation and utilization can bridge knowledge systems. Likewise, Zurba and Berkes (2014) describe a collaborative mural as a means to communicate Australian aboriginal perspectives on how to 'care for country' (i.e. conserve local ecosystems). The artwork's imagery serves as a boundary object to foster discussion of what is important for this Indigenous group in regards to ecosystem management.

Engaging with brokerage as a bridging setting means connecting levels - local to global across time. Brokerage impacts governance of environmental commons by connecting knowledge systems across time and space in efforts to enhance collective action across large commons. For example, bridging organizations can connect municipalities with different priorities across two watersheds in efforts for collaborative water management (Rathwell and Peterson 2012).

4.3.4 Institutional/Governance

Governance refers to "...processes and institutions through which societies make decisions that affect the environment" (Oakerson in Armitage et al. 2012, p. 246). For the purposes of this paper, we focus on formal governance arrangements as a setting to explicitly facilitate the bridging of both science and Indigenous knowledge into learning and decision-making. Adaptive co-management, for example, is a governance approach that has gained some traction in governance practice due to its emphasis on power sharing and valuing both scientific and Indigenous knowledge perspectives on environmental change (Berkes 2004; see also Nadasdy 2003; 2007 for criticisms). Adaptive co-management can provide a setting for social learning where individuals and groups engage in iterative action, reflection, and deliberation to resolve complex challenges collaboratively (Diduck et al. 2005; Armitage et al. 2011).

Some positive outcomes of governance arrangements that facilitate bridging Indigenous and scientific knowledge systems are: 1) direct embedding of lessons into formal governance procedures (e.g. setting hunting quotas); 2) representation of both Indigenous and scientific perspectives in all stages of governance processes, including problem definition, analysis and implementation; and 3) the development of trust and respect between Indigenous and scientific participants of these governance institutions (Berkes 2009; 2012).

Research on narwhal co-management in Arctic Canada illustrates opportunities and challenges for bridging knowledge in co-management settings. Governance structures, such as co-management settings, provide a context where bridging knowledge systems can occur. For example, marine mammal co-management in the Canadian Arctic draws on both Inuit and scientific knowledge for quota setting and enforcement that includes processes such as knowledge gathering, knowledge sharing, knowledge integration, and knowledge application (Dale and Armitage 2011). Embedded within governance and institutional structures are the praxis of participants (e.g. methods and processes, epistemological engagement). Despite settings that seek collaborations (co-management), tensions can emerge during the processes, such as those relating to tagging animals in the Arctic. Tagging is a western resource monitoring practice that is considered by Inuit to be disrespectful to the animal. Engaging in resource management

methods that defy Inuit values, such as tagging marine mammals, burn bridges between knowledge systems because epistemology is disregarded.

Environmental assessment is a setting to bridge knowledge systems. Environmental assessment is a particularly interesting bridging setting because it can be carried out at multiple levels. We have distinguished project based environmental assessment from the global scale assessment initiatives (e.g. IPBES). Opportunities for Indigenous participation are considered during each phase of a BHP Diamonds Inc., mine (Stevenson 1996). However, scholars report difficultly in embedding Indigenous knowledge contributions into existing environmental assessment protocols (Stevenson 1996; Agrawal 2002). Global scale assessments have the added challenge of synthesizing a myriad of knowledge systems from different parts of the globe into comprehensive patterns, changes and priorities at the global level. The Millennium Ecosystem Assessment (MA 2005) had the intention to draw on Indigenous knowledge and it did so, but only to a limited extent. Other emerging global assessments, such as the IPBES, ongoing work within the IPCC, and the Aichi targets of the Convention on Biological Diversity, each seek to better bridge knowledge systems (Tengö et al. 2014; Thaman et al. 2013). Results from this literature point to confusion around how knowledge systems are understood (Stevenson 1996; Usher 2000), and limitations of a discipline-bound analysis (Carpenter et al. 2009) as barriers to effective environmental assessment methods and outcomes.

More accurate and nuanced assessment of changing environmental conditions and human responses can result from environmental assessments that bridge knowledge systems (Laidler 2006; Nichols et al. 2014; Reidlinger and Berkes 2001). Further, assessments that align with the values and priorities of different knowledge systems (e.g., Inuit and scientific) have better chances of improving management of environmental resources because participants feel they were part of a legitimate process (Mitchell et al. 2006).

4.3.5 Settings act in synergy to bridge knowledge

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The various settings, and categories of settings in Table 2, can act in synergy. For example, map-making of sea ice change can be complemented with 'out on the land' trips as scientists and elders make sense of change (Laidler 2009). However, particular settings can also create path-dependency, whereby a particular epistemological perspective may disqualify some methods while prioritizing others. For instance, adopting Polycentric Global Epistemologies (as proposed by Maffie 2009) as an epistemological approach would favour Indigenous driven bridging methods that encourage self-determination, such as sharing of oral histories. Likewise, particular methods employed to bridge knowledge systems lend themselves to specific evaluation techniques. For example, Fazey and colleagues (2014) describe that when knowledge is perceived as an 'item' that can be detached from its source, evaluation of knowledge exchange is limited to "experimental evaluations, with the success of the knowledge exchange being determined by measuring how much a person holds of a particular item or set of facts" (Fazey et al. 2014, p. 212).

In recent years, there has been an expansion of the various methods and processes to bridge knowledge systems in an environmental change context (Gomez-Baggethun et al. 2013; Tengö et al. 2014; Fazey et al. 2014). More conventional scientific methods of mapping and monitoring that seek the expertise of local Indigenous perspectives have been enriched with artistic processes such as role-play, oral history sharing or documentary film making (Cruikshank 2005; Kunuk and Mauro 2010). Place based processes such as hunting trips are highlighted as important sites for bridging (Laidler 2006). The enactment of various methods to bridge scientific and Indigenous knowledge systems by participants has lead to enhanced overall understandings of environmental change and has provided settings that give voice to a diversity of participants (e.g., social scientists, natural scientists, hunters, youth).

The SIKU-Inuit Sea Ice Use and Occupancy Project engaged with multiple bridging settings (Table 3). This project provides an example of how various methods for bridging Indigenous and scientific knowledge can act in synergy to facilitate a robust and culturally sensitive research program. Methods and processes used to design the project were informed by science and community-based research methodologies. Participatory mapping, sea ice trips and focus groups using photo imagery of sea ice,

each contributed to global understandings for the assessment of Inuit sea ice occupancy and use. Boundary objects, such as the SIKU Atlas provide online platforms for participants, community members and academics to learn about and monitor project progress and to contribute to online discourse. The SIKU project is nested within he International Polar Year (IPY), which has served as a kind of bridging setting and organization.

Table 3. Example of complementary use of settings to bridge knowledge systems

	Setting(s)	Example
Methods and processes	Mapping	Participatory mapping; 'Out on the land together' (i.e. sea ice trips); Focus groups using photo imagery for maps
Brokerage	Boundary Object	Laidler maintains a website to communicate ongoing research to communities and academics (http://straightupnorth.ca/Sikuliriji/SUN_Home.html); The SIKU-ISIUOP project has created a user Atlas to provide information to hunters on the trail (http://sikuatlas.ca/index.html)
	Boundary Organization	International Polar Year (IPY) is an international initiative to connect Polar science and policy.
Institutional/ Governance	Environmental Assessment	The SIKU-ISIUOP project seeks to provide an overall assessment of Inuit Sea ice Use and Occupancy, information crucial to future resource management projects and government decision-making.

4.3.6 Policy implications

Our typology can inform policy and practice, but not all individual aspects of the typology have a clear policy connection. This is a potential limitation. However, recognition of the diverse settings in which to bridge knowledge systems points to associated implications for policy and practice. This typology provides four specific lessons for policy and participatory action that include: 1) enabling policy makers to understand how efforts to bridge knowledge systems need to be appropriately supported by adopting a bundle of settings (e.g. using diverse methods and brokerage); 2) encouraging practitioners to use clear definitions of 'knowledge' and 'bridging' in proposals and research reports to support reflexive processes, monitoring and evaluation;

3) reflecting on how bridging organizations and social networks can support, enhance and/or prevent the reach of knowledge system bridging activities and outcomes; and 4) developing evaluation metrics that reflect the process dimensions of bridging in the various settings which cannot be captured if metrics are concerned merely with efficiency. We discuss each in turn.

Programs that adopt bundles of settings require input from diverse knowledge systems to identify and engage appropriate and complementary settings. By practicing multiple methods of knowledge systems bridging, participants allow for a broader spectrum of insights, including for example, cultural and place-based knowledge that can be shared through collaborative fieldwork (Laidler 2006). By bundling settings, certain processes may favour scientific institutions, but these can be balanced with settings that Indigenous participants may deem more appropriate (Weiss et al. 2013).

Policy makers and funders are within their bounds to request clear definitions of knowledge and knowledge system bridging from those they fund. Outlining an epistemological approach in research design or policy programming signals an awareness of the philosophical, ethical and political dimensions of bridging processes. This can help ascertain if/how projects are prepared to respect and engage with diverse knowledge systems.

Bridging organizations and social networks can support or hinder the reach of knowledge system bridging processes and outcomes in the context of governing changing environmental commons (Bodin and Crona 2009; Rathwell and Peterson 2012). International initiatives, such as the IPBES, can consciously determine how social networks and bridging/boundary organizations are best leveraged to connect knowledge across all levels. For example, boundary organizations may or may not have local Indigenous buy-in. Knowing how bridging organizations and boundary organization facilitate or inhibit local knowledge from traveling through networks informs legitimate and salient governance of environmental commons.

Development of evaluation metrics for settings that bridge knowledge systems is a research/policy 'next step'. Metrics can emphasize the importance of trust and reciprocity in the context of bridging Indigenous and scientific knowledge systems.

Metrics of success must consider outcomes beyond efficiency, to account for attributes such as inclusion, capacity building, respect and trust. Metrics can include aspects of *process* (e.g., "were participants respectful?") in addition to tangible knowledge bridging *outcomes* or lessons learned.

4.3.7 Research development implications of knowledge bridging

Outcomes of the meta-synthesis and development of the typology point to several areas for future research, and specifically participatory research. First, much more attention must be given to the epistemological settings of research programming when bridging Indigenous and scientific knowledge systems. Scholars must take the time, perhaps by engaging in multi- or transdisciplinary research programs, to identify how knowledge systems are conceptualized. Second, research programs that encourage bundles of methods and processes for bridging foster insights that have more depth and contextual relevance (Laidler 2006; Reed et al. 2006). Combining methods such as interviews about climate change with the creation of documentary film (including oral history) is an example of creating synergy by leveraging complementary methods (Kunuk and Mauro 2010). Third, social networks and governance/institutional settings offer arenas for bridging knowledge systems at higher levels of governance (regional, global). However, how knowledge is 'scaled up' and recognized as relevant at regional and global levels, whist maintaining knowledge integrity, continues to be a pressing challenge and research concern. Fourth, more effort is required to respectfully and successfully evaluate knowledge contributions, such that insights are salient, legitimate and credible for governance of the environmental commons.

Bridging activities take time and require resources. Meaningful engagement in a cross-cultural context with a sensitive political history (as is the case when bridging scientific and Indigenous knowledge systems) requires trust building. Trust building takes time (Castleden et al. 2012). Bridging activities may span months or years. Ongoing support from funders, for example, is needed to facilitate interaction over longer time horizons and to foster more ethical, engaged and informed bridging processes.

The typology offers lessons to bridge diverse knowledge systems, although our emphasis here has been on bridging Indigenous and scientific knowledge. The rich literature on Indigenous and scientific knowledge system bridging helps inform how any two different ways of seeing the world (e.g. local, traditional, citizen, policy) can be better included into discussions of governance of environmental commons. Projects that engage with diverse knowledge groups (e.g. farmers citizens groups, or artists) can use the typology to better reflect on the settings in which they are bridging knowledge systems. Increasingly projects (both scientific and policy) have mandates for stakeholder engagement, as one way to legitimize and decentralize decision-making. The typology we offer can be used as a guidepost for any project or development that seeks to bridge diverse knowledge's to inform governance of environmental commons.

4.4 Conclusions

Major international initiatives on environmental change are seeking novel ways to incorporate diverse knowledge systems, following the lead of the Millennium Ecosystem Assessment (Reid et al. 2006). The Arctic Climate Impact Assessment, (2005) demonstrates an early effort to bridge Indigenous perspectives with western insights at a regional level to guide knowledge and practice. Global studies, such as the Intergovernmental Panel on Climate Change (IPCC) started looking at bridging seriously only after a UNESCO report provided evidence that there is in fact a scientifically "respectable", peer-reviewed literature base on Indigenous knowledge and climate change (Nakashima et al. 2012). In the case of the IPBES, the biodiversity equivalent of IPCC, knowledge bridging started as soon as IPBES itself came into being (Thaman et al. 2013). It remains to be seen, however, if IPBES can live up to its promise, or if knowledge bridging will succumb to the power politics of knowledge, whereby, for example, lack of engagement with diverse epistemologies results in narrow conceptualizations of phenomena such as biodiversity - limiting local perceived legitimacy of policies and environmental governance decisions (Turnhout et al. 2013).

Research and policy is often initiated and mediated by western institutions (universities, governments, international initiatives). Knowledge system bridging activities that are open to proposals and initiatives emerging from within Indigenous

knowledge communities are critical. Gratani et al. (2014) provide some insights as to why Indigenous participants do not initiate knowledge-bridging practices, and why natural resource management practitioners find it difficult to integrate Indigenous and scientific knowledge for environmental management in the Australian context. They point out to three factors: weak Indigenous internal and external governance related to colonial disempowerment, the tendency of practitioners to validate Indigenous knowledge using scientific knowledge, and a struggle with understanding *how* to engage. The typology offered in this paper provides clarity on this third point. We show that many settings exist to address this challenge. Moreover, there are likely many additional settings, including processes initiated and facilitated by Indigenous peoples to connect Indigenous and scientific knowledge not reflected in the academic discourse.

There are moral, political and practical reasons to bridge diverse knowledge systems in the context of environmental change. Overcoming the continued marginalization of Indigenous knowledge and discouraging extractive methods that dishonour Indigenous knowledge are of central concern (Smith and Sharp 2012; Turnhout et al. 2013). Bridging knowledge systems show promise of enhancing collective understandings of, and collective capacity to navigate, complex environmental change (Krupnik et al. 2010; Eicken 2010) and encourage mutual learning (Idrobo and Berkes 2012). Achieving these outcomes, however, requires a more careful reflection on the settings in which knowledge systems are brought together. The typology we have outlined here is a modest offering towards improving knowledge bridging. Robust strategies to bridge Indigenous and scientific knowledge systems are ultimately a key dimension of the effort to govern local to global commons under conditions of change and uncertainty.

Chapter 5: Art and artistic processes bridge knowledge systems about social-ecological change: An empirical examination with Inuit artists from Nunavut, Canada

5.0 Abstract

The role of art and artistic processes is one fruitful yet under-explored area of social-ecological resilience. Art and art making can nurture Indigenous knowledge, and at the same time bridge knowledge across generations and cultures (e.g., Inuit and scientific). Experiences in two Inuit communities in northern Canada (Cape Dorset and Pangnirtung, Nunavut) provide the context in which we empirically examine the mechanisms through which art and art making may bridge knowledge systems about social-ecological change. Art making and artworks create continuity between generations via symbols and skill development (e.g., seal skin stretching for a modern artistic mural), and by creating mobile and adaptive boundary objects that function as a shared reference point to connect different social worlds. Our results indicate how art and artistic processes bridge knowledge systems through six mechanisms, and in so doing contribute to social-ecological resilience during change and uncertainty. These mechanisms include: 1) embedding knowledge, practice and belief into art objects; 2) sharing knowledge using the language of art; 3) sharing of art making skills; 4) art as a contributor to monitoring social-ecological change; 5) the role of art in fostering continuity through time; and 6) art as site of knowledge co-production[2].

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[2] This chapter is currently in press in *Ecology and Society* (Rathwell and Armitage 2016).

5.1 Introduction

This paper examines the role of art and artistic processes as an increasingly important context in which to bridge knowledge systems, or ways of knowing, about social-ecological change. We situate our study in the context of the Canadian Arctic where rapidly changing sea ice conditions and climate change make the need to bridge knowledge systems an important priority (ACIA 2005; IPCC 2007; Arctic Council 2013). Connecting ways of knowing, such as scientific and Indigenous ways of knowing, is argued to play a key role in fostering collaborative governance, community adaptation and in enhancing overall understandings of, and responses too, environmental change (Reid et al. 2006; Mitchell et al. 2006). Art and artistic processes can make valuable contributions to nurturing Indigenous knowledge and bridging that knowledge with other ways of knowing (Zurba and Berkes 2014; Zurba and Friesen 2014; Rathwell et al. 2015).

Knowledge systems are complex and dynamic social-psychological structures that give meaning to the human experience (Foucault 1991; Godfrey Smith 2003; Dryzek 2005). Knowledge is dynamic and co-constructed, and can change over time as new information about the environment is gathered or observed, and subsequently, made sense of by individuals and communities. Being able to bridge knowledge systems is recognized as playing a critical role in helping to enhance resilience from local to global levels (Reid et al. 2006; Gomez-Baggethum et al. 2013). There are now also international and national legal mandates to better promote and protect Indigenous knowledge (UN 2007; Konstantia et al. 2015). Connecting ways of knowing to create novel insights about complex environmental change, while also maintaining the integrity of those knowledge systems – termed bridging knowledge systems – is an increasingly important area of applied research (Tengö et al. 2012; Thaman et al. 2013; Rathwell et al. 2015).

Many potential settings exist to bridge knowledge systems (McCarter et al. 2014; Rathwell et al. 2015). Popular techniques within an environmental change and natural resource governance context include processes such as mapping, hunting trips (Krupnik et al. 2010), creation of databases and institutions (McCarter et al. 2014), co-development

of tools or toolkits (e.g., mobile geospatial devices) (Gearheard et al. 2012), and local governance structures such as co-management boards (Armitage et al. 2011). Choosing appropriate strategies and settings to bridge knowledge can help avoid pitfalls associated with extractive techniques (Nadasdy 2003) or superficial engagement (Weiss et al. 2012, Gratani et al. 2014). Developing strategies that can engage with and nurture existing knowledge systems (e.g., as pockets of local resilience) (Barthel 2013; Ruiz-Mallen and Corbera 2013), *and* at the same time, bridge them in ways that allow for hybrid knowledge to emerge is a significant challenge (Tengö et al. 2012; Thaman et al. 2013).

One setting that holds particular promise, and which is the focus of our study, involves art and artistic processes (see also Maffie 2009; Zurba and Berkes 2014). Our research aims to systematically examine how art and artistic processes contribute to bridging of knowledge systems in two Inuit communities. We investigate in particular the mechanisms through which art and artistic processes enhance the process of bridging knowledge systems about social-ecological change. In turn, we contribute more broadly to understanding the relationships between art and artistic processes and resilience in the context of change and uncertainty.

5.2 Literature Review

An emerging literature is exploring the relationship between art and artistic process and social-ecological resilience (e.g., as reflected in this special issue 'Reconciling Art and Science for Sustainability'). For example, the relationship between artists and the environment has been explored in an Australian case study examining how artists harvest and utilize different species (Koenig et al. 2011). Art is also described in its capacity to communicate complex ecology (Curtis et al. 2012; Vervoort 2014). Scholars have discussed the need to integrate aesthetics more rigorously into the process of scenario planning (Ramirez and Ravetz 2011), governance (Armitage et al. 2014), and in how knowledge bridging is approached. For example, Maffie (2009) reflects on a case where a researcher may have learned much more had he heeded the words of his study subject, a Shinto priest: "We have no theology, we dance" (pg., 59). Movement is the most compelling way the Shinto priest can share knowledge, and this example highlights the value of movement as a particular aesthetic form in conveying important meaning.

Here, we augment this growing literature relating art and resilience by examining art objects and artistic processes as mediators to bridge knowledge systems about social-ecological change.

