

**Weaving Indigenous & Scientific Knowledges:**  
***Examples from Three Local Early Action Plans***

Laura Shay Lynes & Brooklyn Rushton

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Table of Contents

**ABSTRACT .....3**

**INTRODUCTION .....4**

**TERMINOLOGY.....6**

    INDIGENOUS AND LOCAL KNOWLEDGE.....6

    WEAVING, BRAIDING OR INTEGRATING KNOWLEDGES?.....8

**WEAVING KNOWLEDGES TO ADVANCE THE SDGS .....9**

    EMERGING TRENDS .....9

    CASE EXAMPLES .....10

**DISCUSSION .....15**

    CONTEXT.....15

    CHALLENGES.....16

    CONCLUSION .....17

**REFERENCES .....19**

**APPENDIX: LESSONS LEARNED FROM OTHER SECTORS.....28**

    EDUCATION .....28

    HEALTHCARE .....33

    CONSERVATION.....36

### Abstract

Meeting the Sustainable Development Goals requires transformative thinking and doing. This paper presents examples of participatory initiatives – in close collaboration with Indigenous peoples – that weave Indigenous and scientific knowledge to develop Local Early Action Plans on climate adaptation. The cases presented address the Sustainable Development Goals (SDGs) to reduce inequality (by co-developing knowledge and practices), climate action (in some of the world's most vulnerable communities), and strong partnerships between different knowledge holders. Case examples are provided from initiatives in two First Nations in Canada (the Kainai First Nation and Piikani First Nation) and from a collaborative with South African National Parks, the South African Agricultural Research Collaborative and the Nama peoples living adjacent to protected areas. The process for including Indigenous peoples in the design of Local Early Action Plans is both replicable and scalable. Implications of this work could be beneficial to practitioners and policymakers hoping to advance the SDGs through initiatives that weave local knowledge with scientific findings, provided there is a strong commitment to a long-term iterative process and in working together through the complexities of weaving knowledges that are from different epistemological origins.

## Introduction

The paper begins with a short terminology section and critique of the terms “braiding,” “weaving,” “integrating,” and “Indigenous knowledge” based on a survey of peer-reviewed and grey literature.<sup>1</sup> The purpose of this section is to assist practitioners in critically thinking about the terms used when referring to weaving Indigenous and scientific knowledge. Following the terminology section, the paper is structured as follows:

- Emerging trends in weaving knowledges including guidance from United Nations Framework Convention on Climate Change (UNFCCC) Subsidiary Body for Scientific and Technological Advice (SBSTA) and a brief overview of three cases where weaving Indigenous and scientific knowledges have contributed to Local Early Action Plans;
- A Discussion that highlights approaches to be considered for moving forward in weaving knowledges considering key challenges; and,
- In the Appendix, a synopsis of lessons learned in weaving knowledges from Education, Healthcare and Conservation followed by a section of case examples with much thanks to TRI’s student intern, Ms. Brooklyn Rushton who is working on her masters of climate change at Waterloo University.

The Resilience Institute (TRI) and lead author of this paper are involved in a number of initiatives where Indigenous and scientific knowledge weaving is practiced. It is a dynamic journey and the team is learning throughout the process with TRI’s community partners.

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<sup>1</sup> Examples of grey literature include: conference abstracts, presentations, proceedings; regulatory data; unpublished trial data; government publications; reports (such as white papers, working papers, internal documentation); dissertations/theses; patents; and policies & procedures. Duke University Systematic Reviews: the process: Grey Literature. 2020. Another definition is offered by the University of Toronto Gerstein Science Information Centre: “Grey Literature is any literature that has not been published through traditional means. It is often excluded from large databases and other mainstream sources. Grey literature can also mean literature that is hard to find or has inconsistent or missing bibliographic information.”

Weaving Indigenous and scientific knowledges in a meaningful way is complex. It requires time, resources and a commitment to building strong community partnerships. Based on the experience of TRI, attempting to weave knowledge haphazardly, even if unintentionally, could result in unintended negative outcomes. Nevertheless, there exists a tremendous opportunity to contribute to emerging practices in weaving Indigenous and scientific knowledges to advance the SDGs. With this in mind several recommendations have been provided in the Discussion section that might be helpful for those intending to take a more active role in weaving knowledges.

