Inuit Technology;
Conservation Policy and Innovation in Nunavut

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ABSTRACT

This paper investigates how Inuit will continue to be the most effective advocates for their own landscapes and ways of life by using the Lancaster Sound region and recent development of Tallurutiup Imanga National Marine Conservation Area (TINMCA) as grounding geographies. Inuit technologies are considered in this research as new and existing policy tools that continue to shape the creation of conservation areas, and as innovative conservation tools and devices, emerging from military history in the region and current global influence. This research explores the Arctic provenance of conservation technology tools by outlining their historic involvement in 1) defense; 2) mapping; and 3) climate change while relating them to the Nunavut Land Claims Agreement (NLCA) and relevant legislation. It will then explore 4) Indigenous connectivity in the region as a way of acknowledging the potential for Inuit to increase conservation advocacy, ownership of and access to data and as a way to connect to global support. Recent developments in global Indigenous Connectivity in this way, can be considered a conservation instrument and potential agent for Inuit self-dependence and empowerment. The paper will conclude by synthesizing the previous lines of inquiry and offering a hopeful and engaged vision which posits that the adoption of technological advances combined with ongoing Inuit self-determination efforts will produce positive environmental and economic development results for Inuit Nunangat (Inuit homeland in Canada). Inuit-led governance is made possible, in part, through benefit agreements and feasibility studies. The TINMCA Inuit Impact & Benefit Agreement (Nunavut, 2019), QIA 2018/19 Annual Report and the NMCA Lancaster Sound Feasibility Assessment Report (2017) help illustrate how Inuit are reclaiming and establishing governance through conservation. This is important because the technologies that this paper explores; remote sensing, biotelemetry and satellite internet connectivity all helped establish TINMCA – as an Inuit managed area – and continue to inform its viability and importance as a site for scientific research and biodiversity monitoring. Further, these technologies provide evidence of a viable Inuit conservation economy. Understanding the specific history and application of each technology will contribute to a more nuanced picture of how this landscape comes into focus. Moreover, understanding the applications of these tools will help to identify capacity building needs in adoption by the Inuit associations and capacity building needs in the scientific community.

FOREWORD

This writing came into being after my pursuit of synthesis between environment and technology led me to the study of conservation innovation and its relationship to indigenous peoples. Throughout the MES program, I have been interested in science and technology studies, Indigenous research and critical conservation practices. Conservation technology is an area which allows the logical overlapping of my academic interests. In my Plan of Study, I state that I began the MES program looking for a science fiction-based solution to the technology / nature divide. I think conservation technology and the ways in which it is implemented by indigenous peoples in Canada helps envision a future where these things can exist in symbiosis while addressing the inherent inequalities in settler-colonial relations to the lands and waters of Canada. It also prepares me to undertake more in-depth research on the economic development impact of conservation technology and innovation in regions which are predominantly inhabited and represented by indigenous peoples. Technology can provide a medium through which interests converge to pose questions about solutions-based practices. Arctic Canada is particularly sensitive to the effects of climate change and becomes an important case study area for the impact of technology on sustainable development. Because Canada's Arctic is home to the Inuit, it represents a way to understand how to better serve marginalized communities in Canada with co-productive 'whole of government 'approaches.

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LIST OF ABBREVIATIONS

ARGOS	Advanced Research and Global Observation Satellite
CIRA	Canadian Internet Registration Authority
CIRNAC	Crown-Indigenous Relations and Northern Affairs Canada
CRTC	Canadian Radio-television and Telecommunications Commission
DNLUP	Draft Nunavut Land Use Plan (2018)
ECCC	Environment and Climate Change Canada
ENGO	Environmental Non-Governmental Organization
GC	Government of Canada
GIS	Geographic Information System
GN	Government of Nunavut
GNT	Government of the Northwest Territories
GPS	Global Positioning System
GSM	Global System for Mobile communications
ICT	Internet Connectivity Technologies
IIBA	Inuit Impact and Benefit Agreement
IoT	Internet of Things
IOL	Inuit Owned Lands
IQ	Inuit Qaujimajatuqangit
ITK	Inuit Tapirit Kanatami
IUCN	International Union for Conservation of Nature
LEO	Low Earth Orbit
LTE	Long Term Evolution
MBPS	Megabytes Per Second (Mbps)
MOU	Memorandum of Understanding
NLCA	Nunavut Agreement/ Nunavut Land Claims Agreement
NIRB	Nunavut Impact Review Board
NL	Newfoundland
NMCA	National Marine Conservation Area
NPC	Nunavut Planning Commission
NWMB	Nunavut Wildlife Management Board
NWT	Northwest Territories
PC	Parks Canada
QIA	Qikiqtani Inuit Association
RS	Remote Sensing
TEK	Traditional Ecological Knowledge
TINMCA	Tallurutiup Imanga National Marine Conservation Area
UMTS	Universal Mobile Telecommunications System
UNDRIP	United Nations Declaration on the Rights of Indigenous People

INTRODUCTION

Inuit are positioned to become preeminent Arctic environmental stewards through their adoption of advances in conservation technologies and historic commitment to sovereign acts of legislative independence. The trajectory of Indigenous – Settler conflict in the region roughly follows the well-established National histories of violent and deadly force, subjugation to religious institutions, overt racism and displacement from traditional lands, as in the rest of Canada. Early relationships between Inuit and European whalers produced conflicts beginning in the late Seventeenth Century, and issues were centered around colonial exploitation of natural resources, as they continue to be today. Inuit were at an advantage in the Arctic, in the eyes of the European explorer, with millennia of experience and adaptation to the land and climate. This was exploited through a power imbalance in technology, engineering, economics and trade over many centuries. However, Inuit have a history of being powerful advocates for their independence. For example, *Eskimo* (now Inuit) status has remained different to that of First Nations in Canada since their inclusion in the *Indian Act* as separate from First Nations in a 1924 amendment. In 1950, Inuit gained the right to vote in federal elections, yet First Nations were not afforded this right until 1960.[1] Since 1993, the Nunavut Land Claims Agreement (NLCA) has shaped an Inuit-focused policy framework and legislation that elevate regional Indigenous ways of life, by Inuit and for Inuit. Community leaders have been adept and dedicated champions of Indigenous rights in the region and because of this, northern peoples have been able to insert themselves into the foundations of their own government and advocate for their livelihood, health and wellness. Specific provisions in the Nunavut Land Claims Agreement (NLCA), such as Article 8 (Parks) section 8.4.2 Inuit Impact and Benefit Agreements and the specifics of Article 5 (Wildlife) represent significant departures from other regional Indigenous agreements with respect to conservation.

[1] Canada’s Relationship with Inuit, Indian and Northern Affairs Canada, 2006.

This paper will investigate how Inuit will continue to be the most effective advocates for their own landscapes and ways of life by using the Lancaster Sound region and recent development of Tallurutiup Imanga National Marine Conservation Area (TINMCA) as grounding geographies. Moreover, this writing introduces new and existing Inuit policy tools as Inuit technologies. To provide a definition of technology for this paper, it is important to consider academic writing on the subject which has sought to expand how technology is understood to be constructed and therefore what can be included in its definition. Langdon Winner has written about the social determination of technologies as artifacts in, *Do Artifacts have Politics*. (1986). He writes "for my purposes here, the term "technology" is understood to mean all of modern practical artifice, but to avoid confusion I prefer to speak of "technologies" plural, smaller or larger pieces or systems of hardware of a specific kind." Winner helps expand the notion of technology by helping it be understood as a socially constructed and political entity, among other things. Shapin and Sheffer define three types of technology in *Seeing and Believing: The Experimental Production of Pneumatic Facts*; material, literary and social. (1986). Rosemary Coombe and Eugenia Kisin understand technology as "mediating, stabilizing tools bound up with the demands made of and for collective political subjectivity—we open up questions about objectification and standardization that integrate theories of neoliberal governmentality and anthropological approaches to materiality, vitality, and ontology". (Coombe, 2019). Following from these definitions and frameworks, this paper considers conservation policy and legislation in Nunavut as Inuit technologies. Inuit technology is not meant to refer to traditional artifacts rather it refers to the mediation between western scientific thought and Inuit Qaujimajatuqangit – ecological knowledge. Inuit have used governance tools to their advantage and continue to shape the creation of conservation areas with policy technologies used as innovative conservation tools.

This research explores the Arctic provenance of conservation technology tools by outlining their historic involvement in 1) defense; 2) mapping; and 3) climate change while relating them to the NLCA and relevant legislation. It will then explore 4) Indigenous connectivity in the region as a way of acknowledging the potential for Inuit to increase conservation advocacy, ownership of and access to data and as a way to connect to global support. Recent developments in global Indigenous Connectivity in this way, can be considered a conservation instrument and potential agent for Inuit self-dependence and empowerment. The paper will conclude by synthesizing the previous lines of inquiry and offering a hopeful and engaged vision which posits that the adoption of technological advances combined with ongoing Inuit self-determination efforts will produce positive environmental and economic development results for Inuit Nunangat – Inuit homeland in Canada.

Inuit-led governance is made possible, in part, through benefit agreements and feasibility studies. The TINMCA Inuit Impact & Benefit Agreement (Nunavut, 2019), QIA 2018/19 Annual Report and the NMCA Lancaster Sound Feasibility Assessment Report (2017) help illustrate how Inuit are reclaiming and establishing governance through conservation. This is important because the Inuit technologies that this paper explores; policy tools and configurations of remote sensing, biotelemetry and satellite internet connectivity all helped establish TINMCA – as an Inuit managed area – and continue to inform its viability and importance as a site for scientific research and biodiversity monitoring. Further, these technologies provide evidence of a viable Inuit conservation economy. Understanding the specific history and application of each technology will contribute to a more nuanced picture of how this landscape comes into focus. Moreover, understanding the applications of these tools will help to identify capacity building needs in adoption by the Inuit associations and capacity building needs in the scientific community.

The US and Canadian military presence solidified settler ways of life in Nunavut in the 1950s and caused a tremendous amount of issues for Inuit communities. This is not only due to the forced abandonment of culture by hostile governmental and religious entities but also for the lifestyles associated with settled living. (Wenzel, 2008). However, military presence has also left a legacy of technologies which Inuit have used to their advantage to help conservation efforts and Inuit self-determination today. The Distant Early Warning (DEW) Line was a connected geography of radar installations that linked the region to the rest of Canada, the US and Greenland. These physical stations were installed with the service of Inuit and thousands of migratory military contractors from Canada and the US. (Gagnon, 2002). The DEW Line brought military technology and development to the Arctic, such as aerial photography and remote sensing. DEW line construction and operations also brought pollution in the form of "heavy metals, persistent organic pollutants and radionuclides". (Kafarowski, 2007). However, the defense installations also provided opportunities for collaboration between Inuit and settler populations. Subsequent natural resource development was made possible as a result of these prior defense technologies and relationships. Through innovation in remote sensing (RS) and in-field techniques, mineral exploration and petroleum productions have brought employment and infrastructure, although they have also brought conflict and debatable development benefits from an environmental perspective. The ongoing Baffinland Mary River mine conflict is a good example of this.[2] The influence of natural resource exploration history sets the stage for positive influence in conservation and sustainable economies in the future. As a lasting result of local and global dependence on non-renewable resources, the health of Arctic terrestrial and marine environments is in decline and in some cases, in peril. Inuit have successfully advocated for their independence and protection from exploitation and environmental degradation. For example, the Nunavut Agreement (NA) was developed at a time when environmental issues were experiencing a resurgence. In more recent years, the North West Passage (NWP) has become a site of geopolitical relevance for Canada which has focused shipping and tracking systems to work in tandem with animal tracking efforts. As climate change turns global and National interest in conservation development programs toward Arctic ecosystem protections, it brings a challenge to Inuit Nunangat (traditional territory) to maintain and enhance sovereignty.