Creative methods for bridging knowledge systems that involve, for example, storytelling and oral history, show promise in their capacity to engage with the many dimensions that make up knowledge systems (e.g., ontology, epistemology, axiology, methodology, or knowledge-practice-belief) (Cunsolo Willox et al. 2012; Kunuk and Mauro 2010; Martin 2012). Settings such as collaborative mural making (Zurba and Berkes 2014), collaborative art (Zurba and Friesen 2014), performance art (Heras and Tabàra 2014; 2015), and digital storytelling (Kunuk and Mauro 2010; Cunsolo Willox et al. 2012) all demonstrate how art-making and artistic processes can help participants to better understand each other's values in the context of changing social and ecological conditions.

Art and artistic processes can be conceptualized as 'artistic boundary objects'. As an extension of the boundary object concept (Star and Griesemer 1989), art and artistic processes promise to be particularly robust types of boundary objects (Halpern 2011, Singh 2011). Boundary objects connect social worlds and can help mediate knowledge bridging because they are " plastic enough to adapt to local needs, and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star and Griesemer 1989, pp. 393). Marsh (2012) describes working with aboriginal high-school students in their artistic process of hip-hop song writing. Through the process of creating hip-hop music, aboriginal youth are able to merge their Indigenous narratives with modern culture, and find a hybrid voice to navigate their identity in turbulent times (Marsh 2012).

Aesthetic objects are also valuable because they foster settings for discussion and creation of shared stories (e.g., of change and/or responses to change) (Pink 2001; Singh 2011; Rathwell et al. 2015). In an Indigenous context, moreover, direct exposure to artworks is considered a form of decolonization because one is vulnerable to the cultural values and ideals reflected by the object (Schiwy 2003). For instance, Australian Indigenous peoples and western researchers made a collaborative mural as a boundary

object to communicate perspectives on how to care for their environment (Zurba and Berkes 2014). In another example, an Inuit carving of a woman and child functioned as an artistic boundary object when Sheila Watt Cloutier brought it from a local community to a global decision making arena (see Chapter 1). The carving is credited with bringing a humanity into the meeting and inspiring outcomes in favour of Inuit health and well-being (Johnson 2014; Watt Cloutier 2015). An opportunity exists to better understand the underlying mechanisms for how art objects and art-making function to mediate knowledge system bridging. We contribute to this understanding by drawing on the perspectives of Inuit artists, as well as through action research in the form of a collaborative art process with youth, artists and elders.

5.3 Study location

Cape Dorset and Pangnirtung, Nunavut are two communities in Baffin Island and they provide the context for this research (Figure 1). Both communities are experiencing rapid social-ecological change from external drivers, such as sea ice loss from climate change that impacts the connection between people and the environment (e.g., no access to traditional hunting routes, food insecurity). External social drivers of colonization and globalization also have an impact on the social-ecological system of people, art and nature in Inuit communities. For example, Inuit art, as an economic commodity was introduced to these communities (Bagg 1997). Maintaining the resilience of traditional knowledge is an important challenge with the pressure of ecological and social drivers of change (ACIA 2005; Arctic Council 2013).

Pangnirtung is a community of 1510 residents nestled on a fjord between Auyuittuq National Park and Cumberland Sound. Pangnirtung, first a trading post for the Hudson Bay Company, acquired municipal government status in 1973. The main livelihood activities in Pangnirtung are subsistence hunting, working at the fish plant, art and craft making, and municipal and territorial government services (e.g. water and sewage truck drivers, local nursing station, and Nunavut Health Services). Tourism is active in Pangnirtung, facilitated by the dramatic natural landscape, and coastal access. Textile arts, carving and printmaking are the prominent art forms practiced in Pangnirtung.

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Cape Dorset, with a current population of about 1400 residents, was established as a trading post to service the Hudson Bay Company, and became a settlement in the 1950's. Art making is Cape Dorset's most important economic activity. The community calls itself 'The Capital of Inuit Art' with a reputation for artistic talent extending internationally (Hessel and Hessel 1998). Lithography, stone cut, stencil and etching are all techniques used for Cape Dorset prints. The annual Cape Dorset Print collection is an opportunity to showcase selected works to a global arts audience. Pencil crayons and large format paper are provided to graphic artists in the community; both 'in house' artists and community artists sell drawings to the Kinngait art co-op to be turned into prints or for direct shipment south. Carving with power tools is the other most prominent art form in the community. Plans are emerging for a world-class art center in Cape Dorset, which would provide many opportunities to foster the talent of individuals in this community. Cape Dorset and Pangnirtung were chosen specifically because of the legacy of art making in these communities (Hessel and Hessell 1998).

The art co-op is a center of activity in Cape Dorset. During work hours, artists fill the Kinggait print studio and attached art co-op. Inside, the art studios, artists are drawing, etching, and print making while working in pods. At peak hours' carvers are lined up at the entrance with the hopes of selling their recent work to the co-op (Kinngait 2010) for shipment and sale in the south of Canada. Some artists continue to draw or carve during the evenings and weekends. While walking the streets, one hears the soundtrack of power tools omnipresent as carvers work constantly beside houses. Cape Dorset Fine Arts, a for-profit organization based in Toronto, facilitates the interaction between the local-scale art making and the national and international scales of global art culture.

The first author spent four months in Pangnirtung and six weeks in Cape Dorset during the summer/fall of 2013. The time spent building friendships and trust with community members was pivotal to the success of our project (see Castledon et al. 2012, Wolfe et al. 2007), and has helped to foster the legitimacy and contribution of the project. For example, the collaborative mural project was created at the request of employees and volunteers of the local youth center. Realization of the mural took a time span of three months. Our mural activities and research interviews echoed the participants changing

priorities. An adaptive approach to participatory projects embodies this principle of making the participatory project more meaningful by adjusting the research plan to individuals priorities. This way of approaching research is especially important in an Inuit context, because participant's interests are respected and accounted for in project plans and timelines (Wolfe et al. 2007, Castleden et al. 2012). In this way, although I did not follow a community-based research protocol, I could ensure that my work had meaning for participants and communities where I engaged. For example, following the sudden death of a beloved community member, the mural project was put on hold. In another example, a carver who was happy to meet for an interview was no longer available because the narwhals were passing the bay – providing an opportunity to hunt. In another example, the choice to undertake a collaborative mural emerged because that was the priority of the local youth center. Before living in Pangnirtung, I had anticipated music to be the medium of interest, but quickly adapted my plans to visual arts.

Local community members (e.g. youth leaders, art co-op managers and research assistants) were pivotal to the project. Enhancing local capacity by engaging community members in research was away to add social value to the work, and this is consistent with expectations of researchers in the north (see ACUNS 2003). Community researchers were hired for organization and translation based on recommendations from scholars and community leaders. Lists of practicing artists in each of the communities were compiled based on advice from community researchers, art co-op managers, local artists and community leaders, as well as web and paper resources (e.g. print shop catalogues). Community researchers were also experts in local geography and advisors about local politics and customs. Having the help of these local experts facilitated the research in many important ways. For example, one community researcher knew where each of twenty Cape Dorset artists lived and created mental maps for our days walk around the community to do house visits and interviews. Similarly, a local youth leader leveraged her social network ties to help increase youth participation in workshops during mural creation. The contributions of community researchers and other supportive individuals significantly enhanced the flow, rigor and outcome of our work.

5.4 Methods

Three data collection methods were used in this research: 1) semi-structured interviews about the role of art in the lives of individuals in the community, bridging knowledge and as a medium to reflect experiences with environmental change; 2) facilitation of, and engagement with, participatory art that included two workshops and three months of stenciling, painting, sewing and framing to create the mural; and, 3) participant observation during five months spent in Pangnirtung and Cape Dorset, Nunavut. We use these three sources of evidence to better understand how art and artistic processes can mediate knowledge system bridging in these communities.

In total n = 30 professional artists were interviewed. 'Professional' in this case indicates obtaining at least a portion of income from artworks. Our semi-structured interview guide allowed for conversational (Kvale 1996) and storytelling tangents, especially with elders, as is respectful to Inuit culture (Martin 2012). Interviews were conducted in Inuktitut or English depending on the participant's choice. Length of interviews varied between 20min and 2hr. All participants were given an honorarium of $100CAD for their time, as suggested by northern researchers and the Nunavut Research Institute. In some cases, artists had artworks present during interviews to help with descriptions, and in others they remembered an artwork and described it orally. Interviews were crucial to gain the perspectives of local artists.

In addition to the insights about art and artistic processes from interviews with Inuit artists, the lead author designed and co-facilitated two workshops and helped make a collaborative mural with other youth, artists and Inuit elders. The mural project offered an opportunity to focus on process. We were interested in if/how our interactions, and the experience of making and sharing art during mural creation created opportunities for bridging knowledge about social-ecological change. With the mural project, we were able to identify similarities between what artists identify as the role of art, and, if/how that role manifests in practice. Follow up interviews with participants of the collaborative mural (incl. youth and elders) enhanced our analysis even further.

We used the theme of social-ecological change as an organizing theme for our mural project. Mural creation lasted for the duration of three months from July 2013 to

October 2013. The mural creation process included: planning the process, garnering local support and priorities, two workshops (involving storytelling), ongoing art making activities at several venues (e.g. print shop art studio, elders homes), and a final celebration with the community. We organized a series of games, and invented a method of imagery co-construction for the mural process. We planned a full day workshop and one half-day workshop with advice from local experts about how to engage youth. During the first workshop six Inuit youth and three southern youth wrote on two small cards: (1) something old, and, (2) something new. Sitting in a circle we told a story about the 'something old or new' on our card whilst the person to our left quickly sketched a vignette image of the story. After two hours of stories and sketching, we discussed as a group common themes and ideas for how to synthesize the images onto a mural (see sketches figure 2). The broader story is about connecting to the land in a historical context and in a present day context. In a second workshop we used the mural as a starting point to engage elders in storytelling about sea ice (Figure 3 workshop action photo). We followed the same method of stories and sketches, but focused on the stories of participating elders.

Figure 2 Sample of youth sketches

Figure 3 Workshop with youth, and elders.

The mural project had community and regional support. The municipality of Pangnirtung, NU provided both in-kind support (e.g. connections to the youth Making Connections co-ordinator and her team), and financial support ($500 to have a professional local artist provide instruction and encouragement to youth). The project was featured in the northern regional newspaper (Dolphin 2013). Although some of the art making for the mural was formalized, for example, painting at the local print shop with a lesson from a print maker, other aspects were more informal. We carried the canvas mural to elder's homes for help with sewing seal skin accents onto the mural and for help mounting the mural on a traditional wooden frame. As facilitators, we strived to create stability and availability and aimed for flexibility in working with all participants. For example, being in the print shop working for several hours offered youth an opportunity to come and work on the mural when they were ready and for as long as they wanted.

Interviews were transcribed and open coding performed on all transcripts. Detailed field notes were not coded but functioned to contextualize the themes identified during interview coding. Follow up interviews with mural participants adhered to the same protocol and were cross-checked with themes from artist interviews. Coding was done manually. Open coding established main themes. These themes became row headings in an excel spreadsheet. Every time evidence for a theme came up in an interview the specific quotes from that interview were added to the row of evidence for that theme. Artists and mural participants were each assigned a column, creating a large data matrix. Interviews were re-checked once new themes became apparent (see Oktay 2012). Of the main themes created in the excel matrix, six themes that offer a mechanism to support knowledge system bridging where identified. These mechanisms are presented in tandem with key quotations from participants (see Table 4).

Ethics approval for this research was obtained through the University of Waterloo Office of Research Ethics (ORE) (ORE #: 19045). In addition, a research license was obtained through the Nunavut Research Institute (NRI) (# 01027 13N-M). The process to obtain the NRI license involved consulting with relevant community interests prior to the submission of the application, and modifying the application to reflect the interests and concerns of the communities. This research process has endeavoured to be transparent,

inclusive and empowering for participants and the communities. The identities of the individuals that participated in the research have been maintained as per the ORE consent process:

> "In an interview study with visual artists concerning some aspect of the way they work, it might be appropriate and respectful to identify the respondents. If failing to identify participants would be unethical because of any disrespect it would represent, or if informed participants assert their desire to be named, then researchers should do so, according to the practices of their discipline" (Chapter 10 of TCPS 2).

Participants were asked to give written consent for their name to be used in this research, which they did.

5.5 Results

Our results show that artworks and art making support Inuit knowledge and enhance opportunities to bridge this knowledge across cultures and generations. Specifically, we identified six key mechanisms through which art supports knowledge system bridging about social-ecological change:

1) Embedding knowledge, practice and belief into art objects,

2) Sharing knowledge using the 'special language' that is art,

3) Art making skills shared in practice,

4) Monitoring social-ecological change and anomaly,

5) Maintaining continuity over time in art and art making, and

6) Knowledge co-production/ creation of hybrid knowledge.

5.5.1 Embedding knowledge-practice-belief into art objects

The embedding knowledge-practice-belief into artworks mechanism describes art objects in their capacity to represent knowledge. Artists leverage symbolism, and depictions of real life scenes, to reflect knowledge systems.

Artists generally speak of their works as objects that can depict knowledge. Key evidence to support this theme emerged from interviews with Inuit artists. For example, Jaco Ishulutaq shared that some of his carvings demonstrate "…how one should live…" (pers. comm. August 2013, see Table 4). Here, a value-laden belief of his knowledge system is embedded into his carving. He described one carving titled 'Father and son forgive each other with a hug'. The carving demonstrates that one should live by forgiving others. Several artists also emphasized the art object being able to communicate practical components of knowledge that are required for survival in the north. Tainya Nowdlak (pers. comm. September 2013) describes how her hand sewn sealskin boots called 'kamiks' "…tell a story of how one has to work with the sealskin". Often the art object is described as having the role of embedding lessons so that younger generations can learn. Elisapee Ishulutaq, from Pangnirtung, describes how artworks can enhance connections between elders and younger generations and enhance the exchange of knowledge: "having some sort of visual aid like art would really put a clearer picture into what the elders are trying to say" (pers. comm. August 2013, see Table 4). Thus, many participants in the research illustrated how art objects can facilitate knowledge system bridging by acting as a knowledge-practice-belief artefact.

Table 4 Summary of mechanisms through which art and artistic processes support knowledge system bridging

Mechanism for bridging knowledge systems	Selected supporting quotations from interviews with Inuit artists (n=30) and participants of a collaborative mural process	Brief explanation of how quotes demonstrate the mechanism
Embedding knowledge-practice-belief into art objects	[The kamiks - traditional sealskin boots] tell a story of how one has to work with the sealskin" (Tainya Nowdlak, pers. comm. August 2013). "When I was young the ice was not dangerous…now it's getting dangerous and through art, artists can get it out there, sharing that the ice is getting dangerous. Now a days hunters don't really listen to elders for their knowledge or wisdom and having some sort of visual aid like art would really put a clearer picture into what the elders are trying to say" (Elisapee Ishulutaq, pers. comm. August 2013). "I carve all sorts of things…some carvings depict how one should live life, and some on the climate change" (Jaco Ishulutaq, pers. comm. September 2013).	Stitching and softening of the kamiks can be felt and studied by holding them. Well-made kamiks keep feet warm while standing for hours in wet ice. Art objects are visual learning aids. Jaco Ishulutaq has carvings that leverage metaphor and symbol to embed a value message about "how one should live life".
Sharing knowledge using a 'special language' of art and art making	"In 1970 [I started making art]. The main reason for making art being that the future generations could see my work… I would leave a footprint so to speak…to be able to share history through images" (Elisapee Ishulutaq, pers. comm. August 2013). "To keep it going, we can study more about art to pass on the traditional knowledge…Our elder people are passing away. They drew most days … we can make a print out of these drawings to pass [the knowledge] on. This way young kids will learn more…In Nunavut we want to keep Inuit things alive" (Jolly Atagoyuk, pers. comm. August 2013) "Sharing Inuit culture and tradition: I can use a special language through my sewing and my painting…I have lots of ulu's [in my artworks], like the mountains, they are something I am familiar with and something that [Inuit] woman have used for generations and generations … to achieve what she wants to do" (Madaline Oumauataq, pers. comm. August 2013). "I share my knowledge with my grandchildren, the traditional ways that I know, via the	Elisapee Ishulutaq emphasizes how her artworks allow her to share history through images with future generations. Artists emphasize traditional knowledge and traditional ways to be what is important to share using art and artworks. Engaging with art (studying, sharing) is one way artists approach maintaining traditional knowledge in Inuit communities Artists are especially interested in sharing knowledge with younger generations.

	drawing" (Petaloosie Sila, pers. comm. October 2013).	The ulu is a traditional Inuit women's knife. A woman carries the ulu with her and uses it for cutting food, skins, ice etc.
Art making skills shared (in practice)	"I actually learned from my mother, she used to draw almost every day. I used to live with her… I would sometimes help her with etching, when she needed help…" (Cee Pootoogook, pers. comm. Oct. 2013). "I learned by watching my grandfather and I took his place trying to imitate his carving at that time" (Toonoo Sharky, pers. comm. November 2013). "I think the mural helped us with a lot of thing… It helped me [learn] how to sew better and how to sew it onto the frame and tighten it… [Participating in the mural project] helped me draw better and I learned about hunting and a lot of stuff" (Mary Angmarlik, pers. comm. September 2013). "Jolly showed me how to draw icebergs and the mountains that is his perspective…I kind of wish Eena did more on the mural because she is a really talented artist and printmaker and she is the one who told me the stories about how the snow on the mountains and about how the glaciers are changing. Where Jolly was just showing me how to draw it, not the story behind it." (Eddie Perrier pers. comm. September 2013). "What I can do and what I do, I try to assist and help others when needed. That is an Inuit tradition that we have. Traditional knowledge how to share and treat others in that way. We use to help and assist each other back then in order to survive" (Tainya Nowdlak, pers. comm. August 2013).	Art making provides economic security Sharing the practice of art making is one way elders have inspired younger generations Sharing skills in practice can also be an opportunity to at the same time discuss knowledge and belief. Eena Angmarlik is a professional artist and assistant at the print shop in Pangnirtung. Eddie Perrier draws our attention to the fluidity of knowledge for teaching and learning. He emphasizes how learning the skills to draw and print glaciers, and the stories about glacier change, at the same time are a desirable way for him to learn. Learning how to treat each other is an important component of knowledge. During mural creation, in addition to artistic techniques, we learned how Inuit should respond and help each other with skills and talents when possible.

Monitoring social-ecological change and anomaly	"When the ice forms later, I try to do the best work I can… talking through art about the climate changing… the ice breaking up on the flow edge and people boating much later" (Tim Pitseolak, pers. comm. October 2013). "I have a large watercolour painting a couple weeks ago at the print shop. Painted the fjord where there use to be a lot of glaciers [and] now the glaciers are not there as much as they used to be. That is what I believe I'm showing in the painting" (Andrew Qappik, pers. comm. August 2013) "I noticed that when the sea ice melted, I began to draw a lot of beluga's … there was a lot of beluga's coming in…when there should have been ice on the bay… But the ice was gone and the beluga whales came in right away when there was no ice there" (Papiara Tukiqi, pers. comm. October 2013).	Artists draw observations of a changing environment Artists incorporate the human response to changing environment A bridge is occurring between knowledge systems and the changing environment via the artworks Knowledge captured in artworks can be bridged with existing and future generations to better understand changing environments and how to navigate uncertainty
Maintaining continuity over time in art and art making	"My grandmother was an artist too, my whole family are artists: Like my cousin is a printer, my cousin is a carver, my brother is a printer, my brother a carver… my grandmother won a governor general award for her prints, and my uncle won a governor general award too…My father use to be a master carver, my uncle use to be a master carver too" (Oqituq Ashoona, November 2013). As for being an artist, it is important you know. When you have a family who is an artist for a long time and you do a second third generation of course it is important. That is where re-generation is coming from the family side as an artist" (Padlaya Qiatsuq, pers. comm. October 2013). I'm capturing that transition with my art. But what I've noticed is that I keep putting an Inuk woman there with that amautiq… and I'm not sure why but she always creeps in there [laughs]. I think I'm very comfortable with that" (Madaline Oumauataq, pers. comm. August 2013). "You hear the legends of Sedna and if someone were to fall in the water Sedna would be the one to rescue you. To carry on that story that's why I carve those" (Jaco Ishulutaq, pers. comm. September 2013).	The identity and practice of art making itself creates continuity for some of the Inuit interviewed. Artists described being empowered by being part of an art legacy. The amautiq is a traditional woman's parka. It has a pouch sewn into the back and an extra large hood to accommodate an enfant. Subconsciously, Madaline Oumauataq creates comfort in the midst of transition by using a woman in an amautiq as a symbol. Jaco Ishulutaq is carrying on the stories of Sedna – the underwater sea goddess – in his carvings. Social continuity is created with shared stories and myths.
Knowledge	[The ice is] suppose to be like this, there is suppose to be lots of ice, but there is no ice…What if	Print making in Pangnirtung and Cape Dorset is a

| co-production/ creation of hybrid knowledge | there is no more ice in the future? What is going to happen? These are the questions I ask… When southerner's see the drawing they probably say, 'I know what you mean' and they know it is changing out there" (Cee Pootoogook, pers. comm. October 2013).