*Will you hold the end of the bundle while I braid? Hands joined by grass, can we bend our heads together and make a braid to honor the earth? And then I'll hold it for you, while you braid too.*  
(Kimmerer, 2013)

## Terminology

This section will outline essential terminology that will be useful for practitioners aiming to take an active role in weaving Indigenous and scientific knowledge. Having a common understanding of the following terms will be important between partners.

### Indigenous and Local Knowledge

Researchers working in the field of knowledge co-production have recently suggested the need for further assessment as to what ‘Indigenous’ or ‘local’ actually means and how it is developed including consideration of power relationships (Nalau, 2018). Traditional Knowledge (TK) “is frequently used interchangeably with TEK, indigenous knowledge (IK), local knowledge (LK), and local ecological knowledge (LEK)” (Eybo’rrson & Thuestad, 2015). LK, however, “has spatial connotations, referring to experience-based knowledge derived from practice within a given area or locality, regardless of whether it is handed down through generations or based on recent observations” (Eybo’rrson & Thuestad, 2015).

Indigenous knowledge can also be described as being knowledge that embodies “a web of relationships within a specific ecological context; contains linguistic categories, rules, and relationships unique to each knowledge system; has localized content and meaning; has established customs with respect to acquiring and sharing of knowledge...; and implies responsibilities for possessing various kinds of knowledge.” (Battiste, 2005).

The Inuit Circumpolar Council has developed the following definition of Indigenous Knowledge which could be useful:

*“Indigenous knowledge is a systematic way of thinking applied to phenomena across biological, physical, cultural and spiritual systems. It includes insights based on evidence acquired through direct and long-term experiences and extensive and multigenerational observations, lessons and skills. It has developed over millennia and is still developing in*

*a living process, including knowledge acquired today and in the future, and it is passed on from generation to generation ... IK goes beyond observations and ecological knowledge, offering a unique 'way of knowing' to identify and apply to research needs which will ultimately inform decision makers. It is important to understand that IK is systematic; IK holds methodologies and reasoning; IK has evaluation and analysis processes” (Daniel et al, 2016).*

A definition of Indigenous or local knowledge could also be: “Indigenous or local knowledge refers to a complete body of knowledge, know-how and practices maintained and developed by peoples, generally in rural areas, who have extended histories of interaction with the natural environment” (Boven & Morohashi p. 19, 2002).

An analysis of TK in Ecosystem-Based Adaptation found that there is significant overlap between terms used relating to Traditional Knowledge in the literature and that Indigenous Traditional Knowledge (ITK) and Local Knowledge (LK) “were often used interchangeably and in many instances in the same sentence or paper, which in other literature often seems to be the case” (Nalau, 2018).

It is also important to note that the definition of Indigenous knowledge will differ depending on the community or region, but authors Boven & Morohashi (2002) found some common aspects that might be useful to the Organization. Indigenous knowledge is:

- Locally bound, indigenous to a specific area.
- Culture- and context-specific.
- Non-formal knowledge.
- Orally transmitted, and generally not documented.
- Dynamic and adaptive.
- Holistic in nature.
- Closely related to survival and subsistence for many people worldwide.

While there are various definitions of TK, LK, and ITK, it is recommended that practitioners provide a clear definition and rationale for the terms it uses when referring to Indigenous and/or traditional knowledge.

### **Weaving, Braiding or Integrating Knowledges?**

Both the experience of TRI and the literature scan suggest that the terms “weaving” and “braiding” are used interchangeably. Both terms imply an equal coming together of knowledges derived from different epistemological backgrounds.