[2] See *Diversions, Distractions, and Privileges: Consultation and the Governance of Mining in Nunavut* (Scobie & Willow, 2019).

Climate change has subsequently enhanced the need for Arctic wildlife tracking and research and because of the increased need for detailed species and ecosystem data, new technological solutions are proliferating.

Government of Canada (GC) policy documents, agreements and reports often mention a national dependence on technology for sustainable development in Northern areas, yet national policy instruments related to technology and innovation are disconnected, outdated and based on unsustainable growth models when applied to Indigenous territory management (Shadian, J., 2010; Avango, D., 2014; Tester, 2014). Moreover, technology is entirely missing from conservation policy and legislation. As a tool for and product of innovation, technology development and funding is provided by ministries like the Science, Technology and Innovation Council of Canada (STIC) and subsidized through economic incentives as corporate welfare, siloed away from biodiversity and conservation policy. (Weinberger, N., Jörissen, J., & Schippl, J., 2012).

Arctic ecosystems are specifically important to global biodiversity and climate change monitoring and present a unique challenge to scientific research because of their proximity to major research institutions, extreme climate variation and general inaccessibility. These factors make the development of Arctic conservation technologies that are ideally suited to render, track, monitor and communicate data, valuable tools for supporting sustainable Northern development within an Inuit “conservation economy” (Canada. Crown, 22, 2017). Mary Simon’s report *A New Shared Arctic Leadership Model* (2017) identified that creating a *conservation economy* may be one way for remote northern indigenous communities to facilitate economic control and create indigenous led economic alternatives, or alternative economies. Simon’s recommendations focus on creating infrastructure in terms of power generation and supply, transportation, and food security and access to high-speed broadband internet.

Conservation technologies have been developing at pace with the technology industry since their beginnings in the early 1950s. The past ten years have seen an increase in connected devices and applications as efficiency and miniaturization progress. Advancement in conservation technologies also have the potential to enhance critical biological and ecosystem monitoring data from increasingly remote vantage points. For example, animal tracking systems are some of the earliest forms of conservation technology and critical ecosystem and species data are generated through both active and passive tracking systems. By way of illustration, the Advanced Research and Global Observation Satellite (ARGOS) system currently has 7634 active monitoring units attached to individual birds, terrestrial and marine animals (ARGOS correspondence, June 2020). Because much of this technology and its original scientific foundations have evolved and updated with advances in materials and computer science, the scope of technology in the conservation arena has expanded.

Global dependence on the innovation in the technology sector has placed importance on how digital applications function across all industries. Notable projects using conservation technology have arisen, such as ICARUS[3] by the Max Planck Institute in Germany, the Canadian SmartICE[4] project in the Eastern Arctic and the launch of the WWF Canada TechHub website[5]. The belief that digital technologies can increase the reach and efficiency of data and commercialize results is omnipresent in almost every industry and discipline. There are several key issues that conservation technology researchers are addressing: the difference in research practices that remote and sensory systems effect (Lehman, 2016); the transformation of wildlife into digital assets (Birch, 2020); the lack of sector coordination efforts and the cost of development (Joppa, 2015) are among them.

The objectives of this paper are: to outline the technologies used in conservation, to understand their relationship to Inuit in the region, to characterize their economic benefits and to

3 https://www.icarus.mpg.de/en Global Monitoring with Animals (2019).
4 https://smartice.org/
5 https://techhub.wwf.ca/

assess the effect of either the Inuit Impact and Benefit Agreement (IIBA) or NLCA on these developments. TINMCA is important to this study because, as a newly formed conservation area and one of only five NMCA (two operational) in Canada, it has been developed with technology at its foundation. The park boundaries were created using remotely sensed mapping data mixed with Inuit Qaujimajatuqangit (IQ). The advocacy approach – Inuit community leaders working in collaboration with NGOs and ENGOs – for the expanded and final area used online platforms and data collection techniques only made possible by innovations in web and community-based monitoring tools. TINMCA exists within a highly monitored area where satellite shipping surveillance and hundreds of environmental monitoring research projects dot the landscape. As well, the two mines in the area provide socio-economic research opportunities for Inuit to investigate and create new employment strategies and advocacy for better working conditions. Beginning in 2017, Baffinland – one of the major mining operators and employers in the Qikiqtaaluk region – has created socio-economic reporting specialist positions and consulting firms have followed suit, creating opportunities for social scientists and anthropologists to help mining firms create employment programs and monitor the ongoing wellbeing of staff. (Richards, 2009).

Conservation technology is being used in this research as the umbrella term for technologies that aid in environmental protection. Conservation technology includes technologies that aid in rendering landscapes; biotelemetry; connectivity and environmental monitoring. Conservation projects using new and emerging technologies have increased by 70% globally since 2015.[6] In the Canadian Arctic, conservation research proposals including technology have increased 110% over the last 5 years. There are substantial projects already underway using emerging technology to track and monitor marine and terrestrial species, deployed over 200 km^2 in Nunavut.[7] Canadian conservation targets are based on International

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[6] A Horizon Scan of Emerging Global Biological Conservation Issues for 2020, Sutherland et.al

[7] https://www.nri.nu.ca/nunavut-research-institute-nri

Union for Conservation of Nature (IUCN) biodiversity targets. Because of this and the IUCNs dedication to Indigenous health and wellness, this environmental research will use the definition of conservation put forward by the IUCN; “the protection, care, management and maintenance of ecosystems, habitats, wildlife species and populations, within or outside of their natural environments, in order to safeguard the natural conditions for their long-term permanence.” (https://www.iucn.org/, 2020). It will also take into account the Nunavut Land Claims Agreement (NA) outline of the principles of conservation, section 5.1.5;

> (a) the maintenance of the natural balance of ecological systems within the Nunavut Settlement Area;
> (b) the protection of wildlife habitat;
> (c) the maintenance of vital, healthy, wildlife populations capable of sustaining harvesting needs as defined in this Article; and
> (d) the restoration and revitalization of depleted populations of wildlife and wildlife habitat.

(Nunavut, 26). The worldviews of Inuit are foundational to the work being done in Nunavut and are well represented by the NLCA and through its provisions.

New technology in the Nunavut region has generally been met with enthusiasm as recorded by social anthropologists and as is reflected by consumer demand in the region (Aporta & Higgs, 2005; Tester, 2011; Wenzel, 1983). However, the adoption of new commercial technology is not unanimous across the region. Inuit do not possess a monolithic approach to the adoption of technology in Nunavut, Northwest Territories, Yukon, Alaska or Greenland. As a diverse group of culturally similar peoples attending to a varied landscape of devices, uses, availability and solutions it is dependent on the situation. From a research perspective, Inuit relationships to technology have been couched in settler perceptions of traditional lifeways and the romanticization of a ‘simpler way of life’ which subject Inuit to an uncompromising role of traditional heritage practices based on settler notions of

Indigeneity and not on Inuit desire and ability. (Coombe, 1997; 2019). There are, as in every culture and community, proponents and opponents to new technological developments. Aporta and Higgs argue in *Satellite Culture: Global Positioning Systems, Inuit Wayfinding, and the Need for a New Account of Technology* (2005) that a new model of technology needs to be adopted to account for the varied ways that new technology is adopted. The work attempts to break the research trajectory away from the relegation of technological pursuits to either destructive to culture or through a device-savior narrative. Early accounts of snowmobile adoption, for example, range from the abandonment of traditional sled dog practices and modes of transportation to the speed and advantages of snowmobile use and acceptance. Aporta and Higgs' social anthropology examines the varied rates of adoption of certain technologies in certain regions over others. Just as this research shows there is not one Inuit way of adoption of technology, the technologies outlined in this paper are deployed at various levels throughout the region. In TINMCA, new modes of technology have been adopted as part of government research and development programs, commercialization experiments, transport and defense mechanisms, petroleum exploration practices. The landscape of technological adoption in the Lancaster Sound region was not that of a latent consumer base but rather a site of focused research and development by multiple extensions of government and private industry (Dirschl, 1980). Much like the pursuits of Arctic military development in the 1950s, the reason for regional interest was the exploitation of natural resources like petroleum, mineral exploration, marine species resources, transportation and tourism. The greater context of conservation and ecological integrity seems to be a kitchen table, at which all parties are willing to sit.

INUIT QAUJIMAJATAUQANGIT AND EARLY ADOPTION

Inuit direct relationship to technology as seen through the introduction of settler technology has been a legacy of early and swift adoption; as evidenced by the early and eager adoption of the snowmobile. (Aporta & Higgs, 2005). Stemming from this time, 50 years or more have passed since this introduction and while relevant, the further cultural progression of relationships to Indigenous peoples has changed considerably, this included the attitudes of early anthropologists and Inuit studies scholars. It is not to discount historical contributions, such an option would be foolhardy, it is an attempt to reconvene a new Inuit horizon with Input from Inuit-led examples of this relationship. IQ and profound relationships to the land have resulted in a technology that is the most sophisticated of all devices. It requires no electricity, rare earth metals, produces no pollution, is powered by trust and strong relationships, is always updated through a collective database and doesn't cost a dime. It does, however, require a dedicated investment in the landscape and the keen observation of natural processes. When viewing IQ as an Inuit technology through the lens of the Western innovation paradigm it is clear that Inuit technology can be understood in the ecology of fast-moving innovation and disruption and the evolution of Inuit-led governance in Nunavut. (Diercks, G., Larsen, H., & Steward, F., 2019). It is clear that the adoption of a deterministic approach to technology produces the erosion of traditional lifeways. While on the other hand a solely techno-optimistic approach to human adaptation is disconnected from ecological and relational limits and can, at its worst, attempt to flatten a formative history and continued legacy of, in the case of Nunavut, colonialism. The present reality of colonialism in the North cannot be relegated to the past.

At the TINMCA the Nauttiqsuqtiit Inuit stewardship pilot program through the QIA has trained six individuals – Niore Iqalukjuak, Mishak Allurut, Joshua Kiguktak, Jonah Muckpa, Mike Akumalik and Roland Taqtu – in various environmental technology on the land.[8] QIA focused on including technologies in the program that would complement and enhance existing IQ and experience of the stewards in this preliminary program. The stewards are equipped with GPS tracking and caching devices. Through community monitoring programs and with the support of Nunavut College the stewards are trained with wildlife tracking technology devices like tagging and genertic mark recapture procedures. Technological adoption within the TINMCA stewardship program at the QIA has been swift, and new technologies are being adopted as they become available.

As a preliminary agreement before the funding and inclusion of IQ into the Inuit Impact and Benefit Agreement, an MOU was in place. "The MOU specified that the study would consider social, environmental and economic benefits of establishing an NMCA and included a general description of a study area for the NMCA proposal… It provided for funding to enable the full participation of QIA and to undertake a traditional knowledge

[8] qia.ca environmental stewardship programs; Annual Report 2018-19 of Arctic Bay N Nauttiqsuqtiit.

study which would inform boundary decisions." (National, p. 17). The MOU was created to negotiate the creation of the feasibility study and determined the scope of how QIA would use IQ in the new park boundary formation. Fig. 1 and Fig. 2 show the relative importance the QIA and Parks Canada place on the blending of community defined maps through IQ and scientific research. IQ contributes directly to the NLCA and is legislated into government of Nunavut documents. IQ continues to play an enhanced role in the deployment of new technologies brought in to augment species and ecological research going forward.