" From time to time I reflect on that day together. If that was done more often I would like it…It would be nice if there were this kind of activity. It would really help the younger generation… Drawing highlights what you are learning or what you have in mind, and if you have questions. … The project how it was prepared and put together it looked like some stories and drawings were made…there was a lot of meaning in how different people drew impressions of the same story…They were really brainstorming how to put particular ideas together." (Towkie Qarpik, pers. comm. September, 2013)

"We all brainstormed and like everything we thought of, pretty much everything went on that mural. Like all of our ideas, not just one person" (Mary Angmarlik, pers. comm. September 2013).

"I think that the outcome came out really good. I liked the colors I like how it was all put together and the finishing touches that Mary did, like the tassel. The tassel Eddie loves. Because I got to draw the 'Pang' hat from working at the Uqumiut center and I didn't even think of that, that is such an awesome idea, I like that" (Eddie Perrier, pers. comm. September 2013). | collaborative task. Some artists in Cape Dorset and Pangnirtung specialize in drawing, while others are experts at etching or print making with the initial graphics.

Neegookooloo is a Cape Dorset artist. Cee Pootoogook is working as printmaker on a graphic design Neegookooloo created about sea ice break up.

Cee Pootoogook also extends the invitation for relating to a drawing about sea ice to southerners. He describes how upon seeing the drawing of sea ice breaking up, southerners could relate that the climate is changing.

The second quotation is an excerpt from a follow up interview with Towkie Qarpik a Pangnirtung artist and elder. She discusses how the youth co-created knowledge when they interpreted elder's stories in sketches. |

5.5.2 Sharing knowledge using a 'special language'

Artists emphasized how the action of art and art making serve as a special language that helps bridge knowledge, practices and beliefs among Inuit (e.g., youth and elders), and among Inuit and non-Inuit. This mechanism highlights an important relational aspect that emerges through the sharing of artworks and during collaborative art making processes.

Artists emphasized a goal of their art making was to provide an opportunity to share stories and histories. For example, Elisapee Ishulutaq explains her initial incentive for making art as, "…to leave a footprint…to be able to share history through images" (Elisapee Ishulutaq, pers. comm. August 2013, see Table 4). Pitaloosie Sila also expresses the same sentiment. She says "I share my knowledge with my grandchildren, the traditional ways that I know, via the drawing" (pers. comm. October 2013 see Table 4). Jolly Atagoyuk articulates that "kids will learn more" if artworks are also used to share Inuit tradition and knowledge (see Table 1 for full quotation). Madaline Oumauataq describes how important symbols for Inuit identity are shared using the 'special language' of her artworks (pers. comm. August 2013, see Table 4). The 'ulu' for example is a women's knife and functions as a symbol of female empowerment in Oumauataq's artworks. Artists emphasized the specific need to share Inuit knowledge with younger generations, and art and artistic processes as a means to do so.

5.5.3 Art making skills shared in practice

Art making also bridges knowledge systems by offering an opportunity to share skills. The skills that are shared during art making can be related to: the technique of artistic practice itself, knowledge or stories related to the phenomena of interest (subject matter of artworks), and/or they can be lessons about how to treat each other during interactions.

Artists described how they learned art skills 'in practice' by watching others work (often family). For the majority of Inuit artists interviewed (n=27), learning art skills

occurred informally by watching family members at home, or similarly, in the carving shed beside the home. For example, Cee Pootoogook describes watching his mother draw "almost every day" (pers. comm. October 2013). In another example Toonoo Sharky describes how: "I learned by watching my grandfather, and I took his place trying to imitate his carving at that time" (pers. comm. November 2013, see Table 4). Also, during the mural making, youth learned new skills about art making and traditional practice:

> "I think the mural helped us with a lot of things, like helped all of us. It helped me [learn] how to sew better and how to sew it onto the frame and tighten it... [participating in the mural project] helped me draw better and I learned about hunting…" (Mary Angmarlik, pers. comm. September 2013).

The stories and legends told during the mural process helped participants reflect on a variety of themes important in their lives (e.g., hunting, maintaining skills that have cultural and economic importance).

Other participants also highlighted the skills and knowledge dimensions of the mural process. For instance, Eddie Perrier described how his preference is to use the art making setting as opportunities to learn about how the environment is changing. He described the situation in which one printmaker showed him the art techniques, while another printmaker described her knowledge about the phenomenon being drawn:

> "Jolly showed me how to draw icebergs and the mountains [from] his perspective…I kind of wish Eena did more on the mural because she is a really talented artist and printmaker and she is the one who told me the stories about the snow on the mountains and about how the glaciers are changing. Where Jolly was just showing me how to draw it, not the story behind it." (Anonymous pers. comm. September 2013).

Finally, the practice of art making was also highlighted by participants as an opportunity to learn how Inuit treat each other. For example, Tainya Nowdlak reflects on the practice of sharing Inuit knowledge by demonstrating how an Inuk will help others to the best of her ability. When describing her experience working on the mural, she says: "That is an Inuit tradition that we have. Traditional knowledge is how to share and treat others in that way. We use to help and assist each other back then in order to survive" (pers.

comm. August 2013). We witnessed Ms. Nowdlak do this when she helped us learn how to sew the mural into a skin stretcher using traditional techniques.

5.5.4 Monitoring social-ecological change and anomaly

Art is a medium through which to explore social and ecological change. Of the thirty artists interviewed in the Cape Dorset and Pangnirtung, sixteen of them described making artworks on the theme of climate change and/or sea ice change. Artists explained how their works mirror changing environments, or depict a memorable social-ecological event in their communities. In this way, the artworks themselves monitor environmental change, environmental anomaly, and in some cases how humans adapt to these changes. Artworks then act as picture books that tell stories of an increasingly variable environment.

Tim Pitseolak, for example, says, "When the ice forms later, I try to do the best work I can… talking through art about the climate changing… the ice breaking up on the flow edge and people boating much later" (pers. comm. September 2013). Here the artist embeds knowledge about how the environment is changing *and* how local people adapt to these changes into his artwork. In another example, Papiara Tukiqi talks about how she was inspired to draw a memorable event linked to Arctic sea ice change:

> "I noticed that when the sea ice melted, I began to draw a lot of beluga's. There was a lot of beluga's coming in…when there should have been ice on the bay… But the ice was gone and the beluga whales came in right away when there was no ice there" (Papiara Tukiqi, pers. comm. October 2013).

Papiara Tukiqi is documenting an anomalous event due to changes in sea ice. Other artists create works that mirror the changing landscape. For example Andrew Qappik describes his watercolour of the Pangnirtung landscape:

> "I have a large watercolour painting a couple weeks ago at the print shop. Painted the fjord where there used to be a lot of glaciers [and] now the glaciers are not there as much as they used to be. That is what I believe I'm showing in the painting" (Andrew Qarpik, pers. comm. August 2013).

5.5.5 Maintaining continuity over time in art and art making

Artworks, and art making, create continuity in one's identity- extending through many generations. Eight artists in Pangnirtung and Cape Dorset described how their role as an artist is part of an intergenerational legacy. Below, Oqituq Ashoona proudly describes how he is embedded in an intergenerational web of award winning artists.

> "My grandmother was an artist too, my whole family is artists: Like my cousin is a printer, my cousin is a carver, my brother is a printer, my brother a carver… like my grandmother won a governor general award for her prints and my uncle won a governor general award too…My father use to be a master carver, my uncle use to be a master carver too" (Oqituq Ashoona, November 2013).

In another example, Padlaya Qiatsuq speaks explicitly about the importance of maintaining re-generation of artists in his family.

> "As for being an artist, it is important you know. When you have a family who is an artist for a long time and you do a second third generation, of course it is important. That is where re-generation is coming from the family side as an artist" (Padlaya Qiatsuq, pers. comm. October 2013).

Artists also use symbols in their artworks to maintain continuity of Inuit identity. For example, Madaline Oumauataq describes her artwork on the theme of transition and the role the woman in an amautiq (traditional woman's parka) who keeps "popping up":

> "I'm capturing that transition with my art. What I've noticed mainly in each painting that I've done now, is that I keep putting that Inuk woman there with that amautiq, and I'm not sure why but she always creeps in there. hahaha! I think I'm very comfortable with that…. I have lots of ulues [in my artworks], I really do. Again, like the mountains, it's something I am familiar with and its something that a woman has used for generations and generations that has helped to build a family. To cut something, whatever it might be…food, material. It is an aid that really helps a woman to achieve what she wants to do" (Madaline Oumauataq, pers. comm. August 2013).

The woman's parka and knife, 'amautiq' and the 'ulu' in Inuktitut, are traditional tools and also function for artists as symbols for the Inuit ways of life. Artists emphasized the importance of maintaining these symbols in their artworks to create continuity, understanding and identity, and therefore, as symbols of tradition and empowerment. Even when the content of the artwork is transformation – as described above - these traditional symbols create continuity in the social-ecological system identity (Cumming and Collier 2005).

Artists re-count that maintaining myths and legends is an important role of art in their communities. For example, Jaco Ishulutaq describes how he carves Sedna – the underwater sea goddess who protects and helps Inuit by providing sea mammals to eat – to carry on her story. Indeed, continuity in imagery was also evident during mural creation. When describing the 'old' and 'new' during our workshops, a central theme was people's connection to the land and animals. Youth emphasized this connection both when speaking about the past, and about the present and future. Being on the land was, as a result, chosen as a main theme to be represented throughout the mural. The human/animal/land connection is a consistent framework for seeing the world that shapes Inuit peoples experience and which is expressed artistically.

5.5.6 Knowledge co-production/ creation of hybrid knowledge

Collaborative art making is a platform for knowledge co-production - whereby novel ideas or products emerge from different ways of knowing. Outcomes of knowledge co-production create an understanding of a particular situation or context that is richer than any individual perspective alone can provide (Reidlinger and Berkes 2001, Diduck et al. 2005, Armitage et al. 2011).

Evidence that art making offers opportunities for knowledge co-production and the creation of hybrid knowledge comes from both our interviews and our experiences collaborating with others on the art mural. Towkie Qarpik, an elder and artist who participated in one art workshop, reflects on how she saw art making create space for knowledge sharing and the creation of a hybrid mural (see also Table 4):

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"… drawings or a prints, they highlight particular impressions about what it is like to be up here and they have a meaning. The mural project, how it was prepared and put together, it looked like some stories and drawings were made and there was a lot of meaning in how different people drew impressions of the same story. They were really brainstorming how to put particular ideas together" (Towkie Qarpik, pers. comm. October 2013).

Towkie Qarpik is referring to how each youth participant drew a sketch while she was telling a story about travelling on the sea ice in her younger days, and noticed that youth created new meaning. When discussing each image, youth participants placed an emphasis on parts of the story that connected with their own experiences on the land - putting the same story together in different ways and creating a hybrid mural by linking their own experiences with elder's stories.

Youth participants illustrated opportunities for knowledge co-production during the collaborative mural process, and recognized the mural itself as a hybrid art object. Mary Angmarlik (pers. comm. September 2013) describes how everyone's ideas were welcomed and included: "We all brainstormed and like everything we thought of, pretty much everything went on that mural. Like all of our ideas, not just one person's" (Table 4). These opportunities to learn were enhanced by being open and accepting to building on each other's ideas and finding ways to complement ideas and imagery. While discussing the common themes we identified the significance of the human-nature connection as a consistent thematic foundation for the mural. Together, participants decided and discussed how the images would be put together to tell a story – the whole of which is more compelling than any individual sketch (Figure 4 close up of mural)

Combining material forms (seal skin, ink and fabric) and using different artistic techniques also required a hybrid approach to the mural process. We were open to ideas and contributions of each participant and many materials were available to work with. When reflecting on the mural, one participating youth, Eddie Perrier, commented on how a fellow participant, Mary Angmarlik, took initiative to add a fabric tassel to the stencilled hat depicted on the mural. The spirit of knowledge co-production is evident in

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the quote below, in which Eddie describes how the outcome is better than what he could have thought of on his own:

> "I liked the colors I like how it was all put together, and the finishing touches that Mary did, like the tassel... I got to draw the 'pang' hat from working at the Uqumiut Arts Center and I didn't even think [to sew on a tassel]... that is such an awesome idea, I like that" (Eddie Perrier, pers. comm. September 2013).

Knowledge co-production is also mediated in these communities by the collaborative nature of printmaking. Different expertise and skills are required at each stage of print making, and these include drawing the graphic art, etching the graphic arts onto stone or metal plates, and finally, using the etched plates to create prints with ink and print making equipment. Sometimes artists have expert skill in only one of these stages. Therefore, an opportunity exists for knowledge co-production and the creation of hybrid objects during the printmaking process. Similarly, sharing of artistic perspectives encouraged sense making about the environmental change reflected in the art. For example, working at the print shop in Cape Dorset, Cee Pootoogook describes how he interacts with a drawing about sea ice break up by another artist named Ningeokuluk Teevee. Below is a short excerpt from our interview:

> *"Right now you are working on a print by Neegookooloo? It is about the ice breaking up. When you are working on that, do you think about the sea ice?*
>
> Very much yes.
>
> *What sorts of things were you thinking about?*
>
> That [the ice is] supposed to be like this, there is supposed to be lots of ice, but there is no ice...What if there is no more ice in the future? What is going to happen? These are the questions I ask... When southerner's see the drawing they probably say, 'I know what you mean' and they know [the environment] is changing out there." (Cee Pootoogook, October 2013)

Cee Pootoogook describes how working with a drawing about sea ice break up stimulates his own reflections on change and what it may be like in the future. The perspectives of both artists and each of their reflections make it into the final print (for example in color

nuance, texture and point of view). Cee Pootoogook also reflects on how the art object can bridge Inuit perspectives with southerner's ideas about changing environments. He extends the capacity of artworks to stimulate knowledge co-production beyond the artistic process, and with regards to the final print, feels that southerners could relate to the changing environment represented in the print with their own experiences of a changing environment. The message in this example is that for Inuit artists, art making becomes an opportunity to combine knowledge, to create hybrid knowledge and objects, and to use those objects to support knowledge sharing.

5.6 Discussion

Our results show the underlying capacities art objects and art making bridge knowledge systems through time and space. In doing so, art and art making contribute significantly to nurturing resilience in social-ecological systems. The six mechanisms through which art and artistic processes support bridging knowledge systems identified here are not exhaustive. In addition, relationships and feedbacks exist among the six mechanisms we identified. Nevertheless, our categorization of mechanisms is useful framework for further study and analysis, and as a way to conceptualize the many functions of art objects and art making. As such, we have offered empirically derived insights about some of the mechanisms through which and artistic processes support bridging knowledge systems about social-ecological change.

Art and artistic processes are increasingly recognized for their role in helping to foster individual and community resilience in the context of change and uncertainty (Goldstein 2008, Vancouver art Gallery 2006). Based on our empirical research, we reflect here on how art objects and art making enhance resilience. In doing so we draw on two commonly articulated themes or dimensions of linked social-ecological resilience (see Walker et al. 2004, Folke et al. 2010):

1) Maintaining identity despite change and transformation (e.g. sea ice change; imposition of southern values on art and art making),

2) Increasing capacities (of individuals, communities) for learning and adaptation

5.6.1 Maintaining identity despite change and transformation

Art objects and artistic processes are described by Inuit artists as helping to maintain continuity during times of change. In the current situation of rapid climate change occurring in the Arctic (ACIA 2005; Lenton 2012), Inuit artists reflect their impressions and observations of change and transformation in their artworks. At the same time, several artists spoke about embedding traditional knowledge-practice-belief into artworks. Papiara Tukiqi describes when she drew belugas swarming the bay, during an early sea ice melt (Table 1). Andrew Qappik speaks about painting the Pannirtung fjord to exemplify the glacier melt, and Madeline Oumauataq describes embedding the *amautiq,* the Inuit women's parka with space for an infant in the back, into her artworks about transformation (Table 4). The *amautiq* and *ulu* (women's knife) are important for the female Inuit identity, for supporting women in nurturing and supporting a family. Although her subject matter itself is transformation, Ms. Oumauataq maintains continuity in her art using symbols paramount to the Inuit identity. Artists intentionally embed knowledge about how to hunt into artworks, noting that younger generations need more sources of knowledge because they don't know as much about hunting as their ancestors. Strengthening existing knowledge, traditional ways, and Inuit culture is emphasized by artists as a reason they make art. Strong sense of tradition and identity can help individuals and communities to maintain important functions (e.g. hunting) and identity (being an Inuk) despite changes and uncertainty (e.g. from drastic sea ice change).

The capacity of art to maintain continuity in knowledge across generations is paralleled by stories from other Indigenous cultures. Jim Hart, hereditary leader of the Saangga.ahl Clan (Haida Nation) and also an artist, reflects on how carved totem poles helped his people navigate turbulent times by creating a stronghold of identity and meaning:

> "Our people, when they carved these pieces, they were survivors from the old sicknesses that were going around. We have pieces in collections today that are older then those days, and then when the sicknesses came around...The carvers that survived that – how they got together and worked on pieces to help record our history, and for us today to look at, to hang on to, to study, to talk about, because all that knowledge is in there. We look at [a piece], and study it, and talk to each other about it. If we're lucky, we have relatives that recognize the pieces and also know

its history, even more so, and tell us the stories behind it. For us to have been able to learn from that, and to carry on from that...the amount of history that's in those things where you stand there and hang on to it, you're hanging onto all your history, your past histories. It's so important, the strength that comes through that. And the person that's standing there is the extension of all that history" – Jim Hart as quoted in Raven Travelling (Vancouver Art Gallery, 2006 pp. 182).

This quote expresses the phenomena of art offering cultural cohesion during periods of change. Artists carved the totem poles during 'the old sickness', in other words during a period of crisis when western settlers infected these First Nations peoples with diseases to which they had no immunity (e.g., small pox). The totem poles provide Haida people an opportunity to remain connected to their socio-cultural past as they navigate social-ecological change (e.g. shifting forestry governance in the 1980s, grieving loss of communities from illness).

Similarly, the examples noted above from Pangnirtung and Cape Dorset draw attention to the capacity of arts to carry stories and identity across generations. Continuity, supported by art and artworks enhances the capacity of people and communities to navigate complex environmental change while maintaining a sense of shared identity. In these examples, artworks are leveraged to maintain identity during periods of change and transformation.

Artworks, as aesthetic boundary objects, can be place-based artefacts that function to nurture local social-ecological resilience, as in the examples above, and they can also move through social networks, from local to global levels, creating opportunities to strengthen local identity and voice in the context of global change and uncertainty. Indeed, the Inuit artists interviewed for this project spoke about their artworks sharing the Inuit perspectives beyond communities to global levels. Cee Pootoogook describes how people from other communities may react to a drawing of sea ice change, reflecting on climate change: "When southerner's see the drawing [of sea ice] they probably say, 'I know what you mean' and they know it is changing out there" (Cee Pootoogook, pers. comm. October 2013). In this example, the art object is taken beyond its context of creation and used for learning and knowledge bridging more broadly (e.g. nationally).