As eloquently described by authors Tony Dreise and Evalynn Mazurski (2018), weaving:

*“provides a powerful metaphor for how government and community can weave Aboriginal ways of being, knowing and doing together with Western knowledge threads to ensure that policies, programs, and services are co-owned and co-produced by communities and that such threads possess both cultural integrity and public confidence....co-design and co-production need to be seen as a process toward community wellbeing and empowerment, underpinned by data (both statistical and narrative) that can be truth-tested by communities through data sovereignty. That is, qualitative and quantitative data are co-produced, monitored and owned by community, and are truth-tested against one another”.*

Lynes (2019) presented at a UNFCCC joint event at COP25 in Madrid, Spain on *integrating indigenous and local knowledge into adaptation action*, where participants sought to identify ways of better integrating such forms of knowledge. One of the key points she raised was the use of the term “integrating” as implying that one type of knowledge was being incorporated into a dominate knowledge base. To break down the idea of integrating knowledge systems, TRI proposed the terms weaving or braiding instead.

Further evidence to use the term weaving was gleaned from literature in the education sector suggesting that institutions that express the priority to weave Indigenous knowledge into their curriculum, show their intent is coming from a place of respect and recognition of Indigenous peoples and their intellectual traditions (Kimmerer, 2002).

## **Weaving Knowledges to Advance the SDGs**

### **Emerging Trends**

There is a significant movement in the global community to recognize the importance of Indigenous knowledge in climate change action and in advancing the SDGs. This is evident by partnerships between western scientists and Indigenous communities to co-generate and present research that acknowledges both western scientific and Indigenous ways of knowing (Turner & Spalding, 2013). Since a lot of scientific innovation has contributed to climate change, Indigenous knowledge is essential to educate those who have become disconnected with the natural world (Turner & Spalding, 2013).

Much can be learned in this regard from the work conducted by the UNFCCC SBSTA with contributions from approximately 60 representatives from Parties, constituted bodies under the Convention, international and intergovernmental organizations and non-governmental organizations, and representatives of Indigenous communities on using and collaborating on local, indigenous and traditional knowledge and practices. To illustrate this point, a few examples (SBSTA 2014a) are provided:

- a) The importance of taking an integrated perspective of sustaining livelihoods and culture rather than just focusing on adaptation and climate change...adaptation activities are put into the context of local culture and decision-making;
- b) The importance of respect and trust in collaborating and of the recognition of local, indigenous and traditional knowledge and practices;
- c) The importance of capacity-building and empowerment of local communities and holders of indigenous and traditional knowledge and practices; and
- d) The multiple benefits stemming from the use of indigenous and traditional knowledge and practices. Besides offering adaptation benefits, using and applying indigenous and traditional knowledge and practices can enhance social cohesion and prevent or reduce inter-community conflicts as seen.

## Case Examples

Over the last few years the TRI team has been working with Indigenous communities and other partners on developing Local Early Action Plans (LEAPs). The three examples provided show how participatory initiatives – in close collaboration with Indigenous peoples – can further processes related to weaving Indigenous and scientific knowledge, build trust and develop long-term partnerships that in turn reduce inequality and lead to climate action.

Case examples are provided from initiatives in two First Nation communities in Canada (the Kainai First Nation and Piikani First Nation), and from a collaborative in South Africa with South African National Parks, the South African Agricultural Research Collaborative and the Nama peoples living adjacent to protected areas.

Indigenous People have been adapting to changing environments and climates for centuries. The ability to organize and cooperate during times of hardship and crisis is a strength of many communities. However, the speed and magnitude of climate change since the 19<sup>th</sup> century in context of the consequences of colonialization, make adaptation to new climate scenarios very challenging. Given the complexities of dealing with climate change in these contexts, traditional knowledge when woven together with scientific knowledge can help provide a broader understanding of the strategies that are essential for successful climate change adaptation.

A LEAP is a simple plan that can be used to guide local actions that an Indigenous community can take to start addressing climate change impacts as they develop a more comprehensive Climate Action Plans. LEAPs help generate:

- A portfolio of strategies and actions to better manage the priority threats and opportunities—whether improvements to existing strategies, new strategies and actions, or a combination of both.

- A list of immediate strategies and actions to be considered for implementation—i.e., those strategies and actions anticipated to be the most urgent and feasible to conduct.
- Basic information on actions to support decision-making for implementation.