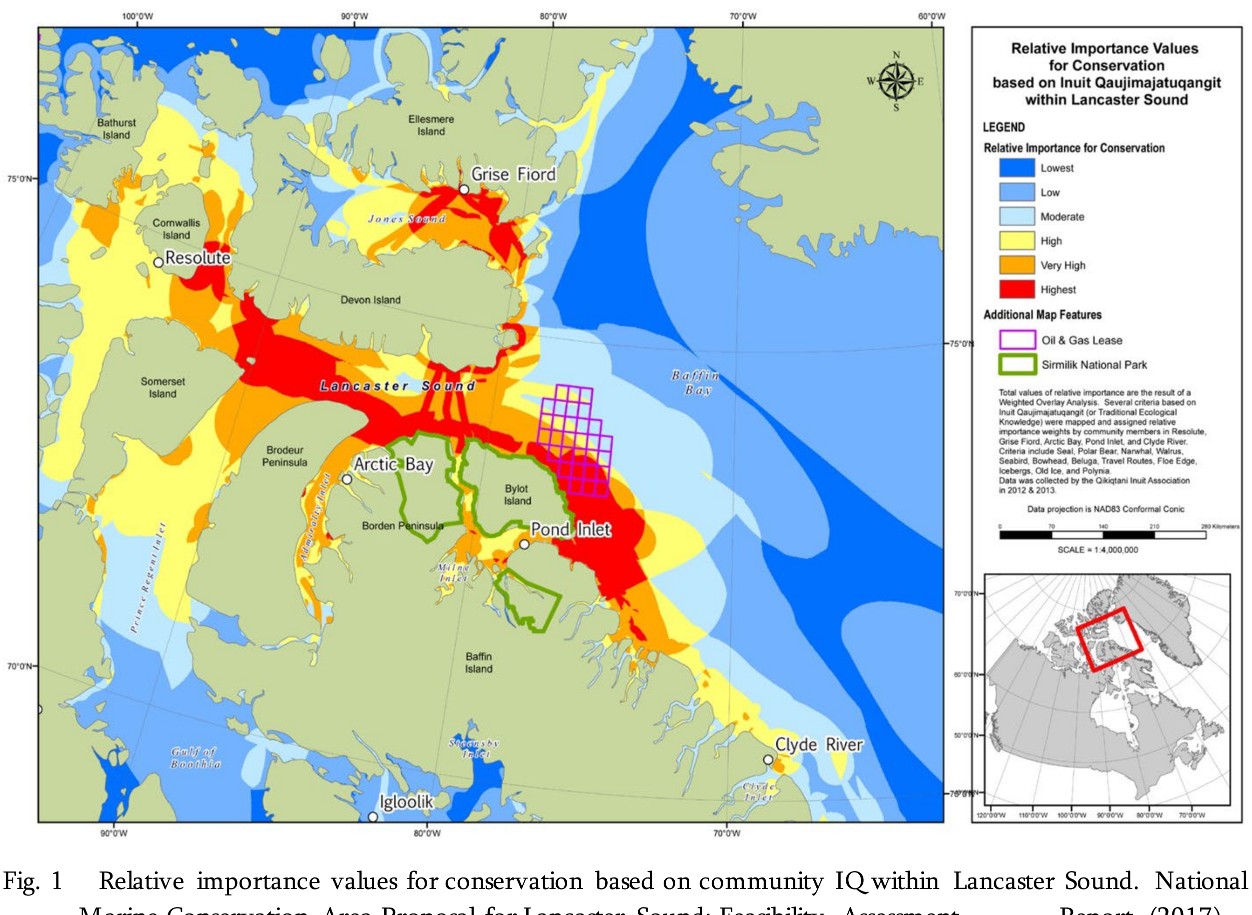

Fig. 1 Relative importance values for conservation based on community IQ within Lancaster Sound. National Marine Conservation Area Proposal for Lancaster Sound: Feasibility Assessment Report. (2017). p. 17.

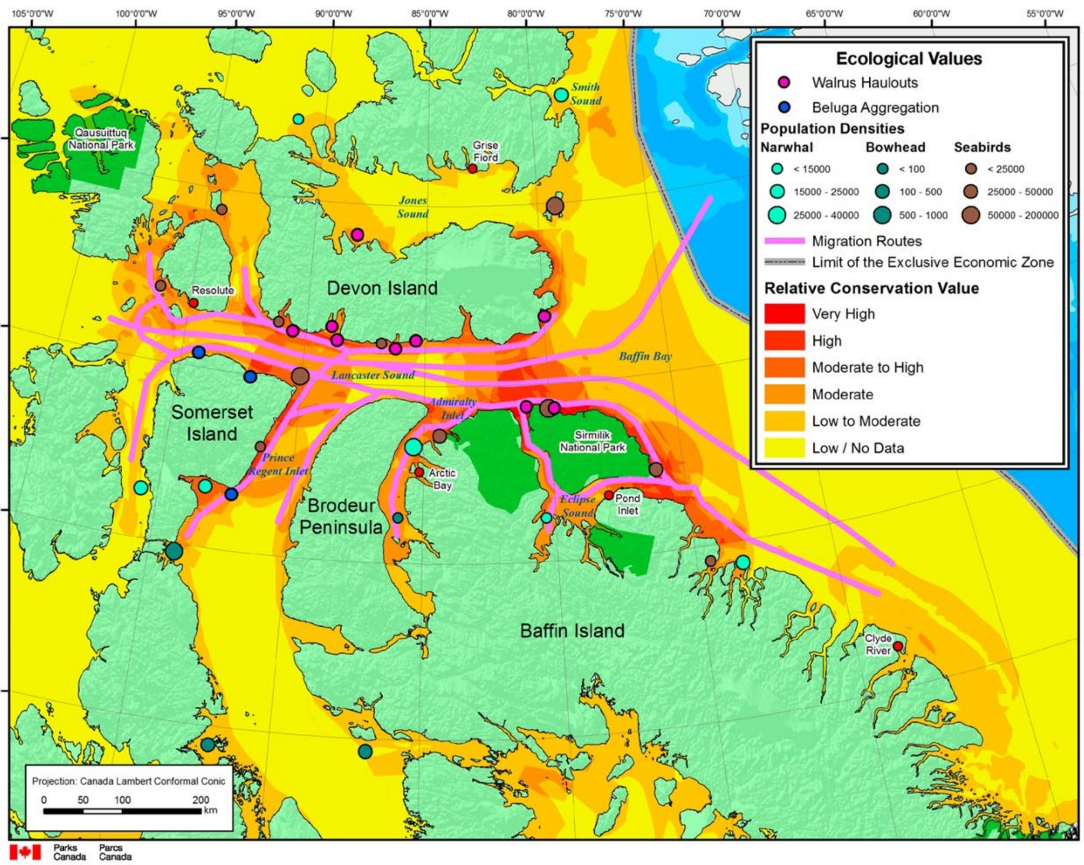

Fig. 2 “Ecological values within the Lancaster Sound region, based on contemporary science. The map shows the major marine mammal migration routes in the region, known walrus haulouts, areas where beluga regularly aggregate, as well as concentrations densities for seabirds and narwhal and bowhead whales.” National Marine Conservation Area Proposal for Lancaster Sound: Feasibility Assessment Report. (2017). p. 24.

LANCASTER SOUND

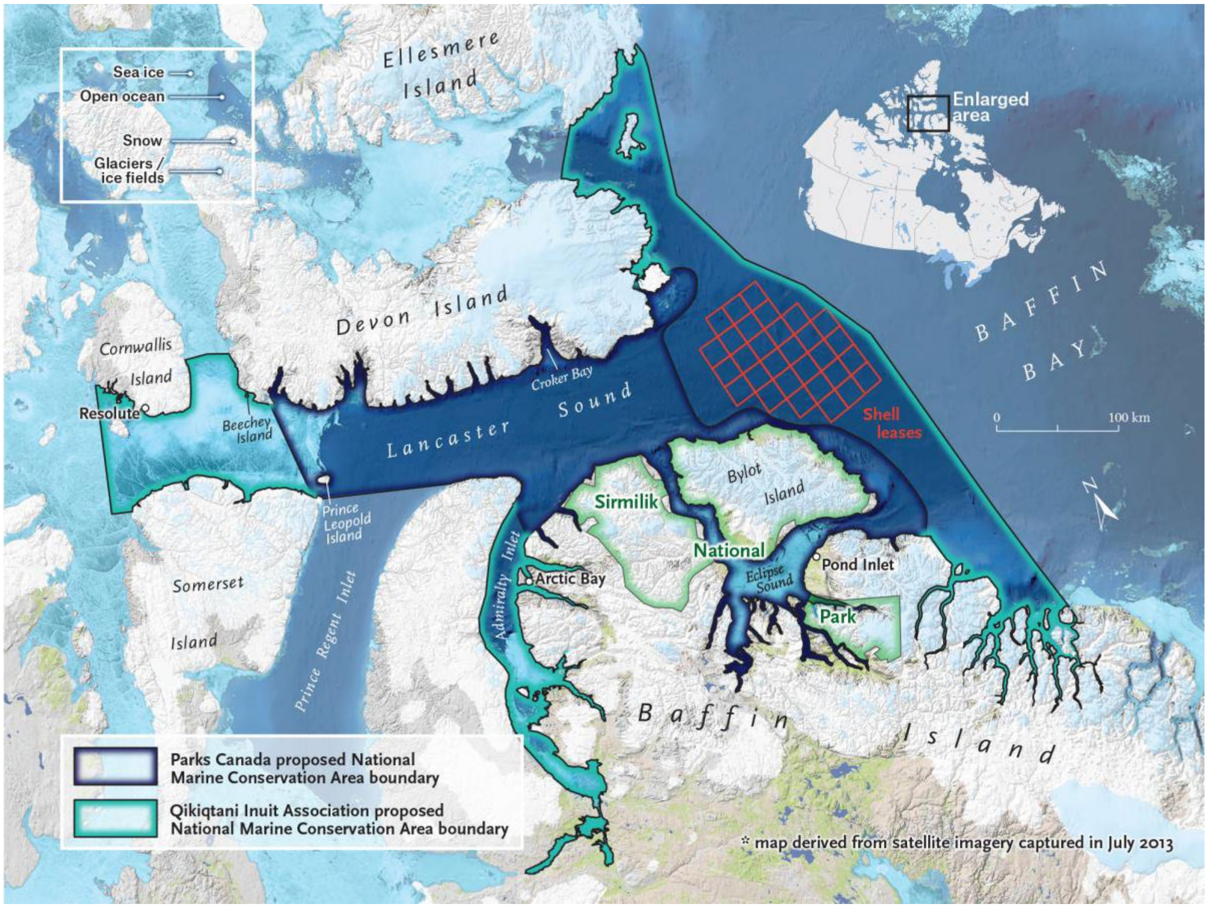

Fig. 3 Two visions of the proposed Lancaster Sound National Marine Conservation Area by Chris Brackley.; Map. June 2, 2017. 2017. Canadian Geographic. < https://www.canadiangeographic.ca/article/mapping-lancaster-sound-national-marine-conservation-area>

Lancaster Sound is the physical site where this paper focuses its investigation. Because of overlapping scientific, government and Inuit agendas, the site continues to be a location of importance. Inuit hunting and trapping, marine and terrestrial wildlife migration pathways, global shipping routes, petroleum and mineral exploration, significant military installments and major settlements, as well as conservation and scientific research all contribute to the complexity and richness of the region.[9] This section will establish the recent environmental history of Lancaster

[9] The National Marine Conservation Area Proposal for Lancaster Sound: Feasibility Assessment Report outlines the major contributing project overlaps in the area, and why it is so productive.

Sound in order to illustrate how successful conservation development relies on Inuit advocacy and the adoption of technology. Key technology areas that foreground the conservation solutions found in Inuit legislations like the Nunavut Agreement and Inuit Impact and Benefit Agreements are established as military contact and surveillance, natural resource development and the scientific monitoring of species.