This function of artworks allows for bridging of knowledge systems across space and time. In another example, a carving of an Inuit woman carrying a child was brought by human rights activist Sheila Watt-Cloutier to an international policy meeting about persistent organic pollutants (POPs) in Montreal, Canada leading up to the Stockholm Convention (Johnson 2014). The Inuit carving was leveraged as a mobile art object to bring a sense of humanity into the meeting, and to use the practice of gift giving and art to stimulate empathy surrounding how POPs affect Inuit people. The artwork is credited with helping to direct meeting outcomes in a positive direction by considering the health of Inuit communities:

> "Watt- Cloutier presented the carving to the lead UN negotiator, Klaus Töpfer, Executive Director of the United Nations Environment Program (UNEP), at a reception UNEP was hosting. Töpfer accepted the gift and then presented it in turn to John Buccini, who was chairing the negotiations "...with the request that it be displayed during the negotiations as a constant reminder to the delegates of the significance and importance of our task" (Buccini 2003). The [carving] therefore became a representation of the health and environmental concerns of Inuit and other Arctic Indigenous peoples. It sat in front of Buccini for the rest of the week, making further appearances at press conferences and at subsequent negotiations in Geneva, Bonn, Johannesburg, and Stockholm" (Johnson 2014: 170).

5.6.2 Increasing capacity for learning and adaptation

Leveraging art and artistic processes for enhanced learning – especially for younger generations - is one way to bridge knowledge systems and enhance. For example, Elisapee Ishulutaq described that "having some sort of visual aid like art would really put a clearer picture into what the elders are trying to say" (pers. comm. August 2013). We experienced the emergence of opportunities for enhanced learning when making the collaborative mural. For example, one participant described how making art about the glacier change on the mural was a good opportunity to learn from elders, and artists knowledge and belief, about these changes (see Table 4). When attaching the mural to a traditional wooden frame, we learned the sewing technique necessary to stretch sealskins

onto a frame. Hence, we had the opportunity to learn traditional skills, and also how to adapt skills for new contexts.

Embracing an adaptive approach to mural making and combining different types of knowledge resulted in knowledge co-production. Knowledge co-production is one mechanism for learning and adapting to change (Armitage et al. 2011). A tangible example of co-production, from our experience, is how the elders and youth combined knowledge and aesthetics to sew small seal skin accents on the parkas and kamiks worn by figures in the mural. The traditional skin stretching techniques used to mount the mural also emerged as an outcome of the sharing of information and strategies among elders and youth (Figure 4 mural on stretch and Figure 5 a close up of the mural). In this instance, Indigenous knowledge about seal skin cutting and sewing is transferred onto an unfamiliar medium – our mural - but still provides an opportunity to share traditional sewing skills between elder and youth on a hybrid platform (e.g. global youth culture of murals, with elder knowledge of sewing seal skins).

Figure 4 Mural on skin stretch

Figure 5 close up of section of the mural

The hybrid mural outcome and process demonstrated that when Indigenous knowledge is being nurtured in creative processes, new forms of knowledge (hybrid) ideas and outputs emerge. The existence of these hybrid forms further strengthens Indigenous knowledge rather than diminishing it. Creative processes strengthen Indigenous knowledge by allowing it to be relevant to new contexts and in that way create opportunities to connect with youth. Traditional skills (e.g., cutting, sewing, stretching) were shared in addition to less tangible aspects of knowledge systems. For example, the elders modeled how to contribute to the common good if you have skills, and how to treat animals with respect when working with their skins.

5.6.3 Synergistic role of art in Inuit communities

While the emphasis of this study is on how art and artistic processes function to bridge knowledge systems, we learned that art and art making have multiple of roles, which resonate with most artists. For example, art making provides income for families, embeds traditional knowledge into art objects, *and* creates an opportunity to bridge knowledge systems. Artists described opportunities to bond with grandchildren via questions and answers over artworks or sketches at the kitchen table (Table 4). The creation of such synergistic and positive outcomes suggests that investing in art and art making is a strategic one.

When asked openly about the role of art in their lives, the most common and immediate answer is as income to support one's family. A few examples are below:

"It's really important in my life, given that there are hardly ever jobs to go around and everything nowadays in this world runs on money. Everything costs money...My main influence is for financial gain. There are no jobs... I have kids and not all of them have jobs... Every little thing costs money from food all the way to shelter" (Manasie Maniapik, pers. comm. August 2013).

"Well we don't have a job, the only way to make money, that's how we are trying to do something, like prints/ arts something like that. Sealskin is like kinda, well Europe doesn't want to buy it anymore so we have to go with the carving, that's

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how we can make money. It's the only way, there are no other jobs" (Oqituq Ashoona, pers. comm. November 2013)

"I started when I got children, growing up little small children. I used to watch my father carve. It got into my mind that I could support my family through carving and that was my goal" (Omalluk Oshutsiaq, pers. comm. October 2013).

Artists demonstrate adapting to external economic signals and drivers of change by creating artworks. Beyond providing economic security, a few artists remarked about the therapeutic benefits of artistic engagement. For example, Elisapee Ishulutaq says, "It can be therapeutic. If you have anxieties if you are doing art you are not thinking about your anxieties" (pers. comm. August 2013). Madaline Oumauataq (pers. comm. September 2013) takes this a step further and describes how art making is a way to heal from intergenerational trauma:

"The art helps with that process, just by remembering, just by drawing, by painting, by embroidering. Because when I am embroidering I remember my mother, if I remember my mother I remember my siblings - it's a common process, very common. Telling stories is a way of healing; it's a way of letting go of baggage that was not even yours to begin with. We have gone through such heavy changes in the last 40-50 yrs. Art is a way of making, not a new start, but using the old for the new, for the new life that we really should be celebrating again".

Art has multiple roles in these communities today including providing economic security, as a form of therapy or healing and, for nurturing and mediating bridging of Inuit knowledge. The emphasis of this paper has been on the latter. Our results show that art and artistic processes create positive synergies in outcomes.

5.7 Conclusions

Our study contributes to the emerging literature on the relationship between art and resilience. We consider enhanced resilience in the context of social-ecological change as an outcome of bridging knowledge systems via art and artistic processes. Bridging Indigenous and western knowledge systems to navigate local to global social-ecological change is an important research and policy priority (Arctic Council 2013,

Thaman et al. 2013, Tengö et al. 2014). Supporting local pockets of traditional ecological knowledge is important for both local and global resilience, to enhance understandings of change, and to create appropriate policy and practice (Gomez-Baggethum, Corbera and Reyes-Garcia 2013, McCarter et al. 2014).

Combining diverse knowledge systems for learning is relevant to resilience of social-ecological systems during change and uncertainty (Berkes et al. 2003). Our research highlights six underlying mechanisms through which art and artistic processes mediate knowledge system bridging: 1) embedding knowledge-practice-belief into art objects; 2) sharing knowledge using the 'special language' that is art; 3) art making skills shared in practice; 4) monitoring social-ecological change and anomaly; 5) maintaining continuity over time in art and art making, and; 6) knowledge co-production/ creation of hybrid knowledge. These insights are important in continued efforts to bridge knowledge systems in the context of social-ecological change, and to enhance individual and community resilience.

Chapter 6: Inuit art and its contribution to understanding Arctic change

6. 0 Abstract

Seven Inuit artists reflect their lived experience of disappearing sea ice and climate change in their artworks. *What* insights are artists communicating about sea ice and climate change in their artworks? And, *how* can these insights contribute to ongoing efforts to bridge Indigenous and scientific knowledge systems? Inuit artworks reflect a cultural response to shifting sea ice conditions and climate change more broadly. Artists' knowledge of a changing environment is woven into artworks in ways that illuminate emotion, sensation, values and belief. As a result, Inuit artworks can: 1) generate novel insights on particular places and experiences that broaden understandings of change; and 2) when recognized as important sources of knowledge also serve to support Indigenous self-determination needed to catalyze effective responses to change. Broadly speaking, artists and their artworks enhance knowledge system bridging about social and environmental conditions by creating narratives that can be used to situate expert knowledge about the environment within the beliefs and experiences of those most directly affected by sea ice and climate change.

6.1 Introduction

Bridging Indigenous and western knowledge systems is needed to enhance understandings of environmental change, and to better support Indigenous self-determination (Reid et al. 2006; Tengö et al. 2014). In particular, engaging with different types and sources of knowledge has important implications in the Arctic for how decisions are made about the environment in ways that reflect the priorities and concerns of northern communities (Jasanoff and Martello 2004; Koutouki 2015).

The rates of environmental change occurring in the Artic are described by the environmental change literature and scholarly discourse as rapid. Inuit perspectives allude to this rapid change as well describing that " the earth is faster now…" (Krupnik & Jolly 2002, pp. 7). Climate change is described as occurring in the Arctic twice as fast as elsewhere in the world (AMAP 2011) with Arctic sea ice loss occurring at a rate faster than scientific models had projected (Stroeve et al. 2007), and there is scientific consensus that the Arctic will be ice free in summer months well within the century (AMAP 2011; Lenton et al. 2008; Overpeck et al. 2005). These changes are impacting the well-being of Inuit people by changing the way they hunt and travel, and by changing the biophysical context that is strongly connected to Inuit culture (Fox Gearheard et al. 2013).

Bridging the knowledge of Indigenous and local people with scientific knowledge creates opportunities for novel insights about Arctic sea ice change. For example, Inuit expertise has made significant contributions to understanding the complexity of Arctic sea ice change (Riedlinger and Berkes 2001; Laidler 2006; Krupnik et al 2010). Honouring a plurality of knowledge in the context of efforts to understand and respond to environmental change is a challenging process. There are diverse settings that bridge knowledge systems, including various methods and processes (e.g., scenarios, workshops), bridging organizations that link different knowledge holders, and institutional/governance arrangements (e.g., co-management boards) (Rathwell et al. 2015). Yet, a key challenge is to choose appropriate settings in which to bridge different types and sources of knowledge, especially since some settings may diminish or mute dimensions of Indigenous knowledge (Nadasdy 2003; Fazey et al. 2014; Rathwell et al. 2015).

Another challenge is the growing need to incorporate more diverse forms of expression into settings for knowledge bridging (Cruikshank 2005; 2012; Maffie 2009; Dale and Armitage 2011). Art and artistic processes provide one example of a novel form of expression that has received too little attention in this regard, but that provides an entrée into the underlying belief systems and emotional context associated with environmental change (see Booth and Skelton 2011; Weiss et al. 2013; Gratani et al. 2014).

Indeed, Inuit art has a long history of containing spiritual and ideological power (Freeman 1995). Small carvings, aesthetic tools and amulets were given, worn and used for with particular cultural and/or spiritual significance. A shaman might wear a particular amulet to take a spiritual journey (Laugrand and Oosten 2015). Upon first contact with non-Inuit, some Inuit gave and traded aesthetic objects to explorers, missionaries and military people (Martin 2012). In more recent decades (since the late 1940's), Inuit art has been expanded into commercial production in some communities. Pangnirtung and Cape Dorset, the communities of focus of this study, were some of the favoured locations for the creation of a local art industry.

In this paper, seven Inuit artists and their artworks provide a novel source of knowledge about sea ice and climate change in the Arctic. Inuit artists and their artworks reflect a cultural experience of sea ice and climate change, and Inuit artists themselves communicate the meanings and symbolism of their work.

6.2 Methods and study location

Cape Dorset and Pangnirtung are two remote communities located in Baffin Island, Nunavut (Figure 1). I lived in these communities between June and November 2013 and again for two weeks in 2015. I was introduced to the Pangnirtung community as part of a summer field school program offered by the Native Studies Department at The University of Manitoba. The five-week intensive field course, based in Pangnirtung, included a curriculum of Inuit studies, ethics and political philosophy, Inuktitut for beginners and ten days on the land hunting and sewing with Inuit families. The program provided an opportunity for me to learn about and engage with an Inuit community.

Cape Dorset (population 1400), located at the south-western end of Baffin Island, is the self-proclaimed "capital of Inuit art", and has maintained an art economy as a

cultural-economic mainstay since the late 1950's. However, several interacting factors resulted in what is now the Hamlet of Cape Dorset: the establishment of a Hudson Bay trading post in 1931; the mandatory and systematic slaughtering of Inuit sled dogs preventing a nomadic lifestyle; a prevalence of new diseases with the possibility for treatment in the settlement; and opportunities for education in the settlement (Tester and Kulchyski 1994; Watt Cloutier 2015). The West-Baffin Eskimo Coop was established in 1959. The art co-op continues to function today, employing many local artists and purchasing works from many more. The art co-op in Cape Dorset and its partner gallery and wholesaler based in Toronto function to connect local Inuit artists with global art markets. Cape Dorset artists leverage art making as a way to maintain culture and create employment.

Pangnirtung (population 1510) is located in an inlet off of Cumberland Sound in the central part of Baffin Island. The history of Pangnirtung is characterized by the introduction of a whaling station in the 1800's, a Hudson Bay trading post in 1921, and the Royal Canadian Mounted Police's (R.C.M.P.) first detachment in 1923, and St Luke's mission hospital in 1929. The settlement of Pangnirtung was also a result of the many drivers of change being experienced in the North (e.g., loss of sled dogs, possibilities for education). The hamlet gained municipal self-governing status in 1973. Pangnirtung also has a fish processing plant that provides occasional employment and economic support in the community. Like Cape Dorset, Pangnirtung has an art economy, and hosts an art co-op built upon the successful Cape Dorset model.

I approached my research with the knowledge of the history of colonialism and systematic oppression of Indigenous people in Canada (Truth and Reconciliation Commission of Canada 2015; Tester and Kulchyski 1994; Watt Cloutier 2015). I aimed to build relationships of trust with the community members I met, while recognizing that I was an outsider and researcher with a pre-defined agenda. I am also a musician and music provided an opportunity for me to connect with community members in ways that would not have been possible otherwise. When visiting people's homes, language barriers limited my ability to speak freely with my hosts. However, playing music, dancing and singing together created a shared experience.

Ethics clearance for this project was obtained through University of Waterloo Office of Research Ethics (ORE). A research license was obtained through the Nunavut Research Institute (NRI). A detailed consent process was used to identify potential concerns with individuals prior to their participation. Each artist was asked if the interview could be audio recorded, whether they wished to remain anonymous, and if their artworks could be photographed and/or used in the context of this research. I also received informal support for this research from municipal officials, as well as local artists, youth and elders. During my field research I was provided with accommodation by local organizations, such as the Kinngait studios visitors apartment, and in a municipally owned house in Pangnirtung.

I used several outreach strategies to increase awareness of and build support for my project (see Wolfe et al. 2007). Information about the project was shared on community radio. Community researchers were hired to facilitate organization and translation, based on recommendations from community leaders. A list of practicing artists in each of the communities was compiled based on advice from community researchers, art co-op managers, local artists and community leaders, as well as web and paper resources (e.g. print shop catalogues). Carving and graphic arts were chosen as the focal medium because artists in Cape Dorset and Pangnirtung maintain strong capacities in both. Once a list of potential participants was established, house visits were undertaken to introduce the project and subsequently invite artists to participate in the study. Finally, a follow up trip in July 2015, was used to further clarify and verify findings, and to report back on progress to study participants, and representatives from each municipality, as well as the territorial government and the Nunavut Research Institute.

Seven artists were chosen from a larger potential research sample of thirty artists interviewed as part of a broader project on the mechanisms through which art and artistic processes may bridge knowledge systems (see Rathwell and Armitage 2016). I highlight seven of those participants here for two primary reasons. First, each of the seven artists had been working on artworks that explore the theme of environmental change prior to the start of my project, thus ensuring that the subject matter was not artificially introduced. Second, each of the participants in this study have established bodies of

artwork and are celebrated artists at local, national and international levels. A summary of each participating artist is provided:

- Elisapee Ishulutaq is a graphic artist. She grew up on the land. She was recently, awarded an Order of Canada for her artistic contributions to her community and Canada.

- Jaco Ishulutaq is considered a master carver for his artworks that are exhibited across Canada and internationally. He is a skilled hunter and mentor in the community of Pangnirtung.

- Tim Pitseolak often has exhibitions in Canada (e.g., Ontario Art Gallery, Feheley Fine Arts). His drawing of Arctic marine life will be on a new Canadian coin. He lives and hunts around Cape Dorset and works as a graphic artist at the art co-op.

- Shuvinai Ashoona, a graphic artist, is emerging as a powerful female voice in Inuit art; her works have been presented in prestigious galleries throughout Canada (e.g., National Art Gallery of Canada) and around the world (e.g., Basel Switzerland). She is the topic of books and movies (Sinclair 2004). Shuvinai lives in Cape Dorset and works full time drawing at the art co-op.

- Atsiaq Allasuaq is a respected elder and one of the oldest men in Cape Dorset. He is known for his storytelling. He is a retired master carver and now crafts harpoons.

- Manasie Maniapak is a master carver, hunter and elder who grew up on the land. He now lives with his family in Pangnirtung, NU.

- Palaya Qiatsuq is a master carver and currently the mayor of Cape Dorset. His works are sold throughout Canada and internationally.

Each artist in this study is well-respected in his/her discipline. Works explored herein have artistic merit in their own right, with the capacity for knowledge bridging extending from there. The artworks, as aesthetic objects, are presented in the results section when the works could be located and where copyright has been granted. It was not possible to locate the artworks described by two artists in this study (Manasie Maniapak and Palaya Qiatsuq). Of relevance to this project, both Maniapak and Qiatsuq remembered specific sculptures they had created on the subject of climate change. However, these works have been sold and distributed internationally, and could not be tracked. For this reason, there

is a slight stratification in how I was able to engage with the artworks of each artist. This creates a research limitation, but I felt that maintaining the participation of Maniapak and Qiatsuq was a way to honour their perspectives and voice given that they have grappled with sea ice and climate change themes in their artistic process and artworks. The artworks presented and/or discussed here are central to my research. However, my analysis focuses on the meanings and narratives that artists themselves create around the artworks (see Pink 2001). In this regard, the artworks are a setting or aesthetic boundary object for discussions about sea ice and climate change, and therefore, an important context in which to explore Indigenous understandings of change in the Arctic (see also Halpern 2011, Singh 2011, Zurba and Berkes 2014).

One-on-one art making projects specific to sea ice change with Elisapee Ishulutaq and Shuvinai Ashoona complemented the interviews and created an opportunity to engage with artists and their artworks in an alternative way. Both Ishulutaq and Ashoona were enthusiastic to participate. They were paid an appropriate honorarium for their time, provided with art making materials, and had the final decision about whether to keep or to sell the piece. As noted above, they were also compensated for the time we spent discussing the works. Storytelling and question/answer sessions about the artworks occurred over several days in both cases. These sessions were digitally recorded and transcribed verbatim.

While interacting with artists and their artworks, I used two main qualitative data collection methods: (1) semi structured interviews and dialogue about specific art pieces, and; (2) one-on-one art making projects with two of the artists. Interviews with participating professional artists followed a semi-structured interview guide. Interviews focused on three areas of interest: a) the role of art in the life of the artist and community; b) changes in the local environment and climate; and, c) the production of art as a reflection of environmental change. Interview procedures allowed for conversational and storytelling opportunities (Kvale 1996), especially with elders, as is respectful to Inuit participants (Martin 2012). My experience in these communities, and the ability to spend time with participants, provided opportunities to engage with stories about life on the land, myth and memory (Cruikshank 2005; Brody 2012). Depending on my relationship to the artist, and the different themes and questions we discussed, the focus of interviews

ranged from short technical responses to storytelling and sharing of oral histories. Sessions for my study were conducted in Inuktitut and simultaneously translated, or in English, depending on the comfort of the participant. All participants were given an honorarium of $100 CAD for their time. Interviews were digitally recorded and manually transcribed verbatim for later coding and analysis. Elders tend toward storytelling and sharing memories at their own pace/leisure. Interviewing length with each artist varied between forty minutes to several hours for the interviews. One-on-one sea ice drawing projects (see below) were initiated based on relationships built over weeks or months and required more regular interactions with the artists.