In all example communities, the LEAP journey started with a series of education workshops and dialogues. This process involved listening to participants' observations, concerns, and ideas for resilience building. Though different in each community, engagements included formal education workshops, presentations, and community conversations. The engagements helped to prepare a wide range of community members for more technical planning, build momentum and engage decision makers.

The following three cases – two from Canada and one from South Africa – illustrate how weaving knowledges can lead to transformative ways of thinking about climate action, reduce inequality by building the capacity of vulnerable communities to address climate change and build strong partnerships.

#### Canada

The effects of climate change are already apparent in the Kainai and Piikani First Nations located in Southern Alberta, Canada with observable changes in temperature, precipitation, and extreme weather events over the last century. Further changes to the climate in the decades ahead are inevitable due to the result of past greenhouse gas (GHG) emissions. Projected climate changes this century may expose Indigenous communities in Alberta to conditions far outside their normal adaptive capacity, deepening threats to livelihoods, health, and quality of life. The impacts are anticipated to be numerous and diverse, giving rise to potentially significant, though uncertain consequences, for all facets of life in these communities—social, cultural, health and wellness, economic and environmental. Impacts may arise through changing patterns of

precipitation with increased risk of flooding and drought, increased strain on water resources, rising temperatures and more common and intense heatwaves, more frequent and widespread wildfires, or increased storminess.

**1. Building Climate Resilience & Adaptation in the Kainai First Nation:** This multi-year, participatory initiative included the co-creation of a LEAP with a community in the Blackfoot Confederacy. Over 100 community members of multiple ages and backgrounds (including elders, council members, directors, technicians, managers in multiple departments, emergency services, and general community members) contributed their time to share observations and concerns related to climate change. LEAP priorities were determined through a process that helped the community streamline the most pressing concerns based on what was heard in over two years of community engagement.

The community identified both traditional coping strategies and new strategies for the identified threats and in a very organic manner wove the information to further develop their plan. Nearly all of the traditional coping strategies identified involved the delivery platform of an Elders Relational Network and Youth Engagement cohort or group. Examples of how traditional knowledge could be woven into adaptation planning include sharing traditional teachings to cope with fire: trauma counselling, sweats, ceremonies; sharing narratives on Blackfoot cultural relationship and values with fire and Bison re-introduction as strategy for mitigation to climate change and adaptation strategy to drought.

**2. At the time of writing this paper, the Piikani Nation,** also a member of the Blackfoot Confederacy, is embarking on a similar journey to develop capacity for climate adaption that includes developing a LEAP but with a twist. The LEAP will be youth-led and will actively engage participants in developing a school greenhouse program while doing the longer-

term adaptation planning. The vision for the greenhouse program is to develop the surrounding lands into a walking path and a dynamic space that connects climate change with healthy food, culture, environmental stewardship, and learning that is inspired by elder and scientific knowledges. In addition to this, a plan is in place for weaving Blackfoot and other scientific knowledges with school curriculum.

Through this initiative partners are building trust and demonstrating positive collaborations between non-Indigenous and Indigenous experts and inspiring a “can-do” attitude towards greater resilience and food security.

On-going documentation of the journey and knowledge sharing with will help build a community of practice in weaving knowledges to advance SDGs throughout the region and beyond through knowledge sharing on platforms such as the Local Communities and Indigenous Peoples Platform.

### South Africa

The Nama people in South Africa are part of the larger Khoi and San groups who could be considered the original inhabitants of the country and signs of their existence date back up to >2000 years ago. The Nama are general pastoralist communities who farmed with both cattle and small ruminants but recently, the latter forms more than 90 per cent of livestock owned. Most Nama reside in the communal areas including the Richtersveld, which is the only area in the country where the indigenous Nama language is still spoken.

The Richtersveld World Heritage Site (RWHS) is 1 600 km<sup>2</sup> in size and is located in the north western corner of South Africa. It is adjacent to the Richtersveld National Park (RNP).

Kuboes Village is located about 10km southwest of the park and forms part of the RWHS along with three other villages.