The Tallurutiup Tiranga region (see Fig. 1) is possibly the richest, most productive area in Arctic Canada and incorporates the newly formed Tallurutiup Imanga National Marine Conservation Area (TINMCA). (Dawson, 2013). The region has long been described by Inuit as a primary cultural resource and ecologically significant region for biodiversity. (Parks Canada, 2019). For thousands of years, Inuit communities have been in direct relationship with the lands and waters which have provided abundant natural wealth. Today, residents of the three Nunavut communities of Pond Inlet, Arctic Bay, and Resolute continue this tradition, depending on its waters for their health and economic well-being. The establishment of TINMCA, a 110,000 km^2 National Marine Conservation Area (NMCA) marked the largest marine conservation boundary in Canada by area. Established in 2017, TINMCA has been in Inuit development for over 60 years. In 2010 the federal government proposed a boundary that was about half the size of the current park. After a 7 year feasibility study of the region and a change to Liberal government, the parks boundary was doubled to 110,000 km2.[10] David Murray of Parks Canada's protected areas establishment branch states that this change was "largely coming out of QIA, IQ and added conservation value information… the feasibility study had provided [QIA] with funding for doing [Inuit Qaujimajatuqangit] studies and so they were doing that and keeping the data and informing us about certain aspects of it, but we don't have any of that data, that's all QIA Inuit owned, it is their own intellectual property."[11] The direct benefit of various technology for Inuit

[10] Though it should be mentioned, Harper was a strong proponent of protection in this area and began the conservation process in 2010.
[11] Interview transcript with David Murray, Protected Areas Establishment Branch, Parks Canada (2020).

living in the communities is usually economic and in the form of GC funding to protect the area and establish feasibility and baseline studies pertaining to the park proposal. This often leads to continued multi-year financial support which is outlined in an Inuit Impact and Benefit Agreement (IIBA). The initial (2009-2017) IIBA included negotiations for an area that was half the size of what is currently protected. As governments change with different agendas, some are more supportive of increased area protections. Part of the GC agreement in the IIBA was to include $26M funding of a guardianship program.[12] GC funding for initial studies, included in the IIBA requirements, made it possible for Inuit organizations to conduct studies and gather data using appropriate technology and to have this data owned by Inuit.

> We are entering into a new partnership with Canada to manage Tallurutiup Imanga National Marine Conservation Area to ensure that Tallurutiup Imanga National Marine Conservation Area, a globally significant ecosystem, is protected for Inuit and all Canadians. We equally retain our rights and interests to self-determination, in which we freely determine our own economic, social and cultural development. Our partnership with Canada must encourage and foster Inuit self-determination with respect to Tallurutiup Imanga.

(Parks Canada, 2019). Establishing the IIBA agreement was a key component to developing reciprocal benefits in this case.

Lancaster Sound was originally named for Sir James Lancaster by English navigator and explorer William Baffin in 1616. Lancaster was one of three main financial supporters of Baffin's exploratory expeditions which included Thomas Smythe and William Cockayne. Starting in 1946, the area was thoroughly mapped during an extensive aerial surveillance program of Northern Canada by the Canadian Government. (Dirschl,1980). Coincidentally, the aircraft

[12] Interview transcript with David Murray, Protected Areas Establishment Branch, Parks Canada (2020).

that was used to complete the mapping program was the Avro Lancaster, a World War II heavy bomber converted for mapping. Military aircraft named the Lancaster MkX performed the majority of aerial reconnaissance mapping of the region between 1946 and 1962. (Chant, 2003). Discovery of hydrocarbon resource potential in the region placed increased responsibility and attention on the natural resources in the area in the 1970s and 80s. Shell was granted over thirty lease titles to regions of the seafloor in Lancaster sound for offshore drilling in this period (see *Shell Leases* fig. 1). They later relinquished the rights to the leases after public advocacy to end oil and gas drilling in the area in 2012. Conservation began in the TINMCA region with the establishment of Sirmillik National Park and the Bylot Island migratory bird sanctuary. After formal studies were conducted of snow geese populations on the Island in the 1950s, the whole of Bylot was declared a sanctuary in 1965. (Reed et al, 1992. p. 15).

Multiple studies are actively participated in and contributed to in the region which conveys the importance of the area as a research site. For example, the Université Laval QC Centre for Northern Studies Bylot island project site is currently one of the largest ecological studies in Nunavut and is part of an international research network which includes; ArcticNet (Network of Centers of Excellence of Canada), ArcticWEB (Multidisciplinary Arctic Research Network), Arctic Wildlife Observatories Linking Vulnerable Ecosystems (ArcticWOLVES), the Circumpolar Biodiversity Monitoring Program (CBMP), International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT) and the Canadian Network of Northern Research Operators (CNNRO).[13] Sirmillik National Park was established in 1999 and encompasses the Bylot Island site and surrounding 22,200 sq. km of the Arctic Cordillera mountain range. Lancaster Sound has 6 glacial formations which border its shores including the Devon Ice Cap and Manson Glacier.[14] When the area was mapped extensively in an early mapping effort by the Government of Canada, bounds descriptions were created for each region

[13] Université Laval Centre for Northern Studies Website.

[14] Sirmillik means 'place of glaciers' in Inuktitut.

and park boundary using Lancaster Avro military technology. Notably, Inuit Owned Lands (IOL) were to be detailed by each owner group and private surveying companies were contracted to complete these tasks. The National Park site covers Oliver Sound and the Borden Peninsula and includes IOL which were part of the original Nunavut Agreement in 1993. The original agreement gives Inuit title to 350,000 km2 of over 2M km2 of ancestral land throughout Nunavut territory.

Technology's role in locating and helping to establish operational mines began in the early 1970s. Lidar – light detection and ranging – surveying and satellite remote sensing helped prospectors produce mineral deposit locations from remote vantage points and without breaking any ground. Employment from mining operations have traditionally been a major source of income for Inuit in Nunavut. There are two active mines in the vicinity of the TINMCA, Nanisivik in Arctic Bay and the Mary River mine near Pond Inlet. Nanisivik was in operation 1976 to 2002 when it permanently closed and Mary River mine from 2015 and is currently still in operation with expansion to a second site at Milne Port in 2018.

The 1980 Lancaster Sound Green Paper Regional Study from the office of Indian Northern Affairs Canada was produced as a result of public consultation from a 1978 Norlands petroleum application which was met with Inuit protest. The report represents a joint effort between the Government of the Northwest Territories (GNT) and the federal departments of Energy, Mines and Resources, External Affairs, Environment, Fisheries and Oceans, National Defense and Transport. National Defense involvement is significant as it expresses GC awareness of this region as strategic from a geopolitical perspective. Technology provides the backbone of the creation of multiple databases from which to plan for the future use of the region. Past developments in military tech, climate and meteorology and surveying, have all contributed to defining conservation areas and spaces.

The TINMCA region was recognized as "worthy of world heritage site" status by the International Union for the Conservation of Nature (IUCN) in 1980. Inuit groups around this time had increased visibility to international advocacy agencies. This meant that Inuit organizations like Inuit Tapirit Kanatami (ITK) and the Qikiqtani Inuit Association (QIA) had the ability to reach wider audiences. During this time, the Arctic Environmental Protection Strategy (AEPS, 1989) was developed as the Circumpolar Council was convened to address the growing research on Arctic environmental issues. Early environmental protection agreements were reached with council consensus around science and Indigenous member input from the various member state communities. The Inuit circumpolar Conference was formed in 1977 and convenes strategic meetings on Arctic environmental issues with an active voting membership from Inuit organizations in Canada. Circumpolar agreements were international collaborations between Arctic nations that began with a wildlife conservation focus. The Joint International Agreement on the Conservation of Polar Bears signed between Canada, Denmark (Greenland), Norway (Svalbard), the United States, and the Soviet Union in 1973 is an example of this process and one of the first international conservation treaties signed by Canada. (Environment, 2020). The agreement was reached to survey and monitor global polar bear populations, create population inventories and enact joint protection policy and legislation, as well to coordinate scientific efforts on the 19 global subpopulations of the species. The original agreement holds signatory member states accountable for taking action to protect the polar bear habitats and ecosystems. This original agreement represented a landmark in international collaboration and is still the benchmark for co-productive agreements among governments today. However, hunting polar bear in the region has been a contentious issue for settler environmental groups in the past.[15] The

[15] See Greenpeace apology for anti seal hunting campaign: https://www.greenpeace.org/canada/en/story/5473/greenpeace-apology-to-inuit-for-impacts-of-seal-campaign/

Nunavut Wildlife Management Board administers (in conjunction with DFO and NRCan) the total allowable hunt (TAH) program. This places specific quotas on total number of prey animals allowed to be harvested each quarter for each of Nunavut's three regions Qikiqtaaluk, Kivalliq and Kitikmeot. This program is monitored with a tagging system based on SARA and ESA designations respectively. There are ongoing conflicts around the TAH and Inuit subsistence needs as well as IQ in each region. In the case of polar bear TAH represents a disconnect between Nunavut subpopulation inventory and the lived experiences of Inuit community members. The Nunavut Planning Commission (NPC), Nunavut Impact Review Board (NIRB) and Nunavut Wildlife Management Board (NWBM) list several written complaints and concerns from individuals who identify higher PB numbers than previously thought and increased contact and conflict with human residents as a result. As PB have become a global emblem for climate change issues it is increasingly difficult for Inuit to successfully advocate for increased hunting quotas. In response to the proposed polar bear management plan 2016, regarding the decline of polar bear populations the Mittimatalik Hunters & Trappers Organization write "…the best available scientific knowledge used for Baffin Bay area population inventory is from 1997. This is too outdated…There is a concern for [the] safety of people, with increased polar bear and Inuit interactions. We need to find out why interactions have increased" (NWMB, October 28 2015).[16] This example shows how innovation which responds to dynamic community observations can produce relevant technology to produce up to date data and accurate timely results. Inuit groups recognize the need for

[16] nwmb.com/ Pond Inlet Hunters and Trappers Organization submission to the NU PB Management Plan written hearing 2015 Eng and Inuktitut.

better suited data to help arrive at responsive policy decisions which can provide a role for technology to fill.

The Arctic region is a key geopolitical trade zone for Canada and the U.S. The Qikiqtaaluk Region, previously known as the Baffin Region, forms the eastern entrance to the Parry Channel and the Northwest Passage (NWP). In 2019 there were 24 full transits – ships that travelled the entire Northwest Passage – and 27 partial transits.[17] This is out of a total 191 vessels recorded in Arctic waters for that year. This is roughly 25% of all marine vessel traffic in the Arctic is going through the Northwest Passage. Shipping regions have been a significant site of protection advocacy as lessening marine disturbance is central to ecological integrity in the area. Inuit work on shipping regulation has been swift and keenly adopted by ENGOs like WWF Canada who commission and collect research data to help substantiate claims with data. This work requires coordination with technology and creates the advantage of increased innovation capacities, in Inuit and scientific communities, which are increasingly one and the same. The TINMCA was formed during a time of increased geopolitical and environmental concerns for the Arctic due to available global knowledge of climate change and ice melt and its impact on transnational shipping routes. The Nunavut Agreement (NA) put Inuit administration in a strong leveraging position as the stewards of the regional environmental agreement governing the NWP. Lancaster is situated as the easternmost entrance point to the NWP and adjacent to four major communities, a military base, national bird sanctuary, Sirmilik National Park and two functioning mines. The NWP entrance is critical to shipping goods from Baffin Bay through to the Bering Strait, Alaska and the Asian and Russian archipelago. Inuit have used technology for advocacy work to champion protection in Lancaster Sound and continue to collaboratively create and promote more responsive programs and projects which enhance ecological integrity.

[17] Marine Communications and Traffic Services Centre, Iqaluit, 2019.