Manual coding was done on all transcripts. Manual coding allowed me to be sensitive to how artists engage with metaphors, emotions, and sensory or felt experiences while describing their experiences of environmental change. I coded for both the content of changes and discussed the experiences of the participants as they were described. I created a large data matrix based on common themes related to knowledge system bridging from a systematic literature review (see Chapter 4), and also based on emergent themes from the interviews themselves. For example, the themes of transformation and adaptiveness where quickly evident from the artists' works and narratives, and these themes where added as thematic codes. I also focused my analysis on how artists communicate narratives and with different forms (e.g., shape, colour, personas). As noted above, my analysis is based on how artists describe their own works. I am not in a position to analyze Inuit artworks directly: Rather, my analysis is based on the discourse surrounding the artworks (see Pink 2001). When an artist describes a particular aesthetic element of their artwork, I take note and reflect on the artwork. For example, artists spoke of particular shades of color in the skyline and the way water ripples on top of the sea ice when it used to melt from the top in the spring. These aesthetic observations that involve perceived beauty based on the senses of sound, smell, and touch, are powerful connectors of the human experience. I have included images of the artworks when possible, and where permissions have been granted. In these instances, the visuals allow readers to see and hear the voice of the artists directly.

6.3 Results

Results are organized based on the artists I interviewed, but in the context of the two primary questions guiding this paper: 1) what insights are artists communicating about sea ice and climate change in their artworks? and 2) how can these insights contribute to ongoing efforts to bridge Indigenous and scientific knowledge systems?. The artists collectively referred to thirteen artworks on the theme of sea ice and/or climate change. Eight of the artworks were created by artists' prior to start of this research project. Five artworks were created during the one-on-one sea ice drawing projects. Of these, Elisapee Ishulutaq created four drawings and Shuvinai Ashoona created one drawing.

Tim Pitseolak

Tim Pitseolak shared his perspective as a hunter and artist. He described his knowledge of changes in the weather and sea ice formation and break up. Pitseolak articulated how sea ice and changes in weather impact Inuit practice in terms of travel safety and ability to obtain 'country food' to feed families and communities (pers. communication Oct. 2013). In his artworks, Tim Pitsiulak creates visualizations of what ice break-up at the flow edge looks like, and how people adapt to these changes in practice (see *Launching Canoe at flow edge* 2012) (Figure 6). His artwork emphasizes both knowledge of how sea ice is changing, and at the same time, embraces change an uncertainty as a part of life:

> "The ice is forming a lot later and it is not as thick as it use to be... once the ice is forming, the ice forms in a pretty bad way - meaning in the spring when the ice starts to thaw there will be open areas in some places where it doesn't freeze up at all. So that is some of the risk that is very bad with the global warming because the ice doesn't freeze as much as it used to… It is very hard, because we need to catch for our families and friends. Catching country food… hopefully someday it will bounce back, the climate that we used to have, but you never know, we can't tell the future. We have to be able to deal with the changes that are around us. Hey, its life I guess" (pers. comm. 2013).

In this quote Pitsiulak describes the challenge of changing sea ice. He emphasizes how the ice is different than it used to be, the impact that sea ice change has on the capacity of hunters to provide for family and community, and how hunters co-operate to adapt to these changes. At the same time, the value and belief communicated by Pitsiulak and in his artworks is the necessity to embrace change and uncertainty as part of life and to maintain a positive outlook.

Figure 6 Tim Pitsiulak 'Launching canoe at flow edge' (2012). Shown with Permission of artist and copyright.

In a second artwork on the theme of sea ice and climate change (*Climate change* 2012), Pitsiulak uses metaphor and symbolism to convey his perspective; a portrait of an elder with half a human face and the other half a reflection of sea ice break-up (Figure 7). He describes the piece:

"… That drawing is a picture of an elder on one side, the half of the face, and the other half of the face is the ice breaking up. [The drawing communicates that] the elders notice the ice breaks up much earlier and the ice does not form as it used to in the past. The elder is facing upward, it means no worries; people tell you that the climate is going to be screwed up, but no worries, keep your head up high. Another meaning to the drawing, if I made the face look downward that would mean that the end is near, but you are always told to keep your head up" (Tim Pitsiulak, pers. comm. October 2013, on *Climate change* 2012).

Pitsiulak emphasizes his belief in the wisdom of the elders and the importance of a positive outlook during change and uncertainty. This artwork tells us about both the practice and emotional dimensions keeping 'your head up high' during periods of change and uncertainty. The elder in his drawing models patience and not holding on to worry, while knowing that change is occurring with the sea ice. Pitsiulak leverages artwork to communicate his perspective, "I wanted to show how I feel or think of the climate change through drawing" (pers. comm. 2013). His drawings about climate change do just that, revealing his specific knowledge of sea ice and climate change, and also his beliefs about how to approach those changes.

Figure 7 Tim Pitsiulak 'Climate Change' (2012). Shown with permission of artist and copyright.
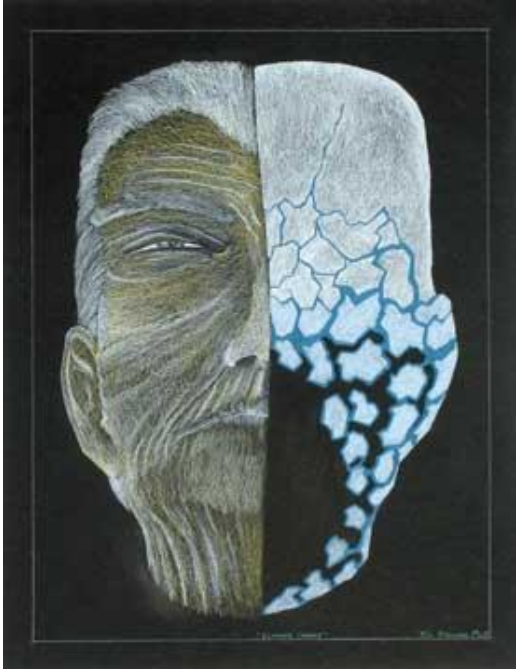
Elisapee Ishulutaq

Elisapee Ishulutaq reflected her experiential knowledge of environmental change during both interviews and the sea ice-drawing project on which we collaborated. For example, to discuss how wind patterns and strength of the wind has changed over her lifetime, she referred to her placed-based knowledge of being on the water in a small boat. In this way, she reveals knowledge and practice together (pers. comm. 2013). Elisapee also described changes in the sea ice, its formation and its thickness. She has witnessed many people falling through the ice and drew a depiction of this during our drawing project (*Sea ice is dangerous today 2013*) (Figure 8).

Figure 8 Elisapee Ishulutaq 'Sea ice is dangerous today' (2013). Shown with permission of the artist.

Figure 8 depicts an Inuk who has fallen through the ice on his snowmobile. In the drawing, a second character is depicted carrying a rope to pull his friend and the snowmobile equipment out of the water. Hence, the drawing depicts a reality of hunting on dangerous ice, and how the Inuit adapt to implications of unsafe ice. The symbolism of this piece seems apparent. However, when she discussed the drawing other dimensions of the environment were surfaced. Ishulutaq emphasized how she chose particular colors to depict that the sky "looks like a glassy blue nowadays; It was nice clear blue back then" (pers. comm. 2013). She emphasized that the ocean has gotten warmer, and assigned this as the reason why the ice does not freeze as much. She says: "the ice is not all that strong anymore: ice conditions are more dangerous now; not forming as thick as back then" (Elisapee Ishulutaq, pers. comm. September 2013). Indeed, Elisapee emphasized this later point when describing her drawing, '*Sea ice is dangerous today*, 2013':

> "[In my drawing] it is visible that is ice is incurring melt from beneath, not the surface. [This is] the flow edge; this is ice and both sides are open water [*pointing to drawing*]. Now he has fallen through, all of a sudden he has gone too close… Right now when you travel, even if you are a good hunter, it is dangerous. [The ice] looks like it is all the same, but underneath it is not" (Elisapee Ishulutaq, pers. comm. September 2013).

Elements of Elisapee Ishulutaq's knowledge that might be considered belief, or spiritual, were raised during the sea ice drawing discussions. It was in this bridging setting that Elisapee described the spiritual importance of sea ice and its role in the maintenance of social norms and Inuit identity. She recounted the legend of 'Qallupilluit', a sea monster that steals children from the floe edge. The story teaches children to stay away from the flow edge. She spoke of her own experience encountering the thumping sounds of the sea monster with her childhood friend. In another example, Elisapee considers sea ice change together with mermaids and how her mother taught her to treat them, should they wash up ashore (pers. comm. August 2013). In describing her relation to mermaids, she alluded to her central belief in the interconnection between humans and nonhumans. She also described a deeply rooted belief about her place in the cosmos when she says '…we are just visitors to the land…' establishing a transient

relationship to the environment and a belief requiring respect and courtesy to be given to the land. She described how in the past they wasted nothing and used every single part of the animal, saying in reference to seal "…even the bladder was used as a window for our igloo" (pers. comm. 2013). In fact, she described memories of drawing on the bladder window, made possible from condensation. Elisapee Ishulutaq used sensory descriptions when conveying her experience. For example, she portrays the warmth and security she felt being wrapped in caribou hides when she reflected "I long to sleep in the layers of caribou hide" (pers. comm. 2013).

During the sea ice-drawing project, Elisapee Ishulutaq shared oral histories of her life on the land. She spoke about using the 'qulliq' (seal oil lamp) inside her warm igloo. Sea ice is interconnected with other aspects of identity and being on the land. For example, the first drawing Elisapee created on the topic of sea ice in the past had no representations of sea ice. From my perspective, this was confusing at first because the thematic focus of sea ice was the only restriction on the project. However, sea ice and its change are intimately connected to the camping scene Elisapee drew (self-titled 'It is a wonderful day, it is a beautiful day') (Figure 9). It is a wonderful and beautiful day precisely because the sea ice is forming. In the scene she drew, her family is waiting for the sea ice to form at autumn camp. Her stories about the artworks and about sea ice reveal an interconnected way of seeing the world.

Figure 9 Elisapee Ishulutaq 'It's a wonderful day, a beautiful day'. (2013). Shown with permission of the artist.

Elisapee also used sensory descriptions of color/texture/light when describing her drawings and telling stories about the changes in the sea ice and climate. For example, when describing a drawing of sea ice in the past, she reflected nostalgically on the aesthetic appeal of moving water on sea ice saying: "Now a days, we don't even get to see puddles of water accumulating on top of the ice… giving a nice ripple" (Elisapee Ishulutaq pers. comm. September 2013). Similarly, in another artwork on the subject of climate change, '*Climate change*' (2010), Elisapee uses the symbolic power of a melting igloo, and a tree growing on the tundra to convey messages about transformation and renewal (Figure 10):

Figure 10 Elisapee Ishulutaq 'Climate change' (2010). Shown with permission of the artist and copyright.

"The igloo is melting and the tree we see; we don't see [trees] here in the Arctic. I was told you won't see it here, but we see more and more new and larger plants… [The drawing is] about the way the climate is changing – it is warming up… The person there is glad to see the tree. The person is happy to see the tree growing where it is not even supposed to grow… I like anything that grows on the land, anything that renews itself, like springtime… The igloo is long gone history and [the Inuk] is happy that things are growing; it is a transition theme" (Elisapee Ishulutaq, pers. comm. August 2013).

Elisapee's drawings and stories reflect key themes for how to live life and the place of humans in the cosmos. She describes her drawing in a way that indicates her pleasure in renewal and acceptance of transformation, yet she points out that the figure still wears traditional clothing, and therefore, represents some continuity in identity. In her artworks, and narratives about them, Elisapee Ishulutaq reflected a cultural response to climate change that embodies her views about the connection between humans and the environment around them, the importance of knowledge gained through experience, and the need for patience in approaching how we live and in our daily practices.

Jaco Ishulutaq

Jaco Ishulutaq revealed detailed knowledge of environmental change during our discussions. He discussed his knowledge of sea ice and climate change specifically during our interview and when describing his carving, *'Global warming (2010)'* (Figure 11). For example, he described how the winter cold is different now, and how one can feel that on the cheek (pers. comm. August 2013). He explained how the wind has changed directions, and described how, "the temperature in the water is warmer now… it is never the same as it used to be" (pers. comm. August 2013). He also described how the ice is softer and how it changes at a different time in the season than it used to. Ishulutaq describes:

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"During fall when the ice starts to form it gets really cold and it seems like the ice is going to form, but then it does not really form for a while. When it does finally form it is softer ice than what it used to be" (pers. comm. Aug 2013).

This level of experience and knowledge of change on the land is the specific context for the insights and important messages he associates with his carving. Indeed, when describing his carving, Jaco connected with his beliefs regarding Arctic sea ice change and how people should respond to it. In particular, he illuminates his belief about human agency and his call to action regarding climate change:

"I've carved climate change. Global warming. One is holding on to the Arctic, holding onto the south, holding onto the whole world. It's a carving of hands holding the world. Its carved out of a walrus skull with the tusks, it has animals on it and hands holding it all. The hands represent that the world is delicate, that we have to take care of it. Since we are ruining it with the atmosphere with the pollution of smokes… it's in our hands. If we take care of our planet, our animals and the plant life won't be ruined" (Jaco Ishulutaq, pers. comm. August 2013).

Figure 11 Jaco Ishulutaq 'Global warming' (2010). Soapstone and walrus bone carving. Shown with permission of the artist. Exhibited in photo as part of Cape Farewell's *Carbon 14: Climate is culture* exhibition at the Royal Ontario Museum, October 2013 - February 2014 in Toronto. Photo Credit: Susana Reisman.

Jaco Ishulutaq also explained that the carving reflects his knowledge of the multi-level component of climate change. In this regard, he depicts humans as the cause, and the solution, to the problem of global warming. Ishulutaq uses the hands holding onto the Arctic ecosystem as a symbol of the responsibility and role of humans in relation to these changes.

Shuvinai Ashoona

Shuvinai Ashoona reflected on changing Arctic sea ice and climate during interviews and in a sea ice-drawing project. She recounted seeing new bird species when out clam digging that were never there before. Ashoona interpreted that the sea ice is warmer than it use to be, making a then/now distinction. She used the metaphor of a 'paralyzed world' describing something not functioning as it did when I asked about changes in her local environment. During the art-making project Shuvinai pointed out important elements of her drawing such as a fisher falling through the ice but still being happy, and her belief in interconnection. Transformation colours Shuvinai's thoughts, memories and artworks. Ashoona created a drawing that reflects a cultural response to climate change.

The cultural response reflected by Shuvinai and her artwork is one that embraces transformation and interconnection. The image Shuvinai Ashoona created during our sea ice-drawing project is a combination of fantasy and real world reflections on her practice of fishing on the ice by the shoreline with a harpoon (Figure 12). Shuvinai describes going fishing like that "all the time"; and re-told some of the family jokes she remembered from experiences on fishing trips (pers. comm. November 2013). The theme of transformation is central to Ashoona's drawing (Figure 12). Ashoona narrates, "Her foot is becoming fish flippers… She is transforming… Her other arm is becoming a northern light" (Shuvinai Ashoona, pers. comm. November 2013). Transformation is approached with enchantment and humour - not fear. She reflects on the person in the drawing saying: "it would be fun" (pers. comm. November 2013). This transformation between human and animal and object (northern light) depicted in her artwork reflects

her belief and values about continuity and connection created via relationships and reciprocity.

Figure 12 Shuvinai Ashoona 'Untitled' (2013). Pencil crayon on large format paper.

Another belief held by Shuvinai Ashoona and embedded into her drawing of sea ice is intergenerational connection. Ashoona portrayed that: "...our grandchildren would be dancing up there [as northern lights]" (pers. comm. November 2013) (Figure 12). The drawing emphasizes belief in the existence of spiritual connection via entities like northern lights. Our grandchildren are dancing and having a good time as the northern lights; in the drawing we see tiny figures moving amongst the swirling skyline. Shuvinai Ashoona has a lived experience of changes in the sea ice and animals that inform her drawing of sea ice. Ashoona emphasized themes of transformation and interconnection as culturally relevant when considering changes in sea ice and climate.

Atsiaq Allasuaq

Atsiaq Allasuaq's situated his experience of climate change and sea ice change with his personal history of being on the land. Accordingly, his artwork is rooted in his knowledge of the importance of physical adaptation to sea ice and climate change. His artwork, hand crafted harpoons, are themselves part of the adaptation story and reflect a focus on the increasingly uncertain Arctic sea ice conditions. Hunters can check the ice thickness with a harpoon, and the need to do so has become paramount. This is the main message in the artwork depicted in a photo of Allasuaq on the sea ice with one of his own harpoons Figure 13.

Figure 13 Atsiaq Allasuaq. Pictured with one of his handmade harpoons. Photo credit: Gita Ljubicic (http://www.straightupnorth.ca)

"I even make harpoons now too…those harpoons are the only source of materials to know if the ice is thick or not thick enough. Men use to use their harpoons to see if the sea ice is well enough to travel. The harpoon is the only friend for a man. Because it tells him if the ice is thick or if it is not thick. When you can see the surface but you can't see the underneath right, and [the harpoon] is how we know if it is thick or thin." (Atsiaq Allasuaq, pers. comm. October 2013).

Indeed, Allasuaq delineated the necessity of the harpoon especially in the context of current changing sea ice conditions (Figure 13) – Allasuaq with Harpoon on the ice.

Atsiaq Allasuaq's experiences are also linked to sensory descriptors of sound. For example, he remembered leveraging the acoustics of crisp cold air to make sounds for navigation:

"…Men would say, if they want to go faster [signalling to the dog team] they would do 'hahahaha' without a voice at all; you can hear it through the wind because of the pitch of the sound in wintertime, you can hear that over long distance. We use to call it 'imina'. That pitching sound in wintertime it doesn't work anymore because it is not as cold as it used to be" (Atsiaq Allasuaq, pers. comm. October 2013).

While this experience with sound (as an aesthetic form) was not reflected in his artworks, it is an example of his aesthetic experience on the ice and depicts how that experience changes because of warmer weather. As explained to me by Mr. Allasuaq, these sounds are no longer possible because the air does not get cold enough. Adaptation is a central theme embedded in Allasuaq's artwork and narratives. The harpoon itself helps Inuit to adapt, at the pace of a footstep, to changes in sea ice. Finding ways to keep interacting with the environment using the senses (sound, feel), even as it changes reflects an adaptive culture. Learning about Atsiaq Allasuaq's harpoons is a way to understand how he is combining craftsmanship with an adaptation technique to changing ice conditions.

Manasie Maniapak

Manasie Maniapak chronicled knowledge of changing weather and temperatures long before 'climate change' started being talked about by white people. During the interviews he emphasized how there used to be glaciers extending from the mountains on the Pangnirtung fjord, but that now the glaciers are all thawed (melted). Maniapak reflected on shifts in Inuit practice on the land due to climate and sea ice change. For example, before he could read the skies and know what the weather would be, but he laments that "today the wind just comes, like really strong wind without a warning" (Manasie Maniapak, pers. comm. August 2013). Maniapak described how in his young days the sea ice was safe for travel and hunting by October, while nowadays it does not form until Christmas. In his examples, being on the land is the source of his experience and knowledge about sea ice and climate change.

Manasie Maniapak explained that he was commissioned to make a carving about climate change several years prior to our interview. He could not locate a picture of the carving, so instead he described it to me. In the carving Mr. Maniapak emphasized the practice of wearing traditional clothing. He took the opportunity to describe all the types of traditional clothing and the different skins (e.g., seal, polar bear, caribou) that his people wore. However, in describing his carving, Maniapak pointed out how traditional clothing is no longer used. Here, he is pointing in his carving to a shift in what people are wearing. There are potentially a number of reasons for this, but Maniapak explained that is no longer cold enough to require traditional skin clothing. This change in clothing reflected in the carving thus reflects a cultural transition rooted in the biophysical changes being experienced by the artist.

Padlaya Qiatsuq

Padlaya Qiatsuq has a broad depth and range of knowledge about the changing Arctic sea ice and climate that is based on his experience on the land. During an interview with Mr. Qiatsuq he described that there is less sea ice than before, and that the snow melts more quickly than it did before. He recounted changes in animal behaviour,

and in the types of animals that he now sees in the Arctic that were not living here before, for example, the wolverine.