**3. Developing Capacity for Climate Adaptation in Kuboes:** With in-country partners, TRI conducted a climate risks assessment on 106 households in Kuboes Village in July 2018 with inputs from local community members and insights from experts who have been working in the region on rangeland ecology and management. These households represented nearly half of the households in Kuboes.

The project team co-developed a LEAP where key climate risks were identified and roles and responsibilities were defined by the community. Some of the main adaptation actions identified revolve around developing an early warning system. Ecosystem-based adaptation options that weave local and Indigenous knowledge were also identified and will inform a plan going forward to deal with desertification by increasing forage for livestock herders through restoration of biodiversity. A stakeholder network and governance plan that involves all parties will help ensure the iterative process of weaving of knowledges continues.

## Discussion

### Context

It is estimated that 80 per cent of the planet's biodiversity is on lands where Indigenous people live, as the relationship between Indigenous communities and the natural world is one that rests on respect, stewardship, and harmony (Sobrevila, 2008). The values of respect and recognition of non-human kinship serve as a reminder to the rest of the world that conservation and protection of non-human species is essential if we are to survive (Turner & Spalding, 2013).

Indigenous communities have gone through intimate experiences with seasonal weather conditions and their knowledge systems are deeply embedded with an understanding of environmental indicators of change (Turner & Spalding, 2013). Since Indigenous knowledge is accumulated through multiple generations, both the perceptions of time and variability in the climate system are strong (Turner & Spalding, 2013). Furthermore, it is seen through history that Indigenous cultures have a strong ability to be flexible and adaptable in their way of life when presented with harsh environmental conditions (Turner & Spalding, 2013). Many Indigenous cultures have narratives to teach about proper ways to adapt to storms, changing sea-levels, and resource shortages, in order to increase community resilience into the uncertain future (Turner & Spalding, 2013).

Inherent in Indigenous knowledge is content derived from place-based systems that are relational. The creation and validation of this knowledge is not “restricted to the academic literature but take place on the land” (Latulippe & Klenk p. 8, 2020). The ability to understand Indigenous knowledge not learned in books; it “is acquired through deep cultural immersion and training over time, often in remote locations” (Lertzman p. 109, 2010).

## Challenges

Clearly it would be quite an undertaking to develop a plan for effectively weaving Indigenous and scientific knowledge for all the unique Indigenous communities, which is one of the reasons why the undertaking of effectively weaving knowledges is complex. Moreover, Indigenous and western scientific knowledge are also based in fundamentally different worldviews with their own philosophy, institutions, and methods. As Lertzman points out “one could hardly develop an understanding and appreciation for science without some basic insight into its methods and philosophy.” Similarly, “without basic familiarity and training one’s understanding and appreciation for TEK is impaired” (Lertzman p. 109, 2010).

Appreciating how Indigenous knowledge is generated is also a critical factor in being able to weave it with other expertise. For example, traditional ecological knowledge is generated through intuitive, somatic, and other spiritual modalities such as “singing, drumming, dancing, dreaming, fasting, praying, purifying, healing, periods of isolation, ceremony, and ritual” (Lertzman p. 110, 2010). Such knowledge “brings understanding of that which cannot be measured in time and space to foster meaning and value for that which can” (Lertzman p. 111, 2010).

While there is no “one size fits all” approach to weaving Indigenous and scientific knowledges, as this paper shows, there are lessons learned regarding processes that can help bring together the best possible knowledges irrespective of their epistemological foundations to further the SDGs.

## Conclusion

Indigenous and traditional knowledge offers a way of thinking about life as “web of relationships” (Battiste, 2005), an interconnected, holistic understanding of the world. Creating space for this way of relating to each other and the natural could go a long way in efforts to transform policies that could strengthen the SDGs.