In 1989 the International Labor Organization Indigenous and Tribal Peoples Convention was adopted by Canada and other nations in Oslo, Norway. This document is the precursor to the UN Declaration of the Rights of Indigenous Peoples (UNDRIP). Member states signed the operative international law which guarantees the rights of protected peoples included in the agreement. (Inaugural, 1996). The next year, 1990, the first Circumpolar Symposium on Remote Sensing of Arctic Environments was held at the North West Territories Centre for Remote Sensing. It was a small gathering which established ongoing topics which remote sensing would tackle in the region: facilities and programs; RS techniques; oceanography, hydrology, snow and ice; wildlife and wildlife habitat; geology; forestry and vegetation; and radar data. This meeting established the groundwork for Arctic conservation tech as RS became the baseline for mapping. (Cracknell, 1991). This technology provides governments with the necessary survey tools to create inventories of natural resource areas. RS surveys are not as granular as in-field survey data but provide necessary big picture geographies that could be packaged into various departmental portfolios. Technology, though helpful and sometimes essential, cannot be relied on as the sole source of data and legitimation. When relied on too heavily, technology produces results that flatten and totalize an issue that requires real-world context and thickening.[18] Satellite remote sensing – using remote sensors which are part of a satellite array in orbit as opposed to attached to aerial vehicle sensing – has only been available to non-defense related industries since the 1970s with the commencement of the USGS Landsat program and RADARSat in Canada. (Lillesand, T., Kiefer, R., & Chipman, J. 2008).

The standards and baselines that newly protected Parks areas, be they national parks or NMCA, are based on the existing assessments developed by a combination of old and new technologies. Scientists and wildlife biologists working in the area use sonar, drones, ROV, and various marine mammal tracking devices to build data sets for inventory, home range, habitat

[18] Gilbert Ryle

interaction, species interaction and various other emerging topics. They provide research findings to PC based on this data to advocate for protection. This traditionally scientific collection of data is essential to establishing baselines and creating protection advocacy but does not solely rely on technology. IQ, consultation and Inuit owned research are the contexts in which technology makes sense and through which, gains legitimacy. Lancaster Sound is a nexus of examples of how to use technology responsively and responsibly. Inuit use a blended style of technology and IQ when data, agencies and organizations deem they are necessary. This new configuration of conservation technology is made possible, in part, by the complex history of defense in the Nunavut region and unpacking this developmental history is key to developing successful ways forward.

DEFENSE

This section will attend to the some of the relevant positive and negative influences of military occupation and development in Nunavut. By illustrating the effects of Northern defense initiatives and expanding on the military development of animal tracking technology it is possible to understand the importance of post-war defense spending on the conservation industry and Inuit worldviews today.

WWII brought US and Canadian military presence into the Nunavut region. As a result of racist settler preconceptions of Indigenous lifeways throughout Turtle Island – North America – Inuit were forced to settle in permanent encampments for the first time in their long history as a nomadic people. There were no Inuit-led advocacy groups to secure the rights of people on the land. *Eskimo* were identified to the Government of Canada by a numbered tagging system called the *Eskimo Identification Tag System*, a federal program that ran from the 1940s until the 1970s[19] as the settler majority could not pronounce or record Inuktitut names. Needless to say, it is hard to construe the effects of this time as equitable by today's standards. Inuit did not have autonomy on their ancestral homelands. Following the narrative of military installation and development in the region, the Distant Early Warning Line or DEW line was a radar connected line of defense against mounting Soviet pressure and nuclear threat. It spanned 4,800 km from Alaska to Southern Labrador and served as an Arctic trip line for incoming attacks above the North pole. What is now Nunavut (then NWT) accommodated approximately 30 sites of the total 54 radar stations across the continent. Construction began in 1954 and thousands of workers were recruited and transported from southern Canada and the US. The DEW line project is credited with much early contact between Canadian civilians and Inuit who brought North the need for physical settlements, infrastructure and government services.[20] Much of the

[19] Canada's Relationship with Inuit, 2016.
[20] Bonesteel, 2006. CIRNAC commissioned history of Northern policy and program development.

infrastructure and technological learning that this initial joint US military initiative developed was used in conservation later on. The initial land surveys and bounds descriptions are used today while radar station sites are still being used? currently and have brought much attention to the environmental effects of war and war time construction.

Innovative military technology has been adapted to serve the needs of conservation science in direct way including tracking species movements and biotelemetry data – detailed information of the biological functioning of the individual animal through sensors in collars and implants. Tracking encompasses active and passive devices that are a) physically attached to individual animals b) positioned in the environment to observe (for example camera traps). Etienne Benson's *Wired Wilderness* (2017) provides backgrounding on conservation technology and in-depth accounts of its military provenance. Benson is an accomplished history of science and technology scholar with particular insight into the American development of conservation technology practices over the last 50 years. Innovative military technology has been adapted to serve conservation since the early 1960s in the U.S.

Historically, the primary focus of tracking technology was to produce movement and biotelemetry data on terrestrial and avian species. Two of the first academic institutions to employ military technologies in service to these goals were the University of Wisconsin MN, and at Cornell in New York state. The U.S. Fish and Wildlife Service commissioned the Minneapolis-Honeywell Regulator Company, involved in defense contracts throughout WWII, to apply electronic know-how to wildlife management.[21] Beginning around 1955 and coming from natural resource sectors in the U.S., managers began establishing relationships with military contractors with electronics know-how to create devices engineered for environmental surveillance systems.[22] Rough Grouse and other game animals were the primary focus.

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The cost of these developments was high, and mainly an investment in pure research as the innovations would not be commercialized for a wider market. Much of the academic literature at the time serves to justify the work in terms of military intelligence. Notably, in 1958 Sydney R. Galler from the Office of Naval Research (ONR) identifies two ways tracking technology could benefit the military; “[f]irst, it could help the navy deal with immediate biological threats, such as shark attacks, biofouling, and bird strikes. Second, knowledge gained about animals could potentially be used to improve navy technologies, including navigation and missile guidance systems” (Benson, 11). While this does help researchers continue to gain funding to continue experimentation, it does not speak to the use value of the technology outside of a military context. Moreover, the people developing these devices and techniques were not military, they were biologists.

The work that was being done to create responsive applied engineering solutions to conservation caught on after a few successful projects by sibling wildlife population managers Frank and John Craighead operating in Yellowstone National Park. The brothers, conducted some of the earliest surveys of grizzly bear populations using collaring technology beginning in 1959 (Benson, 56). There were concerns from the start about how the tags and collars would appear to the public visiting these wild spaces. The managers feared it would detract from an authentically wild experience if tourists encountered a highly and visibly managed population of wildlife. The main industry interacting with the national parks system in the US was tourism or what is now considered ecotourism. The revenues generated from sport and game hunting and seasonal vacationers year-round was part of the lifeblood of park economics.

Concerns from other wildlife managers and conservationists as well as tourism managers over the visibly invasive processes of tagging and collaring led to new developments in technology. Wildlife tracking which includes direct or biotelemetry data from species, has its development history in the US. Particularly from a few dedicated academics and entrepreneurs that worked directly with military technologies and contracted companies to develop specific tech to attach to wildlife. This was happening in a postwar space in the US, the technological systems were in place after R&D defense spending increased the engineering prowess of federal agencies. Entrepreneurial thinkers in the conservation space saw the potential and imagined new modes of conservation.

Acquiring biotelemetry data from top marine and terrestrial mammals in the Arctic is a fraught practice and advocacy work can tacitly reinforce potentially dangerous relationships between settler immigrant and Indigenous populations like those between Greenpeace and Inuit. Environmental NGOs work to advocate for wildlife conservation on the basis of the Species at Risk Act (SARA) in Canada or the Endangered Species Act (ESA) in the United States. “The Notice of Proposed Listing [ESA], and the Status Assessment on which it relies, has very little information on the true and accurate population levels of most of the polar bear populations.” (Cruikshank, 2009). As these determinations rely on population inventories they tend to be outdated because of the cost and scale of operations. In order to be effective, inventories have to be produced by continuous monitoring efforts which are costly to achieve in scale and costlier to implement on the ground.

This section has explored the defense related evolution of tracking devices, infrastructure and some instances of Inuit conflict. Defense spending and postwar migration and development brought the larger world into Nunavut permanently. In the last section of this paper, Climate Change + Shipping, more specific applications of current tracking and monitoring in the region will be outlined. Landscapes mapped for military purposes easily translate into natural resource data while military technology developments, not without their own issues, made way for new innovation. Defense presence in the area fundamentally altered Inuit lifeways in the Nunavut region and changed the course of Inuit advocacy for the right to the resources in their ancestral homeland.

MAPPING

Feasibility for natural resource production in the energy sector over the last forty years has brought significant attention to the region. Nunavut has many natural resources readable to extractive industries; gold, lead, zinc, copper, nickel, diamond and petroleum. It also has an abundance of terrestrial and marine species and unique ecosystems readable to predominantly settler research institutions that are being studied and monitored by global scientific researchers. The technological tools that support and maintain these industries are also being used by Inuit institutions to advance environmental protection and advocate for Inuit ways of life. In order to understand the nature of these natural resources we can explore how technologies like remote sensing and processes like mapping interact with Inuit policy and legislations to create reciprocal benefits for the communities in which they exist.

Remote sensing employs innovative satellite technologies in geostationary and low earth orbits which observe and measure, rendering the use value of landscapes. Satellites use carry 'payloads' that use an array of spectrum analysis instruments to scan and survey the landscape. The Lancaster sound region was mapped via retrofitted military reconnaissance aircraft for the Surveyor General of Canada post WWII as mentioned in the previous section. The development of these technologies spurned the use value of this kind of remote observation which translates into mapping. The payloads that aerial vehicles and satellites employ are combinations of the right kinds of sensors for their intended use. For example, if the purpose of the survey is for mineral exploration, the sensor payload onboard would be capable of detecting the right spectrum of light or the right texture variation to determine mineral availability.

The technologies employed on satellites in both geostationary and low earth orbit have produced detailed maps of geophysical Canada from coast to coast, regardless of the inhabitants, and often without their knowledge. Earth Observation (EO) satellites are employed by the Canadian Space Agency and used by Natural Resources Canada, the USGS and many other global EO organizations. Currently, satellites carry complex payloads of high-resolution cameras and light spectrum sensors equipped for specific mineral exploration purposes, light detection and ranging. The most common type of sensing for mapping is photogrammetry. Here, large swaths of land are systematically photographed and a mosaic of the target area is created and saved in a database, the images are then put through an interpretation process. The interpretation is done by human eye and algorithm or AI and produce a mapping document which serves to render the observed landscape.

The rendered landscape is translated by ministers, policy makers, technicians and executives to encourage on-the-ground decisions that have real world ramifications. Remote sensing, is in this instance, is an integral technological configuration. Landscapes are not visible to planners and to government agencies unless they are mapped and formatted to fit the needs and uses of the population they serve. There is a lot of room for interpretation in the handling of remotely sensed data. The interpretation phase is usually conducted by trained individuals which identify the unclassified assets like type of vegetation, terrain style, geomorphology, and topographic features. Though this stage is is increasingly done by artificial intelligence, it is this interpretation that leads to the troubling of objectivity. Luis F. Alvarez Leon and Colin J. Gleason write in *Production, Property, and the Construction of Remotely Sensed Data* "[i]t is our goal in this article to draw attention to the multiple mediations that intervene in the production process of remotely sensed data. In doing so we question the common view of remotely sensed imagery as the end results of a fundamentally objective process, which follows a Cartesian dualist view of science and data in general." (1076). Scholars of science and technology have been troubling the notion of objectivity in applied science for decades. Writers like Michel Callon (Actor Network Theory), Bruno Latour (Interobjectivity), David Bloor (Sociological Theory of Objectivity), Sheila Jasanoff (Sociotechnical Imaginary), Susan Leigh Star and James R. Griesemer (Institutional Ecology), Karl Popper (The Logic of Scientific Discovery) have worked to overturn objectivity by questioning the fundamentally social nature of our constructions of truth. Yet, the pursuit of neutral data controls the development of technologies that are used to advance conservation in Indigenous regions of Canada and globally. This is to say, that the pursuit of troubling the notions of objective data helps widen the definition of how it is understood, and in the process, makes more room for Inuit worldviews and input from IQ.