Padlaya Qiatsuq showcases the themes of interconnection and transformation in his artworks and articulates an underlying belief in these phenomena. He illustrates the potential for a new world to emerge following a transformation. Qiatsuq narrates the story of one carving: " There is a spaceship, there is also an asteroid that hits the earth and then a tsunami… A shaman is communicating that a new world forms after that" (Padlaya Qiatsuq, pers. comm. October 2013). Padlaya Qiatsuq described his carving as demonstrating potential for a new world following a trauma and transformation. Experiences of changing sea ice and climate are interpreted in the context of a transformation that also has potential for renewal and new beginnings.

In a second carving about climate change, Padlaya again describes the importance of transformation and also speaks to interconnection:

> "There is a little bit of transformation a man mixed with an animal. It is about climate change and the weather and the animals. They are together. The weather it is changing and you know animals behave differently" (Padlaya Qiatsuq, pers. comm. 2013).

A human belief in interconnection between humans, animals and the weather is reflected in his carving. Further, transformation is communicated in his artwork because the form is that of human-animal transformation. Mr. Qiatsuq's carvings create a setting to learn about the underlying values and beliefs Padlaya has regarding sea ice and climate change. He emphasizes knowledge of sea ice and climate change during interviews; values and beliefs about transformation and interconnection become apparent through his descriptions of his artworks.

6.4 Discussion

Bridging indigenous and western knowledge systems in meaningful and respectful ways is important in ongoing efforts to understand and respond to sea ice and environmental change in the Arctic (Reidlinger and Berkes 2003; Smith and Sharp 2012; Arctic Council 2013). Bridging indigenous and western knowledge systems is also important in ongoing reconciliation efforts between Inuit, First Nations and the federal

government (see 2016 Mandate letter to Minister of Indigenous and Northern Affairs). In this study I have revealed how Inuit artworks can set the stage for bridging processes about Arctic sea ice and climate change in ways that showcase the resilience and adaptation strategies already being employed by Inuit people.

In this study, I establish what a group of leading Inuit artists are communicating about sea ice and climate change in their artworks, and how their artworks and related insights contribute novel perspectives about change. Humanistic approaches to engage with Indigenous knowledge, such as documentary film-making and digital storytelling, have been demonstrated to successfully honour the Inuit language (Kunuk and Mauro 2010), and to create space for discourse that expands beyond initial research interests (Cunsolo Willox et al. 2012). Yet, there are a few critical differences between these participatory methods of engagement and engaging with professional artists about their artworks. First, participants involved in methods, such as digital storytelling or photo voice, are engaging with these methods as an extra-curricular activity, and therefore, have not honed in on the individual talents and capacities people may have with other mediums (such as art). However, Inuit artists participating in this study are each established artists capable of manipulating their medium in expert ways and as they see fit. Further, aesthetic objects, and especially carvings and textiles, have a long history in Inuit culture. Engaging with these mediums as used by Inuit creates a broad space for sharing perspectives.

I have focused on what these Inuit artists themselves emphasize in their artworks about sea ice and climate change, and some of the meanings and narratives the artists seek to communicate. In the following section, I reflect on the broader themes that emerged from my analysis as it relates to the role of art and artistic processes as a novel source and representation of Indigenous knowledge.

6.4.1 What do Inuit artists emphasize about sea ice and environmental change?

The narratives Inuit artists share communicate a cultural response to climate and sea ice change. The cultural response reflected by Inuit artworks embraces transformation as renewal, emphasizes interconnection between humans, animals and elements of the environment (e.g., northern lights), and a profound adaptability that connects myth and

tradition (e.g., wisdom of the elders, harpoons) with modern techniques for how to adapt to change and uncertainty. This underlying worldview of resilience and the capacity to embrace transformation is acknowledged as beneficial in the context of the rapid environmental changes occurring today (Berkes et al. 2003; Scheffer 2006). Accepting transformation as a central dynamic in the world (i.e., rooted in one's ontology), and as reflected in many of the artist's descriptions of their artworks, communicates the uncertainty currently being experienced (Cruikshank 2005; 2012; Kunuk and Mauro 2010) Indeed, artists in this study revealed their ontological outlook regarding change and uncertainty by reflecting a world that connects humans and animals and nonliving beings (e.g. northern lights) in transformation. An ontology that embraces transformation may contribute new insights into the decisions individuals and communities make about responding to changes in sea ice and climate. However, the practical challenge in this regard is the still the limited role for communities, or recognition of their multiple sources of knowledge (e.g., art and artistic processes), as well as a lack of effective settings for knowledge to be shared (see Rathwell et al. 2015).

6.4.2 The significance of art as a setting to bridge knowledge systems

Inuit artists and their artworks provide a compelling setting in which to connect with Indigenous knowledge about environmental change. Inuit artists weave together their expert knowledge of environmental change together with emotion, belief and sensory experience in their artworks to create compelling narratives. Formally trained scientists have come to appreciate the value of Indigenous expertise when it comes to environmental change (Nichols et al. 2004; Thaman et al. 2013), yet accounting for values, emotion and belief is crucial for legitimate and salient action. Belief orients a person's understanding of their place in the world and relationship to other living and non-living things (Godfrey-Smith 2003; Wilson 2008). Beliefs are fundamental to maintenance of knowledge systems are often overlooked in efforts to understand Indigenous perspectives on environmental change and resource governance. This neglect has led to negative consequences for Indigenous peoples with direct implications, such as in the context of co-management efforts or climate change adaptation initiatives (see Booth and Skelton 2011: Weiss et al. 2013).

People maintain an intricate web of belief, values, and emotions about the environmental changes they experience. Accounting for these less tangible aspects of knowledge systems that frame peoples experience of environmental change is important for legitimate processes that seek address those changes and their implications (Leduc 2011, Weiss et al. 2013, Daw et al. 2015), and especially in contexts where historical relations of power have negatively affected Indigenous communities (Wilson 2008). Failure to do so may perpetuate existing social divisions and ongoing mismanagement of environmental resources (Nadasdy 2003; Booth and Skelton 2011; Weiss et al. 2014). For example, an investigation of a co-management strategy in Australia found that managers engaged very little with the beliefs and worldviews framing the knowledge of Australian aborigines. Poor understanding of the underlying belief systems and values of aboriginal participants is identified as a major barrier to effective environmental governance (Weiss et al. 2014).

My research demonstrates how artists and their works create settings to bridge the less tangible dimensions of knowledge systems. Artists and their artworks are a rich source of knowledge and insights, and a reflection the beliefs, values and emotional responses people have to environmental change. Illuminating what is considered 'sacred', for example, can help to make multi-stakeholder processes (regardless of their focus) more meaningful (Daw et al. 2015). Indeed, as shown here, Inuit artists are particularly suited to communicate dimensions of climate change and sea ice loss by creating narratives that frame corresponding actions. To date, efforts to draw upon these rich sources of knowledge in an applied decision-making context has been rare (although see Rathwell and Armitage, *in press*). I discuss additional reasons for this in the section below.

6.4.3 The individual and institutional challenges of sharing knowledge through art

My research highlights how engaging with Inuit artists to understand sea ice and climate change, and the broader implications of their insights, must overcome a number of barriers. For example, there is a tension between the expectations of the academy and the expectations of communities and people who participate in the research (see

Castleden et al. 2012). I spent five months in Pangnirtung and Cape Dorset, which was necessary for my research, but more time would have been beneficial and participants would have liked me to stay longer. Maintaining the participation of individuals in data analysis and reflections enhances the legitimacy of findings when working with Arctic communities (as it does in other contexts). The cost of living in northern communities and the timeframe I had available constrained this process to a certain degree. Translation between English and Inuktitut is difficult, and during interviews and artistic processes, information and meaning can be lost (see Leduc 2011). For example, during a workshop with youth and elders, the elders told stories about travelling on the sea ice, and a translator was present to simultaneously share the stories in English. Because we all sketched the stories as they were told, after one story it became clear that one event in a story had not been translated for the English speakers. This became clear when the event was sketched by the youth. Having artworks as boundary objects buffered against this challenge. I could use artworks as a way to clarify what the artist was saying.

Practically speaking, some art materials can be difficult to find in remote communities. For example, Elisapee would have preferred thick pastel crayons rather than paints and colour pencils. But she and other participants described enjoying the artistic approach taken, "I liked that I drew only what I wanted to draw. Just the way I thought about it and the way I planned it. I decided how to proceed" (Elisapee Ishulutaq pers. comm. Oct 2013). While these challenges are specific to my own research experiences, they have broader relevance to others; finding a balance between the demands of the academy and expectations of local populations for useful research processes and outcomes requires ongoing communication and connection, flexibility and an openness for learning (Castledon 2012; Ford et al. 2015).

There are other significant barriers to contend with. For example, Inuit elders may only share knowledge that they feel the listener is ready to hear, and for this reason participants may have only shared with me what they felt was appropriate, or provided only a portion of their full perspective (Martin 2012). Knowledge is shared with purpose in an Inuit context (Brody 2001; Leduc 2011; Martin 2012). Engaging with the artists and their artworks created a portal through which to discuss beliefs and values, sensory experience and practical knowledge about sea ice and climate change. However, two

participants did not touch on belief and values, and two participants did not discuss elements of practice.

The participants who did not reflect practice self-identified as a hunter, and for them, it may not be appropriate to share Inuit knowledge about practice without engaging in that practice on the land (Martin 2012). In other words, practice, as a dimension of knowledge systems, did not emerge during the interviews, or during discussion of artworks because the settings in which I engaged with them did not facilitate that dimension (see also Fazey et al. 2014; Rathwell et al. 2015). Practice is learned 'while doing', while out on the land interacting with animals and the environment.

Elisapee Ishulutaq and Shuvinai Ashoona became very close friends and the relationship of trust and friendship provided opportunities to discuss in more depth some of their underlying beliefs and values reflected in their artworks. The importance of building trusting relationships to engage with different knowledge holders is documented elsewhere (see Wolfe et al. 2007; Castledon et al. 2012), and these lessons should also frame any interactions with artists engaged in discussions about their knowledge and the role of their art in communicating different perspectives on change.

6.5 Conclusions

Bridging diverse knowledge systems is recognized as important in ongoing efforts to understand and respond to environmental challenges (Reid et al. 2006, Tengö et al. 2014; Rathwell et al. 2015). Moreover, the United Nations Declaration on the Rights of Indigenous Peoples (UN 2007) emphasizes the legal rights of the first peoples over their traditional lands (Konstantia et al. 2015), and also recognizes the importance of Indigenous knowledge as it relates to Indigenous self-determination. This is the case in Nunavut, where Inuit Qaujimajatuqangit (IQ) forms the foundation for how decisions are supposed to be made. In settings such as Nunavut, efforts to bridge knowledge systems will continue, and respect for Indigenous peoples will be enhanced when cultural perspectives are accounted for (Koutouki et al. 2015). Engagement during knowledge bridging processes must be more than superficial (Booth and Skelton 2011; Weiss et al. 2013; Gratani et al. 2014). As illustrated here, artists and their artworks are an important

and rich source of understanding that offers both practical insights and a window on the underlying values and beliefs that shape people's actions.

The artists showcased in this study reflect experiences of disappearing sea ice and climate change in their artworks. Beliefs, including values and emotional responses to sea ice and climate change, are also illuminated by Inuit art. When Elisapee Ishulutak spoke about her drawing, 'Climate Change' (2010), she described the Inuk as happy looking up at a tree growing on the tundra. Elisapee narrated that the character is happy to see the tree because it symbolizes renewal and regrowth "like springtime" (pers. comm. August 2013). Likewise, the character in Shuvinai Ashoona's drawing is transforming into a fish flipper and the northern lights at the same time, and Ashoona says "it would be fun" sharing an emotional tone of excitement and joy. She describes interconnectedness, saying "our grandchildren would be dancing up there as the northern lights" (pers. comm. Oct. 2013). Connectedness between humans, animals and the changing climate, for example, was a main theme in Jaco Ishulutaq's carving, and the emotion conveyed in this is of hope in human agency to heal the planet. Indeed, the artists and the artworks highlighted in this study reflect a wide range of themes, such as the resilience and renewal of individuals in the face of change, the importance of connections among humans, animals and the land, and the need to reconcile the past, present and future.

Artists and their works have a significant role to play in creating settings for robust knowledge bridging processes. Through art and artistic process, knowledge can be bridged between Inuit and scientific knowledge systems, or it can be bridged between elders and youth. In both cases, artworks and artistic processes create a platform to connect with the many dimensions of knowledge, including content, values and beliefs, emotions and sensory experience.

Chapter 7: Discussion and Conclusions

7.0 Introduction

Arctic sea ice is changing in potentially irreversible ways, with profound implications for Inuit people (Lenton 2012a; Krupnik et al. 2010). Connecting Inuit and scientific views about sea ice change and what to do about it is a priority of international entities, governments and scientific organizations (UNDRIP 2007; Tri-Council 2010; Thaman et al. 2013). Indigenous knowledge is being increasingly advocated for as it can contribute important perspectives on environmental change, and insights on how to enhance decision making processes in response to change (and see section 7.5 below). Yet, to engage respectfully with Indigenous people, it is crucial to embed their knowledge and perspectives within a historical and cultural context. As delineated offer a potentially novel and robust setting to consider Inuit perspectives on environmental change, and the broader cultural and knowledge systems from which these perspectives emerge.

In this chapter, I revisit my dissertation research objectives, and identify how each has been successfully met. I discuss six main findings, and I reflect on the broader contributions of my research. Moreover, I discuss the implications of my research for policy and practice, and to the communities of Cape Dorset and Pangnirtung, where the empirical work took place. I summarize some final thoughts on study limitations and my own positionality in this research. Finally, I reflect critically on the potential role of art and artistic processes in helping to bridge knowledge systems in the context of environmental change.

7.1 Revisiting my purpose and objectives

The goal of my research was to investigate art and artistic processes as a potential setting to bridge knowledge systems about environmental change. My experience in Pangnirtung and Cape Dorset, Nunavut for five months provides the rich empirical data upon which this dissertation is based. I outline below the three objectives that guided my research process, and I identify briefly how I have succeeded in meeting each of these objectives.

(1) To create a typology of settings used to bridge Indigenous and scientific knowledge systems about environmental change, and situate art and artistic processes within the typology.

This objective was addressed using a meta synthesis approach to identify the various settings in which bridging of knowledge may occur based on an analysis of the literature; I identified how those settings function, and how diverse settings can act in synergy (see Chapter 4). This 'typology of settings' to bridge knowledge systems is the first framework of its kind. We organize the typology as four broad settings – epistemology, methods and process, brokerage and networks, and institutions and governance - and discuss how they relate to each other in theory and practice. The typology can be used as a touchstone for scholars and practitioners interested in knowledge bridging. In addition, two main insights were emphasized in this analysis: 1) the necessity of engagement with the philosophical dimensions of knowledge and knowledge systems (epistemology and ontology) when seeking to bridge knowledge systems; and, (2) consideration of how diverse settings can function to complement and/or contradict each other. Future efforts in the area of knowledge integration, or knowledge bridging for decision-making about the environment must be cautious of settings chosen, especially since knowledge and power go hand in hand. Settings chosen can empower or disempower participants and their voice and knowledge. As research continues on the topic of knowledge bridging in the context of environmental change, the typology presented in this dissertation can help orient scholars towards the plethora of settings to bridge knowledge, and how to find synergies between them in ways that enhance research and foster positive social interactions.

(2) To study the underlying mechanisms through which art and artistic processes may contribute to efforts to bridge knowledge systems about environmental change.

The literature on environmental change governance is increasingly turning to the use of participatory art methods as a novel 'setting' to bridge knowledge systems (e.g. Cunsolo Willox et al. 2012; Heras and Tabàra 2014; and see Chapter 4). Artworks are recognized as an aesthetic boundary objects in this space and time, by serving as a context in which to foster continuity between generations and as a shared reference point to connect different social worlds. (Singh 2011; Zurba and Berkes 2012; Rathwell and Armitage 2016). My work adds to this literature by providing an empirical analysis to strengthen our understanding of *how* artistic approaches enhance bridging diverse knowledge systems about environmental change, such as sea ice change. To do this, I interviewed thirty professional Inuit artists, and facilitated collaborative art projects (Chapter 3).

Combining diverse knowledge systems for learning is relevant to nurturing resilience of social-ecological systems during change and uncertainty (Berkes et al. 2003). Six underlying mechanisms are highlighted here through which art and artistic processes mediate knowledge system bridging: 1) Embedding knowledge-practice-belief into art objects; 2) sharing knowledge using the 'special language' that is art; 3) art making skills shared in practice; 4) monitoring social-ecological change and anomaly; 5) maintaining continuity over time in art and art making, and; 6) knowledge co-production/ creation of hybrid knowledge. These insights are important for continued efforts to bridge knowledge systems in the context of social-ecological change, and to enhance individual and community resilience.

> *(3) To identify how artworks and the artists reflect both tangible and intangible dimensions of knowledge about climate and sea ice change (e.g., reflections of lived experience, elements of emotion, values), and the implications for knowledge bridging processes.*

This objective was informed by a focused study of seven Inuit artists who created artworks specifically about sea ice and climate change (Chapter 6). I examined how the artworks and artists use symbolism, metaphor and other aesthetics devices (e.g., colour, sound, texture) to convey messages about their lived experience of sea ice and climate

change. Stories told by artists about their artworks emphasized the importance of adaptation and interconnectedness, and also embraced themes about transformation and renewal. The insights provided by the artists participating in this research are crucial in the context of bridging knowledge systems to enhance our understanding of, and potential responses to, environmental change. Connecting with the intangible aspects of knowledge systems is an ongoing challenge (Weiss et al. 2012; Skelton and Booth 2012), yet, accounting for these aspects of knowledge is a critical component of salient and legitimate responses to environmental change (UNDRIP 2007; Koutouki et al. 2015). Artists and their artworks can illuminate the less tangible aspects of knowledge about change, and hence, have an important role to play at the interface of diverse knowledge systems.

7.2 Summary of major findings and academic contributions

I have identified six major findings and related academic contributions, each of which I summarize below. These findings and academic contributions both reflect and build upon the specific insights presented in my three empirical chapters (see Chapters 4, 5 and 6).

7.2.1 A typology of settings to bridge knowledge systems

I identified how authors and practitioners have so far engaged with bridging Indigenous and scientific knowledge about environmental change. I created a typology of settings that facilitate bridging of knowledge systems. As noted, the typology is the first of its kind (Chapter 4). I used a meta-synthesis approach and conceptual grounding in multi-level and cross scale dynamics to create the typology. My results point to four broad settings: (1) An epistemological and philosophical setting; (2) methods and processes that are the tangible acts of interaction between participants, such as identifying sacred sites on a map; (3) brokerage and networks provide the structure in which bridging occurs. For example, bridging organizations have an important role to play by bridging knowledge across scales and regions; and, (4) institutional and governance settings provide the formal arrangements and opportunities for bridging knowledge systems. Environmental assessments for example, increasingly require both Indigenous and

scientific knowledge to be considered (Sinclair and Diduck 2001; see Chapter 4). In addition to identifying these four settings, my results indicate that the settings act in synergy and therefore can complement each other and enhance overall bridging of knowledge systems. Importantly, however, by identifying these four broad settings, I set the stage for further analysis of art and artistic process as a particularly interesting and novel setting that has received limited empirical attention.