There remains much to learn about effective practices when it comes to weaving Indigenous and scientific knowledge to address the SDGs, but based on the literature scan and from our experience in weaving Indigenous and scientific knowledges in the development of Local Early Action Plans, those aiming to weave Indigenous and scientific knowledge systems to advance the SDGs should consider:

1. Designing a process for iterative learning on how knowledge can be obtained and presented from multiple ways of knowing that is validated either scientifically or at the community level.
2. Incorporating a sense of gratitude in your work. Having and showing gratitude has been a common theme in the literature and has emerged in TRI’s experience of working with Indigenous peoples. This could be a key component to successfully weaving Indigenous knowledge with other knowledge systems.
3. Adopting the relevant recommendation identified from the 2014 UNFCCC SBSTA meeting on-going participatory initiatives. For example: (UNFCCC, 2014a):
  - Ensure ongoing two-way communication, transparent processes and good governance (including the rights of Indigenous peoples) and the full and effective participation of indigenous and local communities in the design, development and implementation or delivery of climate services;
  - Complement modern scientific knowledge, practices and tools with indigenous and traditional knowledge and practices. For example, weaving indigenous and traditional observations and insights can complement modern meteorological observations and help to extend the record back in time and place;
  - Develop guidelines and protocols to protect and recognize local, indigenous and traditional knowledge and practices. Agree to treat local, indigenous and traditional knowledge and practices as a resource/asset, which should be subject to the application of a rights-based approach and protected under an appropriate intellectual property rights regime;
  - Implement pilot projects for demonstrating positive interventions and impacts;
  - Use participatory rural appraisal tools, including participatory assessment and evaluation; and,

- Facilitate multi-stakeholder dialogues to facilitate interaction among the different stakeholders and knowledge exchange platforms to facilitate exchanges between communities, scientists and policymakers.
4. Adopting the First Nations Principles of Ownership, Control, Access and Possession (OCAP), which is a set of standards for how First Nations data should be collected, protected, used, and shared. The following table outlines the OCAP components which could be helpful when thinking about standards for data collection, protection, usage and dissemination of other Indigenous knowledges as well:

The Four Components of OCAP Ownership, Control, Access and Possession	
Ownership	refers to the relationship of First Nations to their cultural knowledge, data, and information. This principle states that a community or group owns information collectively in the same way that an individual owns his or her personal information
Control	affirms that First Nations, their communities, and representative bodies are within their rights in seeking to control over all aspects of research and information management processes that impact them. First Nations control of research can include all stages of a particular research project-from start to finish. The principle extends to the control of resources and review processes, the planning process, management of the information and so on
Access	refers to the fact that First Nations must have access to information and data about themselves and their communities regardless of where it is held. The principle of access also refers to the right of First Nations communities and organizations to manage and make decisions regarding access to their collective information. This may be achieved, in practice, through standardized, formal protocols
Possession	While ownership identifies the relationship between a people and their information in principle, possession or stewardship is more concrete: it refers to the physical control of data. Possession is the mechanism by which ownership can be asserted and protected
<i>Source: The First Nations Information Governance Centre (FNIGC), 2020</i>	

Contributing to the understanding of good practices in weaving multiple ways of knowing to address the SDGs, now in the daunting context of SARS-CoV-2, is one of the organization’s priorities and a key area of interest for the lead author of this paper. We welcome ongoing dialogue and opportunities to strengthen this process.

Laura S. Lynes L.L.M, President of The Resilience Institute & Brooklyn Rushton BSc, Master of Climate Change Candidate, Waterloo University, TRI Student Intern

Contact: [laura@resilienceinstitute.ca](mailto:laura@resilienceinstitute.ca)  
 Twitter: @TRInitiative; @\_laurashay  
 Website: [resilienceinstitute.ca](http://resilienceinstitute.ca)

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### **Appendix: Lessons Learned from Other Sectors**

The following serves as additional reference on how other sectors have approached weaving Indigenous knowledge. A brief synopsis of lessons learned in weaving knowledges from Education, Healthcare and Conservation is provided followed by a few case examples.

#### **Education**

In the realm of education, much of the literature reviewed was focused on determining how science can be defined and how Indigenous perspectives compare and contrast to western science.