In Nunavut, the parceling of Inuit Owned Lands (IOL) was initially conducted based on 50-year-old data from the Surveyor General's office. Inuit received 300,000 km^2 (1100 terrestrial parcels) in the original Nunavut Land Claims Agreement (NLCA, 993) which represents about 15% of the over 2M km^2 of the entire region. The age of the data is not as relevant here as the time in which it was collected. At the time of the signing of the NLCA, Inuit were required to obtain detailed field surveys of IOL at their own expense if they were to register businesses and gain economic benefit from the land through bounds descriptions.[23] Bounds descriptions are verifiable, legal descriptions of geographic coordinate boundaries.

The Inuit Land Use and Occupancy Project (1976) "shifted the prospective of mapping, particularly in the Arctic; provided means for the Inuit communities to portray their own knowledge using tools that were familiar and readily understood; and resulted in deliverables that were culturally relevant and politically useful." (Krupnik, 356). This study helped to change the way that Inuit resources were recorded and were a continuation of Inuit political activism advocating for self-governing devolution processes. Biographical maps were produced by interviewing community elders, recording oral history and exploring the land through traditional practices. At the time, it represented a paradigm shift in settler centric narratives that has had ripple effects through Indigenous research and approaches to natural resource development. Notably, the inclusion of Inuit perspectives in *The Lancaster Sound Region 1980-2000 Draft Green Paper* (Dirschl, 1980) is credited with the rising political economy of Inuit advocacy in the region at that time. The Green Paper completed a study of the economic potential for regional

[23] Interview with William Crews, Regional Manager, Nunavut at Natural Resources Canada.

petroleum production. It was developed using traditional survey methods by the office of the Surveyor General in combination with IQ and consultation. Aerial photography and sensing were used to produce detailed maps of crown land at high resolution and detail. Parts of shoreline and floe edge were detailed in-field with on-the-ground surveying which partnered with regional hunting and trapping organizations (HTO). The result is a packaged geography, informed by IQ and technology with implications for future geographic innovation and inclusion.

Mapping natural resources can create opportunities for the inclusion of worldviews that do not at first exist within the parameters of established systems. Remote sensing is a powerful and ubiquitous tool that can welcome alternate perspectives on the mapping and sensing geographic data. The developments of the last four decades have put Inuit in a unique global position as preeminent environmental stewards with a proven track record of political advocacy for their own natural resource development. By taking control of some of the narratives surrounding mapping, the use of technology and politics, Inuit have situated themselves as expert witness to address Arctic climate change.

CLIMATE CHANGE

Researchers and scientists are in search of ways to generate accurate data to better understand the effects of climate change. This has led to the increased use of technology in the Arctic where climate change is acutely pronounced. This context has created opportunities for Inuit to conduct their own research and to design methodologies for addressing climate challenges by adopting technology and blending IQ with science based solutions. Inuit have been effective in ensuring research that takes place in Nunavut, will benefit Inuit directly. POLAR knowledge Canada lists six different types of active monitoring in Nunavut; atmospheric, cryospheric, freshwater, marine, terrestrial and human health. These modes of data collection all have discrete technologies that have been developed to collect monitoring data. Active and passive sensors, human observation, remote surveillance and community consultation are among the technologies used to monitor. This section will focus on the benefit that monitoring technologies have had on Inuit communities as a result of climate change research.

Article 13 of the Tallurutiup Imanga Inuit Impact and Benefit Agreement governs research and monitoring within the TINMCA. The objectives emphasize Inuit ownership, benefits an integrated involvement in decision making and research. Section 13.1.6 states "to ensure that research and monitoring activities in Tallurutiup Imanga NMCA provide social, cultural, economic and environmental benefits for Inuit in the Qikiqtani region."[24] This mandate asks researchers and technicians, not from the landscapes they wish to monitor, to first consider the lived realities of Inuit. Technology, in this case, exists in a space where it is employed as a neutral, data collection tool which acquires information as it exists in the world,

[24] Tallurutiup Imanga National Marine Conservation Area Inuit Impact and Benefit Agreement, 52.

without interpretation bias. This is not wholly inaccurate, however the complex nature of how and why the data is obtained and which worldviews and livelihoods it will benefit in the present and future is what is in question. Because technological instruments and virtual applications like software and databases are at the foundation of this economy of monitoring, in order to have Inuit benefit from the ongoing development of monitoring innovations, a specific capacity has to be built in to educational and programming initiatives in the region. This conversation is much broader than the TINMCA itself, but the specific effects of these programs can be seen in their application.

The Aulattiqatigiit Board, established by the QIA will act as the operations committee which oversees decisions within TINMCA. It is tasked with the development of a Research and Monitoring Strategy through collaborative and equitable processes. This IIBA refocuses the resources being put in to the development of a new NMCA and ensures at least two levels of Inuit management before any implementation or approval. There are currently 222 active scientific monitoring projects and proposals in the Lancaster Sound region.[25] In these cases, if monitoring instrumentation are to be set up within TINMCA boundaries, the researcher or organization has to provide proof of benefit to the adjacent communities.

The QIA established Nauttiqsuqtiit pilot program consists of 6 Inuit from Arctic Bay, where the program is focused, as the largest and most active community within TINMCA boundaries. Monitoring is an essential task and one that is particularly well suited for stewardship programs in the region. Inuit Qaujimajatuqangit or IQ is a body of knowledge focused on the innerworkings of nature, humans and animals. It has both practical and theoretical aspects that stem from a belief that human beings have an infinite potential for problem-solving within the principles of nature and technology which are based in a history of living together with the landscape.

[25] Nunavut Planning Commission website (https://www.nunavut.ca/), public registry search of active and proposed scientific research “monitoring” proposals.

> As part of these efforts Inuit are working to build economies rooted in environmental stewardship and sustainable industries. Programs like the Tallurutiup Imanga Nauttiqsuqtiit pilot program in Arctic Bay allow Inuit to have meaningful jobs in conservation that also stimulate the local economy, rebuild traditional skills such as harvesting, and honor our legacy of protecting and preserving our ancestral homeland.[26]

SmartICE, is "the world's first climate change adaptation tool to integrate traditional knowledge of sea ice with advanced data acquisition and remote monitoring technology."[27] The program uses monitoring techniques that blend in-field or *on-the-land* observation with sensor technology that work in a symbiotic relationship to benefit community members and contribute to ongoing research. The Nauttiqsuqtiit pilot program is in collaboration with SmartICE. As part of their work, the team is collaborating to gather data on sea ice conditions throughout the region. The SmartICE system relies on a mix of sensors to transmit ice data and IQ to enable safe travel over ice. Information from the sensors is paired with satellite data and local ice knowledge to create ice travel hazard maps.[28] Because much research is being conducted on the benefits and requirements of co-development schemes and prior consultation, new regional initiatives are often Inuit owned or take into consideration Inuit livelihoods in the research design. There are many interdisciplinary avenues that are being pursued to use this information and data as it comes online from the pilot program. It is still in its infancy and will require more time in order to fully realize and understand the impacts. It is an important enterprise to help Indigenous organizations to build capacity for implementing and developing new technologies and innovations.

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26 Ibid.

27 https://smartice.org/

28 QIA.ca environmental stewardship programs; Annual Report 2018-19 of Arctic Bay N Nauttiqsuqtiit.

Technology is a fundamental part of this research relationship between settler and Indigenous institutions and contributes to shared goals of conservation. There are a multitude of emerging technologies which can contribute to furthering constructive relationships. From an initial scan of the conservation landscape from *A Horizon Scan of Emerging Global Biological Conservation Issues for* 2020 (Sutherland et.al, 2020) which attempts to identify contemporary issues being addressed by conservationists globally monitoring devices, animal tracking connectivity and technological innovation are at the top of the list. For example, the Max Planck Institute in Germany has completed the initial round of a project called Icarus.[29] This project installs micro-monitoring devices on avian species and uploads their movement to a global database called move-bank. Tagged animals can be tracked in real-time, and researchers are provided paid access options to interact with this system. Move-bank™ bridges the innovation space between the Internet of Things (IoT), wildlife biology and conservation advocacy and much scholarship has been written about the potential benefits and risks of these technologies. (Geist, V. 1995; Hovardas, T. 2018; Joppa, L. 2015; Kosek, J. 2010; Lehman, J. 2018; Maffey, G. et al. 2015;). At this current time, the potential benefits and practical realized benefits of tracking and monitoring wildlife using IoT and connected technologies outweigh the existing detractions.

Technology capacity building can bring in substantial economic benefits to the host community. Potential sources of economic development come from the administration and monitoring of the data that is generated by these technologies. This data can be proprietary to Inuit community members which will keep the ownership in the regions which it will serve directly. If the pilot program in combination with development work begins to realize economic benefits for the communities this beneficial relationship to technology will advocate for further

[29] https://www.icarus.mpg.de/en

innovation and situated solutions to be funded, both federally and privately. There are a number of new initiatives to which the Ministry of Natural Resources, the Department of Science, Technology and Innovation, ECC, Parks Canada, Northern Development and Research are all contributing. There is also a substantial scholarship on programs and projects that have been initiated from within Indigenous communities and are being facilitated by scientists and researchers, as well as being funded from academic institutions and federal granting agencies. (Diver, S. 2017; Canada 2017; LaDuke, W. 1994; Leydet, D. 2019; McMahon, R. 2017; Moola, F. et al. 2019).

The previous three sections have demonstrated how Inuit are best positioned to become preeminent Arctic environmental stewards through their early adoption of advances in conservation technologies and dedicated commitment to devolution through self-determination advocacy. It is possible to gain a wider perspective on Inuit innovation in conservation through historical insight into some of the technologies that directly influence environmental protection practices today. Through military beginnings and post-war spending to inclusive and incremental changes in mapping and Inuit representation, a portrait of self-determination and adaptation emerges. Remote sensing and monitoring projects, as well as new developments in connected technologies will bring about the new phase of Inuit conservation in Nunavut. Inuit technology can be partially defined as Indigenous solutions to environmental issues that are a hybrid of science and technology and land-based advocacy. As I will illustrate in the following section, the rapid development of Indigenous connectivity organizations and associated internet connectivity technologies (ICT) can empower Inuit technology in service of conservation.

CONNECTIVITY

Internet Connectivity Technologies – the various devices and systems that connect us online – are conservation technologies. The amount of ecosystem data that is generated, analyzed, collected and shared and the speed at which it is transferred is made possible by internet connections. Robust and accurate field data is collected and used to gain accurate, robust and increasingly real-time data to contribute to more and more detailed pictures of ecology and advocate for biodiversity by ENGO and governments globally. Advocacy groups use the power of the many and specific data that increasingly informs evidence-based policy and legislations. Part of conservation work is advocating for the area or species via online outlets such as major news media, blogs and social media. In order to generate interest, research attention and funding these channels are a fundamental part of the conservationist experience.