7.2.2 Art supports knowledge system bridging via six main mechanisms

My analysis identified six underlying mechanisms through which art and artistic processes enable bridging of knowledge systems. In this context, bridging knowledge refers to that which can occur between elders and youth (intergenerational knowledge bridging), as well as between Indigenous and scientific knowledge holders. The first mechanism through which the bridging process occurs is by embedding knowledge-practice-belief into artworks. In this regard, art is a representation of knowledge and artworks provide a narrative through which others can learn. For example, artists emphasized the importance of artworks for sharing traditional ecological knowledge with younger generations. Secondly, artists describe that artworks provide a special language for expressing their knowledge and memories. Third, art-making skills can be shared in practice, thus the art-making process creates opportunities for learning skills related to art making, as well as the knowledge, practices and underlying beliefs related to the subject matter of the artwork (e.g., sea ice change). Fourth, artworks and artistic perspectives enabled bridging between social and ecological knowledge. Artworks mirror environmental change and can, therefore, transfer information about environmental change to the social realm. Art and art making creates continuity over time by bridging knowledge-practice-belief from the past with modern art. For example, the *ulu* (Inuktitut for traditional woman's knife) is used in artworks about transformation to demonstrate the strength of tradition during change and uncertainty (see Chapters 5 and 6 for additional examples). Artists spoke about continuing a legacy of art making that they had learned from grandparents. Artworks were leveraged to showcase themes of continuity and resilience, and by doing so can help people navigate change and uncertainty with psychological preparedness. Finally, art making provided opportunities for knowledge

co-production and the creation of hybrid knowledge. This latter insight, and an understanding of the six mechanisms more generally, provided the foundation for further in-depth engagement with seven Inuit artists to better understand the tangible and intangible dimensions of knowledge reflected in artworks.

7.2.3 Artists and their artworks enhance knowledge system bridging

I found that art and artistic processes offer an important pathway to bridge knowledge systems, and to understand and make sense of environmental change. Artists in Cape Dorset and Pangnirtung are making drawings and carvings that address the complex environmental changes they experience. Not only do these artists demonstrate an intimate knowledge of the local environment and how it is changing, but artworks contain sensory and emotive energy that can better colour and contextualize their voice (Shimamura and Palmer 2012). Artists leverage metaphors and symbols that help make sense of change, and to share Inuit perspectives with non-Inuit. For example, the carving, 'Global Warming', by Jaco Ishulutaq used human hands cradling the Arctic ecosystem to emphasize that the health of arctic ecosystems is in our hands.

Art and artistic processes turn the spotlight on the *belief* component of knowledge. Belief in transformation, connection between humans and nature, and the capacity of Inuit to adapt, are central themes in Inuit art about sea ice and climate change. These themes frame how Inuit perceive sea ice change and their relationship to it. Belief is the dimension of the 'knowledge-practice-belief' complex (see Berkes 2012) that is often missing in the literature (Smith and Sharp 2012; Weiss et al. 2012; Koutouki et al. 2015). Belief provides a window into the ontology and epistemology of a knowledge system and engagement with ontology and epistemology is also identified as an important priority for bridging knowledge systems (Chapter 2).

7.2.4 Inuit artworks about sea ice and climate change embrace transformation, interconnection and adaptation as central themes

Themes of transformation, connectivity (between humans and nature) and adaptation are central to Inuit art about climate and sea ice change. For example, the interviews I had with artists tended to initially emphasize the material dimensions of

knowledge. In contrast, the artworks and discussions I had with artists about them shifted the conversation toward beliefs and values, and to some extent practice. Belief in transformation and the connectedness between humans and nature are evident in the carvings and drawings examined in my research. Elisapee Ishulutaq drew an Inuit looking at a tree growing on the tundra, while an Igloo melts (see Figure 10, Chapter 6). She described the transformation occurring in her drawing as 'renewal' and that the Inuk is 'happy' to see the tree because it signifies regrowth. Embracing transformation, as articulated by Inuit artworks is one way to address the environmental change occurring in the Arctic. Connectedness between humans and nature was also a central theme in all artwork related to my dissertation. During the collaborative mural project (see Chapter 5), youth and elders emphasized stories of travelling on the ice and being connected to the land. Elder's stories involved dog teams on the ice, and youth described adventures on snowmobile and boat while hunting or camping. Both ways of connecting with the land are depicted on our mural (See figures 4 and 5, Chapter 5). Inuit artists continue also to adapt to change in ecological and social systems, and accordingly, some artists depict scenes of adaption to changing ice conditions in their artworks. Atsiaq Allasuaq crafts hand-made harpoons that are themselves an adaptation to changing conditions. For instance, when travelling on ice, the Inuit use harpoons to tap twice on the ice, and if the ice holds then they keep walking. Adaptation in this case is practical, with the use of an aesthetic object, and at the scale of the individual navigating changes in his/her environment.

7.2.5 Knowledge co-production via artistic process results in innovation and empowerment

In the process of creating a collaborative mural (see Chapter 5), participants noted how synthesizing knowledge created opportunities for innovation and empowerment. Follow-up interviews with participating elders and youth were helpful in understanding their experience in our collaborative mural project and the links to innovation and feelings of empowerment. For example, youth described the importance of being able to build on each other's ideas and drawings in the mural (see Chapter 5). Participants described feeling that the end result was enhanced from the contributions of each

participant. This exercise in knowledge co-production also resulted in some innovative outcomes, such as combining a modern mural with traditional skin stretching techniques to create a hybrid art object. Youth felt they had learned both new skills and new knowledge of the past by interacting with the elders. Elders described enjoying the process of connecting with youth in creative ways. All participants hoped for more of these initiatives in their community.

7.2.6 Art and artistic processes can make contributions to better decision making about and responses to environmental change

Bridging knowledge systems is identified as an important issue in ongoing efforts to improve how we make decisions about the environment (Reid et al. 2006; Thaman et al. 2012; Fazey et al. 2014). However, in this dissertation I did not seek to examine or test the role of art and artistic processes in a particular decision making setting (e.g., Arctic council meeting about increased arctic shipping, or co-management of wildlife). Rather, I investigated the potential of art and artistic processes as one novel setting to bridge knowledge systems in the context of environmental change. As such, this research prepares the conceptual groundwork to test art and artistic processes as a setting to bridge knowledge systems in particular environmental decision making contexts. At the same time, there are several insights for decision making about the environment that do emerge from my research. First, artworks encourage engagement with sensory and emotional experiences associated with the environment. Connecting information and knowledge about a subject of interest, for example sea ice and climate change, with the emotional and sensory experience of people increases the capacity for empathetic exchange and motivation for action. Second, and as noted previously, artworks and art making leverage at least six mechanisms to help bridging knowledge. These complementary and diverse mechanisms enhance opportunities for meaningful connections between knowledge holders and they can serve as a touchstone to foster and assess knowledge bridging strategies that engage with art and artistic processes. Third, artists and their artworks illuminate *belief* as one component of knowledge in bridging processes that is often not adequately addressed. An understanding of belief systems is considered crucial for creating effective and legitimate decision making strategies (Fairhead and Leach 1995;

Forsyth 2003; Inuit Qaujisarvingat 2013). As these insights reflect, my research has contributed to a better understanding of how to create robust settings to bridge knowledge systems, and in particular, how art and artistic processes can play a role.

7.3 Reflecting on the broader messages and implications of my research

I have outlined above the main findings and academic contributions that emerged from my research. These findings and contributions about knowledge bridging, and the specific role of art and artistic processes in knowledge bridging, are largely captured in the three empirical chapters in my dissertation. However, these findings and contributions must also be situated in a broader context of Inuit art and the social-political history from which they emerge. In this section, I consider my dissertation results and the role of art more broadly in light of the history of Indigenous 'art' in the north, and the more recent history of social and ecological change in what is now Nunavut. In doing so, I also reflect on my own positionality as an artist and non-Indigenous researcher, and the manner in which I engaged with music as a way to find common ground with the individuals that participated in my research. Finally, I reflect on the contribution of my research to ongoing efforts to foster more interdisciplinary or transdisciplinary forms of scholarship.

7.3.1 Inuit art about transformation in the context of prehistoric and historic social-ecological transformations

As noted previously, the theme of transformation (as well as adaptation) emerged in several ways during my research and was present in many Inuit artworks (see Chapter 6). These themes can be considered in light of the long history Inuit and their ancestors have with social-ecological transformation. In Chapter 2, for instance, I reflected on the Dorset and Thule ancestors of today's Inuit and the significant transformation of ecological systems (warming period and then the little ice age) they experienced, as well as social transformation associated with conflict between Dorset and Thule peoples. The narrative of embracing transformation as a source of renewal may very well date back to these ancestral experiences with transformation, and also be reflected in generations of Inuit art such as amulets, stories and songs.

Indeed, in an Indigenous context, amulets (and other forms of aesthetic expression) have been used for millennia for spiritual and ideological purposes. For example, a particular carved amulet could help to sustain identity during periods of change and transformation (see Chapter 2). Historically, Inuit shaman used aesthetic amulets when performing rituals and spiritual journeys, and young men and women wore special amulets for rites of passage (Laugrand and Oosten 2015). Amulets and small carvings on tools such as knives and harpoons hold stories and legends, and can even hold power – these properties are likely reinforcing. For example, in the Inuit film, Arviq! (Kunuk 1998), hunter Paul Quassa proclaims that the carvings in his ivory comb are legitimate forms of evidence about the Inuit right to hunt whale at the interface of western and Indigenous knowledge (see Chapter 2). Similarly, using artworks and oral histories to prove title to land is salient for many Indigenous peoples and is a way western institutions can better understand and respect how knowledge systems that are linked to long-term associations with particular places (Kunuk 1998; UNRIP 2007; Koutouki et al. 2015). If aesthetic objects can be leveraged to reflect a culture and in turn an ethical and political right to govern environmental resources, they give Inuit people tremendous power.

The recent history of Inuit people has also been one of change imposed from the outside. Contact with non-Inuit, and the period of forced settlement and assimilation also represent significant transformations in the Inuit experience. Today's Inuit artists are embedding stories of embracing transformation into artworks as a way to reflect social and emotional cohesion during these changes. Changes in sea ice and climate, the result of exogenous drivers that impact Indigenous communities, are similarly being captured in artworks. As with historical artefacts and other forms of expression, current artworks have the capacity to carry important narratives about change that reflect transformation as renewal and that offer evidence of Inuit ability to adapt (see Chapter 6). Ultimately, for those seeking to bridge knowledge systems about change, this is important for two reasons: First, because it demonstrates how change can be perceived on very different temporal scales by different knowledge systems. One knowledge system is thinking with the stories on a timescale of millennium; Also it demonstrates that artworks, as aesthetic boundary objects create stability during change and uncertainty and are therefore cultural

artefacts of what is important to maintain an honour over time and between knowledge systems.

7.3.2 Inuit art and knowledge during the political-economic transformation of the mid 20th century

As noted above, Inuit art has long reflected experiences of change and transformation, and these and current experiences with change are also reflected in modern forms of expression. At the same time, however, it is important to understand how the role of art has simultaneously shifted in Inuit society from a largely spiritual endeavour, to an economic endeavour in which art is an 'object' for western consumers. Over the past several decades, for example, Inuit artworks shifted from being used for ideological, spiritual, social and political purposes, and in ways that connected Inuit to each other and the land, to a reflection of the connection between Inuit and the welfare state, or western political-economy system.

Even still, many Inuit have leveraged the introduction of commercial art making as a way to embed and maintain knowledge and culture in the context of colonial subjugation and to make money to support their families. The artists that participated in my research described the cultural assimilation that was occurring at the same time that art making became one option to start to earn income and have the opportunity to participate in an emerging wage economy (see Chapter 2). In this regard, Inuit artists could sell works to a local Hudson Bay Company representative, or later to the local co-op stores.

Even today, however, the artists that participated in my research reminded me of the power of their artworks to reflect a culture and knowledge system, even when they are also functioning as a means to earn income. Yes, some Inuit may carve only 'dancing polar bears' – a sure sale for southern tastes. But, the artists showcased in my work demonstrate their talent at combining a nuanced and intimate knowledge of changes occurring around them, together with emotions, sensory experiences and values, all of which can help people interpret and react to change. Themes of transformation and continuity are both present in the artworks highlighted in my dissertation and the artworks themselves help give agency to people, animals and elements of the earth such

as the northern lights. Inuit artists continue to leverage the commercial art making institution as a way to adapt to new circumstances, and at the same time preserve, practice and honour their Indigenous knowledge by embedding it in aesthetic form. This again demonstrates the adaptability and strength of their culture.

7.4 Contributions to transdisciplinary scholarship

Working towards sustainable societies requires diverse tools and strategies to understand environmental change, and to collectively navigate that change (Mitchell et al. 2006; Reid et al. 2006). Scholars have begun to recognize that art making and artworks have a particularly valuable role to play in this regard (e.g., Zurba and Berkes 2014; Heras and Tabàra 2015; and see current special issue in *Ecology and Society* on art and science). In this dissertation I teased apart different capacities for why and how this is the case: (1) art creates opportunities to see the world in new ways, helping people reflect on epistemological and ontological biases, and to imagine futures different than the present; (2) artistic processes create space for multiple forms of expression (e.g. stories, songs) that encourage a fuller picture of the human experience of environmental change; (3) artistic boundary objects function to mediate exchange between knowledge holders and can scale up and out via social networks; and, (4) artworks and art making can create continuity in times of change and uncertainty. Engaging with knowledge system bridging practices requires one to imagine the world in new ways by trying to understand the epistemological and ontological basis of the participating knowledge holders. The artworks and the collaborative mural functioned as a boundary object. In this way, my research contributes insights that suggest how and why broadening the forms of expression used in sustainability science, to include the arts, can enhance how we bridge knowledge systems across cultures (e.g., Inuit and scientific) and generations. The arts connect us with information in emotional and visceral ways, ultimately enhancing ongoing efforts to foster more transdisciplinary forms of scholarship and conversations across cultures and communities of practice (see Pohl and Hirsch Hadorn 2008; Pohl 2010).

7.5 Contributions to policy, practice and communities

This winter, Artic sea ice extent was at an all-time low for the 13th consecutive year (National Snow and Ice Data Center 2016); These very real changes in environmental systems are having profound impacts on the people who live in the Arctic. While much of the world continues to debate how to approach climate change, the Inuit of northern Canada and other Indigenous peoples are living the impacts of a changing climate in their day to day lives (e.g., changes in sea ice greatly impact hunting practices) (Krupnik et al. 2010; Kunuk and Mauro 2010). Increasingly, national and international policy arenas are advocating for Indigenous rights and knowledge to be at the fore of initiatives and decisions making processes about the environment (Thaman et al. 2013). Here, I discuss the implications of my research with reference to three arenas of policy and practice: 1) in the context of environmental assessment and cumulative impacts assessment activities at local and regional scales; 2) nationally, in the context of the Ministerial mandate letters relating primarily to climate change (Environment Canada) and Indigenous peoples (Aboriginal Affairs and Northern Development); and 3) internationally, in the context of expectations and responsibilities enshrined in the 2007 United Nations Declaration on the rights of Indigenous Peoples.

Environmental assessment (EA) and cumulative impacts assessment activities in Canada must account for the perspectives and knowledge of Indigenous peoples. In particular, environmental assessment processes under the Canadian Environmental Assessment Act (CEAA 2012) state that all environmental assessments must take into account "the level of concern expressed by Aboriginal groups or the public". As well, 'valued components' as defined in CEAA include the spiritual and social value of ecosystems for Indigenous and local people. Understanding the significance or the 'value' of ecological components requires robust settings to bridge knowledge systems. As I have demonstrated in this dissertation thesis, art and artistic process have a role to play in this regard.

Increasingly policies and protocols require that environmental governance account for indigenous knowledge beyond the technical expertise that these perspectives offer. The less tangible valued components of an ecosystem, such as the spiritual

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importance of transformation, the role of sea ice in Inuit belief and culture, and the historical importance of dogs for Inuit culture and self-determination must be acknowledged for their critical role in steering adaptation and adoption of environmental governance protocols (Mitchell et al. 2003; UNDRIP 2007; Zurba and Friezen 2014). To approach the concern expressed by Indigenous peoples requires listening to the diverse forms of expression through which they voice their concerns. Artworks and artists can inform environmental assessments by bringing to the fore both the tangible and intangible dimensions of the Indigenous experience of environmental change (see chapter 6).

Current policies and implementation plans for climate change adaptation and EA at local and regional levels are less focused on empowering youth and building adaptive capacity of communities, and more focused on technical issues and their tangible fixes (e.g., how to protect houses from landslides). Both are important and novel approaches to bridging knowledge systems, like art and artistic processes, will shed light on how environmental assessment and adaptation strategies can best support the strengths and priorities of indigenous communities. Elders and artists in my research stressed the importance of supporting youth to learn traditional skills such as hunting and sewing. They also described the importance of listening to the elders and having patience. Further the gratitude for, and prevalence of, interconnectedness and transformation in Inuit art about climate change and sea ice change each provide clues for how to better empower and support communities.

Nationally, Ministerial mandate letters provide important context for further emphasis on knowledge bridging processes, and thus, the potential role of art and artistic processes. Here are a few of the most pertinent examples, selected for their resonance with this thesis:

> To the Minister of Environment and Climate Change:
>
> "Work in collaboration with the Minister of Fisheries, Oceans and the Canadian Coast Guard and the Minister of Science to examine the implications of climate change on Arctic marine ecosystems" (See more at: http://pm.gc.ca/eng/minister-environment-and-climate-change-mandate-letter#sthash.uhI2ivnz.dpuf).
>
> To the Minister of Aboriginal Affairs and Northern Development:

"Undertake, with advice from the Minister of Justice, in full partnership and consultation with First Nations, Inuit, and the Métis Nation, a review of laws, policies, and operational practices to ensure that the Crown is fully executing its consultation and accommodation obligations, in accordance with its constitutional and international human rights obligations, including Aboriginal and Treaty rights.

Collaborate with the Ministers of Natural Resources, Environment and Climate Change and Fisheries, Oceans and the Canadian Coast Guard to ensure that environmental assessment legislation is amended to enhance the consultation, engagement and participatory capacity of Indigenous groups in reviewing and monitoring major resource development projects.

To support the work of reconciliation, and continue the necessary process of truth telling and healing, work with provinces and territories, and with First Nations, the Métis Nation, and Inuit, to implement recommendations of the Truth and Reconciliation Commission, starting with the implementation of the United Nations Declaration on the Rights of Indigenous Peoples" (See more at: http://pm.gc.ca/eng/minister-Indigenous-and-northern-affairs-mandate-letter#sthash.aCdrh0Sn.dpuf).

Each of these objectives requires the strategic use of settings to respectfully bridge knowledge systems, and specifically knowledge from scientific, Indigenous and policy contexts. Insights from this dissertation are thus of relevance. For example, in Chapter 4 my co-authors and I describe a typology of settings to bridge Indigenous and scientific knowledge systems. This typology can be used as a touchstone in policy development, implementation and evaluation to ensure that the approach taken is salient and legitimate from the perspective of the people most impacted by environmental change and/or resource development activities. Policy makers can use the typology to guide expectations around bridging Indigenous and scientific knowledge in natural resource management and environmental governance contexts. For example, the typology demonstrates that taking time and energy to establish a philosophy (i.e. epistemological setting) improves bridging processes in practice. For funding and evaluating projects that bridge knowledge systems, the typology can be used as a guide. For example, to understand why a project failed to successfully connect Indigenous and scientific perspectives, the typology can be used to illuminate what gaps (e.g., institutional, process –based) existed in a project or program.

The mandate letter guiding for the Ministry of Aboriginal Affairs and Northern Development is also aligned with the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP 2007). This UNDRIP reflects a third domain of policy and action that endorses Indigenous peoples and their knowledge as a priority area for global decision making (e.g., about climate change) and local resource governance (e.g., in resource extraction projects like mining). Specifically, the UNDRIP document (2007) stresses the need to "…provide effective mechanisms to prevent, and redress actions that deprive Indigenous peoples of their cultural values and ethnic identities" (pp. 5). The loss of the sled dogs is a cultural legacy that requires acknowledgement and redress. It was by engaging artistically with Inuit that I learned first-hand about both the tangible experience and the social-emotional impact of the loss the sled dogs for Inuit hunters and their families (see Chapter 2). Further, the importance of ice and experiences on the ice such as hunting and travelling are vital to Inuit cultural and social well-being (Krupnik 2010; Fox Gearheard et al. 2013; Watt Cloutier 2015). Inuit artworks about climate change and sea ice change portray the complex perspectives of Inuit about these issues, and they have a role to play in environmental governance.