Connectivity in rural and remote communities, which represent the vast majority of global protected areas, are disproportionately represented by Indigenous peoples, which means that the issues important to those communities are often under-recorded, because the connectivity required to do the conservation work is lacking. This section will further explore connectivity as an Inuit conservation technology by providing an understanding of the connectivity issues facing Inuit and northern communities and the contemporary positions on Indigenous connectivity in general. In the mid 90s, internet connectivity technologies (ICT) created new conservation advocacy platforms; websites, blogs, donation portals, and opened up new avenues from which to track and monitor individual species. Moreover, connectivity is a tacit function of economic and social life in urban and suburban regions and centers. Northern Indigenous and Inuit regions are overrepresented landscapes in Canada's biodiversity target totals, yet are

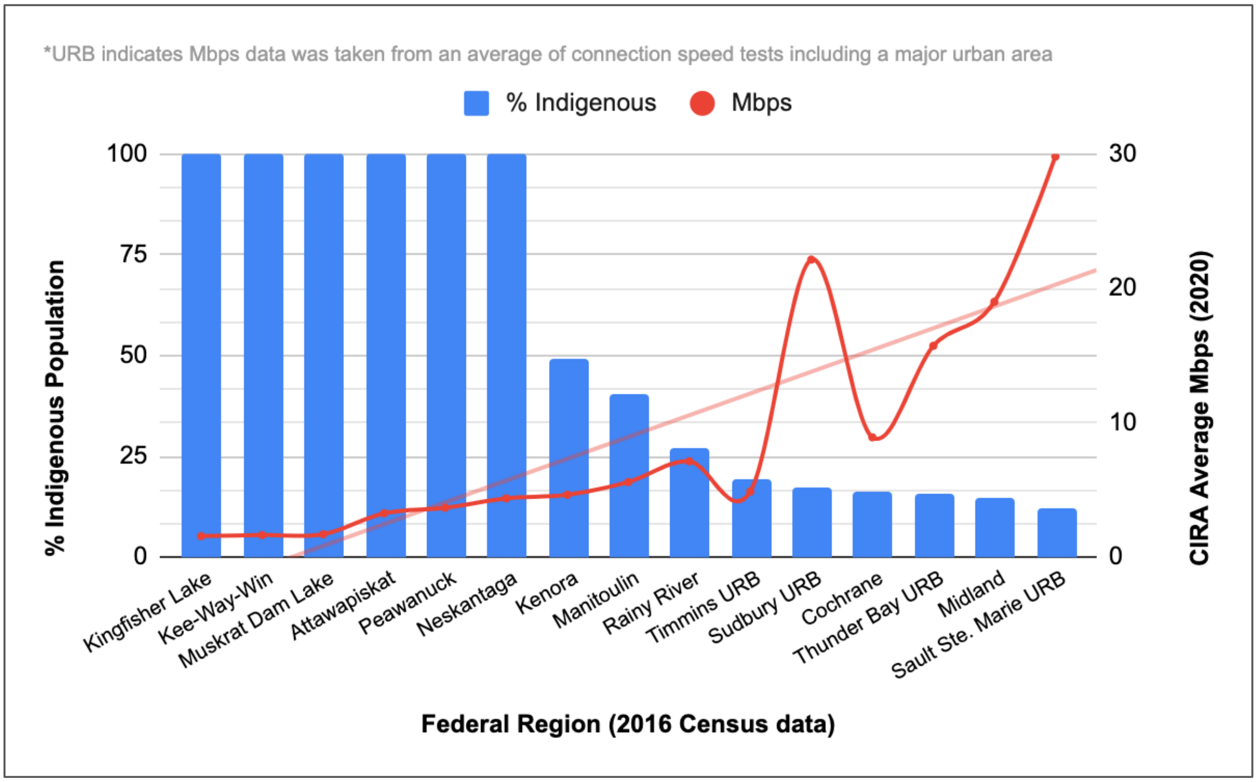

Fig. 4 Indigenous population and average regional connection speed. Data taken from 2016 Census (https://www150.statcan.gc.ca/) and CIRA Internet Performance Test website (https://performance.cira.ca/).

The left vertical axis represents data taken from the Statistics Canada Indigenous Peoples Resource compiled from 2016 census results. The fifteen regions in this chart were identified as the regions with the highest Indigenous population in Canada. The first six communities being first nations reservation areas. The right vertical axis is megabits per second (Mbps) taken from the Canadian Internet Registration Authority's (CIRA) performance test website. The region was viewed at an appropriate scale to capture speed-test results from a) official federal district boundaries b) urban areas. Where URB is included, the Mbps speed test data was collected from the direct urban area of the identified city or region. For areas with high test-instance rates a total average was determined by recording each test result and averaging the results. For example, Sudbury Mbps download speed data is readily available because there are many connected users in this urban area who are connecting to the CIRA service. Because internet technology evolves quickly, it is important to capture the latest data available. The chart produces a comparison that shows the general trend; if the region has a higher percentage of its population that identifies as Indigenous, it has a low Mbps download speed average. Sudbury is the exception of this general result. Urban centers produce more available connections which increases the average connection speed further afield, which explains the jump in Mbps between Timmins and Cochrane.

communities in Canada are underserved to the degree that broadband access still functions at pre high-speed levels across the region or at about a 1999 (dial-up) speed. Broadband is a high capacity transmission technique using a wide range of frequencies, which enables a large number of messages to be communicated simultaneously. For most world economies this means being connected to the global fiber network. Fiber is the physical cabling system that links all major global economies using in-ground (residential and business customers in populated areas) and undersea cable networks where necessary. In order for any community to have access to high-speed internet at a reasonable cost, or at all in some cases, it has to be physically linked to the fiber network, as the current technology stipulates. This is expensive, particularly so for Arctic communities where permafrost makes it impossible to trench fiber optic cables. In this case, the cables would have to be laid on the ground or in the air, making them vulnerable to the elements. Service throughout Nunavut is currently provided by TeleSat. Connections are made through a geostationary satellite at high altitude and the latency – lag time between sending out and receiving back information – is long in comparison to current urban and semi-rural regional speeds. The user has to purchase a modem which can 'speak' to a terrestrial station, which communicates with the satellite which then connects to a global internet exchange hub in an urban center or costal area.

Undersea cable systems were the only way to achieve high bandwidth in any community globally, until recently. For example, the Greenland Connect system is 4,780 km of undersea cable and connects Iceland, Canada (NL) and Greenland.[30] The Nunavut Undersea Fiber Optic Network System is listed by TeleGeography as slated for completion by 2023. This proposal would install 1,700 km of cable connecting Cape Dorset, Iqaluit, Kimmirut and Nuuk Greenland. It comes at a substantial financial and political cost that governments are weary of having on their public expenditure. It has taken over a decade for the GN to create and tender this infrastructure project. It should be noted that this proposal has been tabled for over 15 years and has had many iterations.

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[30] TeleGeography's submarincablemap.com, the working group provides an interactive map which displays connected undersea cables globally.

However, recent developments in space-based internet technology have the potential to disrupt established connectivity standards. This may also make it possible for high-speed connectivity to be universally available in Northern regions of Canada. This would make the online sharing of information possible in real-time. This has dramatic implications for conservation monitoring efforts related to climate change and wildlife tracking. SpaceX has slowly been launching hundreds of satellites (at the time of this writing 540 satellites have been launched) into low earth orbit (LEO) in order to offer ubiquitous 5G coverage across the globe through its StarLink service offering. 5G (fifth generation) is the fifth and newest generation of ICT and is preceded by 4G, 3G and 2G networks. A beta version is currently up and running on several SpaceX employee devices for testing within the company. Elon Musk (Tesla and SpaceX founder) has tweeted in January 2020 " public beta testing begins in ~6 months (November 2020), starting with high latitudes". (@elonmusk). Communities in the Arctic will be home to the first people to publicly test the service. The promise of a ubiquitous 5g network provided by low Earth orbit satellites mentioned previously, does have the potential to equalize the field. In this respect, it will no longer be referred to in terms of distance from, or distance to national fiber optic internet exchange points, because the link will be provided directly to connected devices instead of having to go through fiber optic cables connected to a wireless or LTE router and then sent out to phones based on terrestrial cell towers. So not only will this change the advocacy landscape for indigenous communities but it will also affect the way that conservation networks can advocate for the protected areas in these communities. More research needs to be done to this effect when the systems are operative. For example, how does space based internet changes the socio-economic dimensions of connected communities?

Although space-based internet requires terrestrial stations for coordination and control, the provision of this kind of internet is not dependent on connected trenches of physical wires. The satellite arrangements are linked together creating a giant mesh network which devices access through user terminals. This technology, if proof of concept is accurate, will change the access landscape for Inuit conservation. It will open the door for continuous monitoring, internet of things (IOT) and create new economic models for communities that have struggled for rudimentary access. Satellite constellations like StarLink employ optical inter-satellite links to communicate with one another and stay in the desired formation to increase coverage efficiency and avoid orbital collisions with themselves and other objects. A space-based internet will produce continual, even broadband distribution to all regions of the globe regardless of their relationship to major economic centers.

Currently in Canada and the U.S., internet service for Indigenous communities is spotty at best. Connectivity in these communities is considered the 'last mile 'by the CRTC and other industry groups, referring to the challenge in overcoming remote geographies and isolation and in some cases extreme climate variation at the 'end of the service road 'or the last mile out from large urban centers. This has been explored and exposed as a settler-centric narrative by Indigenous scholars. Advocacy for increased access to broadband identifies the internet as a basic human right and seeks to address the inherent inequalities associated with high-speed access. As the majority of global economic activity is done online in 2020, it becomes glaring that communities without access are being left behind. Communities that exist in and around conservation areas and protected ecosystems require the same access to broadband in order to create, envision and benefit from situated opportunities, responsive to the people who exist there. As much research shows (Alantara, C., etal. 2012; Bernauer, W. 2019a; Bernauer, W. 2019b; Campbell, B., 2017; Christensen, J., 2007; Henderson, A., 2008; Natcher, D. C., 2007; Weber, B., 2014), Indigenous communities and governments are engaged in the process of devolving from a colonial relationship to settler states. What does this mean for conservation in TINMCA? In order to assess this one needs to look at the current role that the internet plays in connecting Inuit communities, scientific and research communities, ENGO and conservation advocates.

Broadband sovereignty is a term used in current Indigenous scholarship (Rajabiun, R., 2013; Jayakar, K., 2018). It relates to devolution and Indigenous led practices at the core of self-sustaining governance. Community-controlled access to broadband helps nation-building and provides autonomy over pricing and provision of services. Instead of a community relying on national providers run by a small number of firms who control pricing and access, a group can fund and create their own network access. The Kuhkenah Network or K-Net, is owned and administered in Sioux Lookout Ontario and was started by the Keewaytinook Okimakanak tribal council. Once established, it helped local initiatives come to life and raised awareness around issues that came from within the community and on wider environmental impacts and applications. It has also allowed residents to participate in an online, global economy on their own terms.[31] High speed access is provided free of charge and is maintained through federal and private funding. Research done through the 'first-mile' initiative identifies the need to treat broadband access as a human right which pertains directly to quality of life. The research on K-net found that after the Native owned broadband service was in effect, nation building activities increased along with Indigenous owned research and data. This ownership itself can contribute to self-determination efforts by directing the initial research design to better fit the community with which it is concerned and by creating ownership for the community involved.

So not only does the research design ensure that community needs are being addressed in equitable ways but that the data is owned by the community. This direct benefit relationship is overt. Relating back to conservation, community access to the means of communication can ensure that internet-based solutions are connected to the lands on which they are involved a) the latest technologies can be secured and will benefit from high-speed broadband, the information can be shared and collected freely by the select group of

[31] McMahon et al., 2010 *Putting the 'Last Mile' First*.

administrators and that designated organizations or individual researchers treated as customers are ensured access to data products.