My research demonstrates the capacity of art and artistic processes to connect knowledge in ways that illuminate both its tangible and intangible dimensions (Weiss et al. 2013; Booth and Skelton 2011; Croteau 2010). Further, the artworks showcased in my dissertation research have a role to play in illuminating Inuit voices in decision-making arenas that cross local and international levels. Sheila Watt Cloutier describes in her memoirs that bringing the carving of mother and child to the POP meeting was her most strategic move in her campaign regarding human rights in the Arctic (Watt Cloutier 2015; and see Chapter 1 and 2). The potential of artistic boundary objects to travel through social and organizational networks should be acknowledged and used more frequently in policy and decision making settings. The Inuit artworks about sea ice and climate change explored in this thesis can be contemplated by decision makers, and used as boundary objects during discussions about how to proceed with climate change adaptation or resource development projects.

My work also provides insights for participatory artistic engagement and practice. The methods I used for designing and facilitating participatory art projects could be

useful for other practitioners seeking to engage with Inuit communities or other marginalized communities. The approach I took to integrate Inuit youth and elders with the collaborative mural project provides useful strategies for communality engagement. For example, I have been in contact with the Government of Nunavut to provide advice for their upcoming project engaging youth using artistic methods in Cape Dorset, NU regarding permafrost change.

With regard to community benefits, engaging with art and artistic processes has a demonstrated social value of empowering the participating communities of Cape Dorset and Pangnirtung. This thesis showcases the artistic talent of these communities and the way that Inuit artists are sharing perspectives of climate change and sea ice change in their artworks.

Youth empowerment is a practical contribution to the community that I am proud to have made. Follow-up interviews with participating youth indicate that the project helped them to learn new skills and hear stories that they had never considered before about how their elders travelled on the sea ice. Cross-generational connections were facilitated through the project. Elders and youth connected during storytelling and drawing, as well as when sewing and stretching the mural. Connecting Inuit youth and elders is an important activity for not only youth empowerment, but also for maintenance of traditional knowledge (Cunsolo Willox et al. 2012).

Community researchers and translators had the opportunity to learn scientific techniques and approaches for project management while they helped me navigate the local context. One field assistant started a program of translation and Inuit culture at Nunavut Arctic College following our work together – evidently feeling positive about potential future experiences in this area. Assistants and interviewees were all paid generously, providing financial support to communities as well. In a small community, making decisions about who will be hired as a community researcher, and who might participate in the research process itself, can create political tensions. I sought to alleviate these tensions by being open about my research intentions via community radio and house visits. Moreover, my criteria for inclusion of research participants was straightforward. If artists made a proportion of their income from art making, then they were invited to participate. To decide who was hired for translation, interpretation and

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community research assistant work, I took the advice of local administrative staff and scholars who had had successful experiences in these matters.

Finally, my work provides data about the multidimensional role of art in these communities and can support a rationale for funding of further projects and programs in the arts domain. During a follow up trip I was able to meet with municipal officers and the managers of art co-operatives in these communities to share how they could leverage my research results for local arts programming and the acquisition of funding.

7.6 Ideas for future research

How to engage at the interface of Indigenous and scientific knowledge about environmental change is an area of interest for both research and practice. The capacity to bridge diverse knowledge systems is heralded as an important component of local to global resilience and for enhanced environmental change governance and resource management (Folke 2010; Reid et al. 2006; Tengö et al. 2014). This dissertation contributes to this need by accounting for the many settings to bridge knowledge systems, and by examining the setting of art and artistic processes. I would encourage further research in the area of settings for bridging knowledge systems, specifically in terms of evaluating dimensions of power and knowledge in different settings and also for creating better opportunities to connect with the intangible dimensions of knowledge (e.g. beliefs, emotions). Further, evaluating the outcomes and impacts of settings and bundles of settings to bridge knowledge systems is a pressing research need, and crucially important to further guide policy and practice.

The mechanisms through which art and artistic processes bridge knowledge systems were explored in this thesis. More engagement with the role of artworks and aesthetics in the context of specific environmental change and decision-making contexts is also warranted. Further research would explore the specific contributions of art and the artist in terms of sensory, emotional and knowledge dimensions of bridging knowledge systems. For example, scientists at Berkeley study the impact of art on the brain using MRI imaging (Shimamura and Palmer 2012). This is important because it demonstrates at the cognitive/ individual scale the real and visceral impact that art has on people. As such, my research is related to this cognitive research because bridging knowledge

systems requires people to have open and responsive experiences that start with individual brain responses. At the scale of the community, Turner (2012) has explored how art making and collective art practice impact communities of people by changing the social and emotional state of individuals as part of communities. Research efforts at different scales can contribute to understanding the role of artworks and aesthetics in the context of bridging knowledge systems.

The role of aesthetic or cultural boundary objects within social networks in an environmental change context also shows promise as an area of further research. In this regard, I will continue to study the role of art, aesthetics and art making during change and transformation. In my research so far, I can conclude that artworks create cohesion and can carry important cultural information. Political philosophy points to the capacity of artworks and art practice to disrupt a dominant social order and offer an alternative set of values and perspectives (Marcuse 1979). Of particular interest here would be continued study of Inuit art about environmental change and transformation. Other Indigenous and First Nations groups have strong art cultures and I would be interested in how the topic of environmental change and transformation is explored by artists from diverse Indigenous groups.

7.7 Conclusions and final thoughts

Of the many settings in which to bridge knowledge systems (see Chapter 4), my research shows that art and artistic processes have potentially significant advantages over other forms of knowledge bridging. I conclude my dissertation by discussing my views on how artworks and artistic processes contribute to knowledge bridging in ways that value Inuit perspectives and culture, and in doing so, I reflect on the different roles played by art and artistic processes that have been identified in my research.

One advantage of using artworks to bridge knowledge systems is that they can move through networks of people and organizations. In doing so, artworks facilitating a scaling up and out of the knowledge, information, symbols and feeling they contain. As noted earlier, for example, the Inuit carving that traveled from the local scale to an international environmental meeting is credited with impacting the discussion and outcomes of the delegation (Johnson 2014). Likewise, artworks as boundary objects of

Inuit artists travel from their local context to southern and international markets for sale and display. In this way, the stories of Inuit artists are being scaled up and out. The mural project component of this research project (see Chapter 5) provided further evidence that artworks can function as boundary objects that move between social worlds and geographies to connect knowledge systems. For example, the mural played the role of boundary object to connect youth and elder knowledge. Likewise, the artworks showcased in Chapter 6, can themselves be thought of as aesthetic boundary objects. Inuit artworks are carried (with permission and copyright) into this thesis and as such are travelling between social worlds of Inuit art and local culture to the academy and the public.

As one setting to bridge knowledge systems, artworks also have an advantage in that multiple forms of expression can be leveraged simultaneously, or at the preference of participants. Artists in my study described that the wisdom of the elders can be communicated through imagery to help the younger generation understand what the elders are trying to communicate (see Chapter 5). The significance of Inuit artists embedding traditional knowledge into artworks, as a mechanism to teach younger generations, becomes more evident when Inuit art making is situated in a socio-political context. Both historical and ongoing individual and community traumas are related to the loss of identity and meaning. Youth in my study described feelings of empowerment and personal growth as a result of their experiences engaging with art in participatory ways, and in collaboration with elders. All participants alluded to their desire for more projects with art making components. Moreover, as reflected in this dissertation, it is possible to undertake rigorous research and, at the same time, facilitate local settings for bridging knowledge using art in ways that combined multiple forms of Inuit expression (e.g., symbols, stories, memories and drawings, sounds and songs) (see Chapter 6). This is consistent with previous arguments made to engage with broader forms of expression at the science-society interface (Maffie 2009; Reid et al. 2006; Dale and Armitage 2011). Exploring diverse ways of relating to the world through artistic practices can be an opportunity to connect with another's worldview, which is particularly important in the Indigenous settings (Tuhiwai Smith 1999; Wilson 2008). For example, environmental governance scholars have used artworks as boundary objects to better grasp how

Indigenous people care for land (Zurba and Berkes 2012; Zurba and Friesen 2015). They found that the artworks were an effective means to broaden a discussion about how to govern natural resources.

The ability of artworks and artistic processes to facilitate sharing of both the tangible and intangible dimensions of knowledge about environmental change reflects another particularly crucial role the arts can have in knowledge bridging processes. For example, Inuit artists use symbols in the artworks to portray beliefs and values that can stimulate emotions in the viewer (see Chapter 6). Artworks are a compelling means to understand the cultural experience of another knowledge system because art connects with emotion, sensory experience and factual information (Palmer and Shumaurma 2012). When learning about the worldview, or knowledge system of another person and culture, it occurs that one's epistemology can be stretched to see the world in new ways (Elgin 2002). Indeed, art can invoke imagery that challenges people's perspectives and values, offering a new way of seeing the world that is invoked by the mutual experience of art and the artistic process (Marcuse 1979). During my research, I was challenged to see the world in new ways (see section 7.4.3). The artworks and stories of Inuit artists altered how I see Arctic sea ice and climate change. For example, comparing the music I composed about Arctic change before and after my time living in the Arctic reflects a shift from seeing Arctic environmental change as only a threat, to also seeing how Inuit can at times also embrace change as transformation and adapt (see Chapter 6 and section 7. 4.3 above).

Shifting knowledge and expectations for how the world works is a way that artworks demonstrate a role in social and political change. Art philosophers with an interest in the politics of knowledge describe how art has emancipatory attributes:

"…The radical qualities of art, that is to say, its indictment of the established reality and its invocation of the beautiful image (schooner Schein) of liberation are grounded precisely in the dimensions where art *transcends* its social determination and emancipates itself from the given universe of discourse and behaviour while preserving its overwhelming presence" (Marcuse 1978, pp. 6).

Art expresses imagery that, while holding us in our current reality, also offers us the opportunity to transcend our current experience of the world to form novel conceptualizations of how the world works. In this regard, my study contributes an important lesson. Specifically, artworks and associated stories of Inuit artists create a compelling narrative about sea ice and climate change and how individuals and communities may relate to those changes (see Chapter 6). Themes of connectedness and transformation between humans, animals and elements of nature, are central in many artworks examined for this dissertation, and embraced as the way the world works. Several artists have created a story of resilient Inuit people who can adapt to sea ice change with 'chins up', perhaps using an aesthetic object in their art, such as a harpoon, to navigate the dynamic ice, one step at a time.

As argued above, artworks and aesthetic objects have an important role to play in shifting our knowledge systems and expanding the ways in which we see the world. Paradoxically, artworks can maintain continuity in knowledge by bridging knowledge systems over time or space. So, while art and aesthetic objects are credited with having a role in stimulating change in knowledge systems, they also create cohesion in knowledge systems over time. Hence, artworks and art making have diverse roles and capacities that prompt useful outcomes for periods of stagnation when change is desired, *and* during periods of change, when connection and stability are a priority.

During periods of rapid, unexpected environmental and/or social change, art and artistic processes can help maintain emotional and social cohesion by guiding collective vision. At the scale of the individual, for example, the field of art therapy emphasizes the role of art in maintaining emotional cohesion of disturbed and disadvantaged individuals and communities (Reynolds et al. 2000). In my study, some artists described the role of art making as a therapeutic activity. Some participants use art making as a way to both honour family legacies that include trauma and pain, and to heal from the past by creating artwork that reflects change (see Chapter 5).

The Inuit artists in my study create artworks about environmental change and transformation, and in so doing the artists convey the emotional, practical and spiritual response that it carries for them. Artworks about transformation, such as Elisapee Ishulutaq's *Climate Change* (2010), or Padlaya Qiatsuq's *Transformation (nd.),* or Tim

Pitsiulak's *Global Warming* (2010) (see Chapter 6), all present a situation of extreme transformation. Yet, those artworks also reveal elements that remain constant during that transformation – the wisdom of the elders, keeping one's 'chin up', and being adaptive and embracing transformation as renewal. Symbols of Inuit culture such as the *ulu*, *amauntiq* and other traditional clothing are reflected in artworks about transformation to demonstrate that even when there is change, some elements of identity are constant and bridge pre- and post-transformation.

I have identified and reflected on four roles that make art and artistic processes particularly compelling as a setting to bridge knowledge systems. The aesthetic boundary objects that emerge from artistic processes are mobile enough to move from their place of origin to bridge knowledge over time and space. The capacity of artworks and artistic processes to embrace multiple forms of expression broadens how people can share their experiences of environmental change. Some forms of expression are more suitable or preferable to different cultures and legitimate and salient settings for bridging knowledge will respect these differences. Furthermore, combining different forms of expression creates diversity and allows for more opportunities for participants to connect to each other's experiences, values and emotions. Artworks and artistic processes can help people to stretch their epistemological bounds and to see the world in new ways. When bridging knowledge systems between cultures and generations, an open mindset and the capacity to broaden one's views of the world are crucial. Finally, artworks and artistic processes help people to maintain continuity during periods of change and transformation.

My dissertation research demonstrates that artworks and artistic processes can and do contribute meaningful settings in which to bridge knowledge systems. However, artworks and artistic processes are not a 'silver bullet' or panacea for knowledge bridging. Power and knowledge are inextricably linked (Foucoult 1989), and making sure participants, and their artworks, are brought to bridging settings from a place of empowerment is crucial for legitimate and salient outcomes. The influence of the southern art market and the advice of collectors to 'make large pieces', or the limited access to art materials in these Inuit communities may suggest that artists are not working from a place of freedom and empowerment. Certainly, there is much work to be done to

address the tumultuous history of change that was imposed on Inuit people and how that continues to impact lifestyles and well-being of Inuit today.   But we can never underestimate the adaptability and resilience of Inuit people and their culture.   Even during a period of forced assimilation and subjugation, artworks and artistic processes were used as a way to nurture traditional knowledge.   Even while catering to southern tastes in order to make income from artworks, many artists still embed their own ideology and knowledge into artworks with the intention to bridge knowledge with younger generations and diverse cultures.

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ECGG Environmental Change
& Governance Group   **WATERLOO**
                            ENVIRONMENT

Dear _____:

This letter is an invitation to consider participating in a study I am conducting as part of my Doctoral degree in the Department of Environment at the University of Waterloo under the supervision of Professor Derek Armitage. The title of my research project is *"Exploring Inuit artistic voice about Arctic environmental and sea ice change: How does art and artistic process contribute to bridging knowledge systems and navigating complex environmental change?"* I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

The purpose of my doctoral research is *to explore and advance the artistic voice about Arctic environmental and sea ice change, to understand the role of art and artistic process for bridging knowledge systems (e.g. scientific and Inuit) and helping society navigate complex environmental change.*

The research goal is too learn about, and bring attention to, Inuit artistic responses to Arctic environmental and sea ice change (e.g. drawings, songs, sculpture). Further, this project will assess how art and artistic process may serve as a method, strategy or approach to connect ways of knowing (e.g. scientific, Inuit and policy oriented). The project will provide insights about how Inuit artistic perspectives can inform science and policy.

It is my hope to connect with you, as a practicing artist in your community, and invite you to participate in this research project. I believe that Inuit artists have unique understandings and stories relating to Arctic environment change and have powerful ways of communicating these understandings through art. During the course of this study, I will be conducting interviews with artists I will ask about their artistic process and in particular perspectives on art that explores the topic of environmental change. I will also invite artists, youth and elders to join in a participatory art workshop where together we will explore perspectives on Arctic environmental change through artistic mediums, such as music and drawing. At the end of this study the publication of this thesis will share the knowledge from this study with other environmental change researchers, art programmers, and community members.

Participation in this study is voluntary. It will involve an interview of approximately 1.5 hours in length to take place in a mutually agreed upon location. You will be provided with a financial honorarium of $100 for your time. The amount received is taxable. It is your responsibility to report the amount received for income tax purposes. You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time without any negative consequences by advising me - the researcher. With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis. Photos and video recordings of art pieces may also be taken, with your permission. Photos and videos of artworks will be used for research purposes to compliment interview transcripts by clarifying descriptions of art and capturing nuances, such as color in the artworks. Shortly after the interview has been completed, I will send you a copy of the English transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish. All information you provide is considered completely confidential. You can choose if you would like your name to appear in any thesis or report resulting from this study. Otherwise, with your permission anonymous quotations may be used. Data materials collected during this study will be retained for three

years in a locked office in my supervisor's office. Only researchers associated with this project will have access. There are no known or anticipated risks to you as a participant in this study.

If you have any questions regarding this study or would like additional information to assist you in reaching a decision about participation, please contact me at (519)-222-7146 or by email kaitlyn.rathwell@uwaterloo.ca. You may also contact my supervisor, Derek Armitage at 1(519) 888-4567 ext. 35795 or by email at Derek.armitage@uwaterloo.ca

I would like to assure you that this study has been reviewed and received ethics clearance through a University of Waterloo Research Ethics Committee. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Maureen Nummelin, the Director, Office of Research Ethics, at 1-519-888-4567, Ext. 36005 or maureen.nummelin@uwaterloo.ca.

I hope that the results of my study will be beneficial to empowering the northern artistic voice and Inuit perspectives on environmental change, to your families, and to northern youth and communities, as well as the broader research community.

I very much look forward to speaking with you and thank you in advance for your assistance with this project.

Yours Sincerely,

Student Investigator

CONSENT FORM

By signing this consent form, you are not waiving your legal rights or releasing the investigator(s) or involved institution(s) from their legal and professional responsibilities.

_____
___

I have read the information presented in the information letter about a study being conducted by Kaitlyn Rathwell of the Department of Environment at the University of Waterloo, under the supervision of Dr. Derek Armitage. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be audio recorded to ensure an accurate recording of my responses. I am aware that I have the option of allowing photo/video recordings of art pieces during interviews.

I am also aware that excerpts from the interview and photo/video recordings may be included in the thesis and/or publications to come from this research, with the understanding that the quotations will be anonymous if I desire.

I was informed that I may withdraw my consent at any time without penalty by advising the researcher.

This project has been reviewed by, and received ethics clearance through a University of Waterloo Research Ethics Committee. I was informed that if I have any comments or concerns resulting from my

participation in this study, I may contact the Director, Office of Research Ethics at (519) 888-4567 ext. 36005.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

☐ YES ☐ NO

I agree to have my interview audio recorded.

☐ YES ☐ NO

I agree to have artworks described in the interview video-recorded or photographed.

☐ YES ☐ NO

I agree to the use of my name in quotations in any thesis or publication that comes of this research.

☐ YES ☐ NO

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

☐ YES ☐ NO

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Witness Signature: _____

Date: _____

Semi-Structured Interview guide- Artists

    Name _____
    Community_____
    Art forms_____

1. Are you comfortable with being called an artist? If so, what does that title mean to you? If not, why not?
2. What forms of expression and mediums do you use in your artistic process (e.g. music, drawing, carving)?
3. What is the role of art for you in your life? e.g. means of expression, reflection, sense-making, income?
4. Who/what are your artistic influences?
5. Where did you learn to engage in artistic processes? Like, in what setting? How was it facilitated?
6. What platforms do you use to share your art results (e.g. Uqumaumut Center, gallery in Toronto, community hall)?

7. What do you like to draw (carve)? Why?
8. What do you want your art to communicate? What story are you telling with your art?
9. If someone can take home a message or so from your art (performance, carving), what would you want it to be?
10. I noticed you take inspiration from _____a) Sedna stories b) hunting songs c) Arctic Landscape d) hunting Can you tell me about how/why you get inspiration from that?

11. Are you experiencing changes in the local environment?
12. Are you experiencing climate change? how?
13. Are you experiencing changes in sea ice?

14. What is the relationship between art and environmental change? e.g. changes in sea ice

15. Do you explore these environmental, climate and sea ice changes in your artistic process? How?
16. Do you have a particular piece(s) that tells a story about these changes?

17. What is the role of art in your community? Story telling as art, printmaking as art.

18. Do you think art has a role to play for helping society navigate change? For example changes in sea ice?
19. Do you think policy makers and governance practitioners, e.g. Arctic Council can learn from artists? What sorts of things do you think they could learn?
20. Do you think scientists can learn from artists e.g. IPCC? What sorts of things do you think they could learn?

Is there anything that you think is important that I have overlooked? Or anything else you would like to talk about?
Thank you for your time!
Thank you.