The geographic areas in which biodiversity targets are being met are the same areas that have the lowest or no connectivity in the countries that are represented by biodiversity targets (see Fig. 3). The importance of understanding conservation technology in the connectivity context is made visible by the research which shows areas need to be able to generate economic sustainability and development for the communities in which they are located. In following with Indigenous research and scholarship of the past 20 years, the economic benefits that precede the creation of a protected area, need to be completed, and envisioned and imagined by and for indigenous peoples.

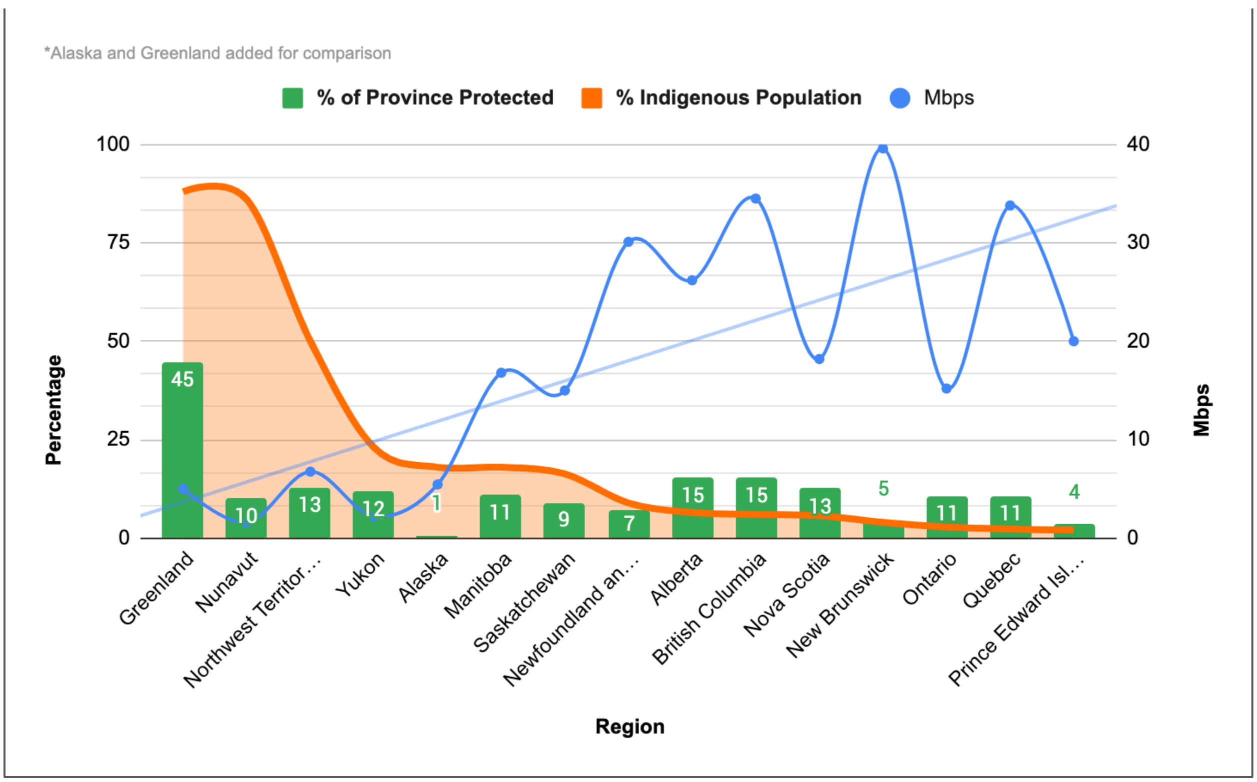

Figure 3. Protected area, Indigenous population and average connection speed. Data taken from 2016 Census (https://www150.statcan.gc.ca/) and CIRA Internet Performance Test website (https://performance.cira.ca/).

This combination graph uses a collection of unrelated data from various sources. The left vertical axis is total percentage and represents two input sources; percentage of region that is protected by legislation and percentage of region that identifies as Indigenous, as indicated on official census results. Regional protected and conserved areas data is provided by the IUCN World Database on Protected Areas website. These numbers were compared with regional data provided directly from local government to ensure accuracy. Protected area total square kilometres represent both terrestrial and marine protected area. Percentage of Indigenous population data is taken from the most recent census results in Canada, official state census data in Alaska and government data in Greenland. Alaska and Greenland were added as they are attached and neighboring landmasses that have a significant ecological and Indigenous profile globally. This suppression of ridged national boundaries represents a more accurate snapshot of social and biodiversity data which is not constrained by political geographies. The right vertical axis is megabits per second (Mbps) taken from the Canadian Internet Registration Authority's (CIRA) performance test website and Statista Inc. The region was viewed at an appropriate scale to capture speed-test results from a) rural and reserve areas and b) urban areas. An average was then taken from 30 real-time (July 2020) test-sites per region and compared against Statista market and consumer data on average internet download speeds in Canada as of March 2018 to produce an up-to-date snapshot of Mbps. Because internet technology evolves quickly, it is important to capture the latest data available. The chart produces a comparison that shows the general trend; if the region has a higher percentage of its population that identifies as Indigenous, it has a high percentage of protected areas and a low Mbps. There is some cognitive dissonance that exists between charting Mbps, demographics and environmental protection data together. However, as these factors are investigated as more and more interrelated and as impactful on each other, unconventional interrelations may become less and less dissonant.

Given the current state of emerging conservation technology, connected devices will provide a competitive advantage to the scientific community. This technology, if developed by Inuit, could be a source of economic stimulus in the communities that are developing the new connected devices. As Fig. 2 and Fig. 3 show, there is significant inequality in internet access in the areas which steward the vast majority of protected areas. The graphs show an inverse relationship between connection speed (Mbps) and both the percentage of area protected and the percentage of population that is Indigenous identified. As discussed, this has historically been for reasons of geographic inaccessibility and unequal settler Indigenous relationships. The adoption of new configurations of internet connectivity technology will position Inuit to continue successful self-directed environmental advocacy. Further, capacity building in Inuit communities could bring economic benefits as well as the benefits of data ownership and control generated by proprietary technology.

CONCLUSION

This research was not intended to be an account of the triumph of technology or to mourn the departure of traditional knowledge. It is an attempt to investigate the propensity for Inuit adoption of emerging technology by exploring the historical context of specific technologies now used in conservation. Further it attempts to represent a new configuration of Inuit technology that explores how policy tools and adoption position Inuit as preeminent Arctic environmental stewards. The technologies selected for review in this research are technologies that have a direct relationship with current conservation and have helped to form the 'data-backdrop' on which current environmental protections happen, they are also new configurations of emerging applied research techniques that are new to the region.

The types of technology omitted were not excluded to neglect the existence of a history of specific Inuit relationships with their own technology or the introduction of some forms of technology into the region like snowmobiles and GPS. Though this work does touch on some of the same notes, it is concerned with new configurations of environment/technology relationships centered around Inuit-led governance and conservation. Nunavut and the Nunavut Land Claims Agreement can provide future guidance by becoming a precedent for taking steps in the right direction nationally for the more equitable transfer of power to First Nations in Canada. While colonial relationships to Northern Inuit are fundamental and provide continued and lasting effects within communities, they are not the sole determinants of the future. In this sense, it is a misguided pursuit to adopt a purely techno-optimist position. The examples in this paper show it is clear that applied science is only successful when it is appropriately developed to suit the needs of the community and when it is deployed with the dedicated support of the individuals using it. This work did not attempt to answer the question of the relationship between Inuit and technology, any more than it could attempt to answer this for any other community. Technology can be contentious and has proven to be contentious in the Nunavut region since the introduction of settler-military developments after the second world war. The remaking or redefining of the term technology to function as a configuration of innovative Inuit processes and tools, as a conceptual device, is to help recenter the focus of developments as Inuit driven solutions.

This work attempts to stitch together instances of Inuit adoption and in some cases creation of technology in order to set forward a new view of the possibilities of this relationship - of Inuit and emerging technological advances - forward into the future. The modes of technology included in this paper are limited to the scope of applied conservation technologies that were identified as having significant impact on the trajectory of Inuit self-determination. During the research design phase of this paper I applied for and was granted HPRC permission to conduct interviews with Indigenous leaders who work on conservation and have a relationship to conservation related technology. Three interviews were scheduled with Individuals working in Arctic conservation and the government of Nunavut; Stephen Bathroy at the QIA, Madeline Redfern (former mayor of Iqaluit) and Paul Okalik (former premiere and WWF Arctic team member). However, the COVID-19 global pandemic quickly made it impossible to complete the interviews before it was too late to write due to scheduling constraints from the interviewees. These perspectives would surely have helped to build-out the Inuit input on the topics of this paper and opportunities to include more direct Inuit perspectives. While I did manage to conduct interviews with William Cruze at the Surveyor General's office and David Murray (Senior Planner, New Northern Protected Areas, Protected Areas Establishment Branch) at Parks Canada whose insights were invaluable, **notably absent are firsthand Inuit accounts of the technologies that are included in this research.** A high level environmental scan was necessary for this paper to explore and understand the relevant landscape of conservation technologies from a lay person's perspective as a first step in narrowing down the research and to help make decisions about the most applicable areas. As a settler researcher with no direct connection to the Inuit communities at large that are included in this paper, it was important for me to stay within the boundaries of my own position and to avoid misrepresentation of Inuit worldviews without conducting more extensive first-hand interviews. Too often, settler academics will pose disconnected solutions that suit theoretical and conceptual ends without connecting with the lived realities of people on the ground.

I wanted to avoid being a techno-optimist in the sense that I do not want to pose conservation technology as a catch-all solution which is constantly on the brink of providing positive change. It was not my intention to communicate this through the research. In conducting as much historical analysis surrounding the technologies that were used in the paper, I attempted to locate the issues and attend to some of the contentious relationalities present between Settlers and Inuit in Nunavut.

In regard to the history of technological adoption by Inuit in Nunavut, the position of this work shows that it is far too vast and varied a pattern to understand with any conclusive evidence or results that do not reinforce a colonial relationship through its submission.

Through exploring the TINMCA IIBA one is able to understand the need for control over the landscapes that support communities located within them. The Inuit Land Use Occupancy Project illustrated how beneficial an Inuit centered narrative is, not just to Inuit Nunangat but to the wider mapping profession. By reconfiguring what constitutes a 'map' it is possible to reimagine traditional inequalities in representation. This is true of the objectivity conversation with remote sensing. Alvarez and Gleason (2017) helped disprove the tacit notion that data is objective; an important distinction for the Inuit worldviews left out of traditional interpretation methods. Developed through military R&D, remote sensing has emerged as a powerful and ubiquitous tool in breadth and application across disciplines. It has helped make Inuit owned lands readable and established their boundaries for the Government of Canada as part of the original Nunavut Land Claims Agreement. This unparalleled agreement in Canada has set the tone for Indigenous negotiations and Inuit knowledge inclusion since. Inuit inclusion in legislative and policy agreements was made possible by strong Inuit voices and continued support for Indigenous agendas nationwide even in the face of lasting generational trauma related to residential schools and Arctic military occupation during WWII. However, enduring research and development done at this time has produced technologies that have the potential to carry forward new hope for Inuit nation building and conservation efforts alike. By investigating key developments in policy and in technological tools it is possible to begin to see how Inuit are best positioned to become environmental stewards, through their adoption of advances in conservation technologies and commitment to self-governance and government.

This paper has endeavored to create a novel exploration of Inuit technology as both digital tools and instruments and as conservation policy and legislation in Nunavut. It has explored the idea of Inuit technology as the mediation between western scientific thought and Inuit Qaujimajatuqangit. Inuit have used governance tools to their advantage and continue to shape the creation of conservation areas with policy technologies. Inuit continue to champion the Arctic provenance of conservation technology tools by revisioning their historic involvement in defense, mapping and climate change and can chart new ways forward through Indigenous connectivity.

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