While ‘integrating’ knowledge systems has been noted by various education institutions as a priority, Indigenous knowledge should continue to be its own entity where it is valued for its own merits, can play a vital role in science education, and maintain a position of independence to critique the practices of Western science (Cobern, 2001). Western science has dominated the public sphere by making other sources of knowledge be viewed to have a lesser value (Cobern, 2001). To combat this presence of dominance, it is vital that education institutions emphasize the importance of epistemological pluralism - or several valuable ways of knowing (Cobern, 2001). This is where the term weaving comes in because knowledge systems need to be recognized for their individuality and importance, instead of trying to break down the knowledge systems into compartments to find cohesion. When institutions express the priority to weave Indigenous knowledge into their curriculum it comes from a place of respect and recognition of Indigenous peoples and their intellectual traditions (Kimmerer, 2002). Indigenous knowledge has mostly been highlighted in the education sector to teach students how to understand the natural world and understand cultural differences. Both Lertzman (2010) and Kimmerer (2002) recognize the important of weaving Indigenous knowledge into the teachings of sciences, including ecosystem-

based management and biology to teach both Indigenous and non-Indigenous students that western science is not the only way to understand the natural world. Furthermore, weaving Indigenous knowledge into education is extremely important from a cultural standpoint to reinforce Indigenous identity, values, attitudes, and behaviours that are deeply rooted in different Indigenous cultures (Ball, 2004). Indigenous students have been noted to be 50 per cent less likely to have completed post-secondary education than their non-Indigenous counterparts due to the fact that the curriculum is not culturally relevant (Ball, 2004). All of these barriers and education gaps between Indigenous and non-Indigenous students further emphasize the importance of weaving Indigenous knowledge into education in Canada.

The next section presents some successful Canadian case studies that have weaved Indigenous knowledge into the curriculum on both the secondary and post-secondary level. From the cases reviewed, it is evident that there is significant movement in the Canadian education system at both the secondary and post-secondary level to increase awareness of Indigenous knowledge and history. The practices outlined in this section highlighted that weaving Indigenous knowledge goes beyond just knowledge integration and involves rekindling relationships between non-Indigenous and Indigenous parties.

The Alberta Regional Professional Development Consortia noted that education design attempting to weave together Indigenous and Western practice in education design is thought to be: Holistic: Recognizes distinctiveness of both Western and Indigenous knowledge systems through a “Two-Eyed Seeing” approach; Collaborative: Inclusive of Indigenous community members, such as Elders, into curriculum development and program implementation; and, Relational: has Indigenous representation at all levels of the institution, from administration to teachers (ARPDC, n.d.).

According to the Netherlands Organization for International Cooperation in Higher Education, best practices using Indigenous Knowledge in education have the following characteristics:

- They are innovative. (a best practice has developed new and creative solutions to common problems of poverty and social exclusion.)
- They make a difference. (a best practice demonstrates a positive and tangible impact on the living conditions, quality of life or environment of the individuals, groups or communities concerned.)
- They have a sustainable effect. (a best practice contributes to sustained eradication of poverty or social exclusion, especially by the involvement of participants.)
- They have the potential to be a source of inspiration to others. (A Best Practice could serve as a model for generating policies and initiatives elsewhere.) (Boven & Morohashi, 2002).

The cases reviewed by TRI's student intern further demonstrate that institutional recognition and accountability to Indigenous communities is essential and success comes when Indigenous students are more empowered in who they are as Indigenous people and non-Indigenous students have a better understanding of the complexities, richness, and diversity of Indigenous perspectives, history, and culture (Pidgeon, 2015).

Secondary Schools	
<i>Inspiring Success: First Nations and Metis PreK-12 Education Policy Framework</i>	In 2005, Saskatchewan's Ministry of Education embarked on a journey to renew their province wide learning program based on five new foundations (Aikenhead & Elliot, 2010). One of the foundations was to begin to weave First Nations, Metis, and Inuit content, perspectives, and ways of knowing into the provincial curriculum in order to engage and increase success of Indigenous students, while enhancing the quality of science education for non-Indigenous students (Aikenhead & Elliot, 2010). The Ministry of Education recognized that the under representation of Indigenous knowledge in high school science curricula presents several inequalities for Indigenous students as the current system had required them to set aside their culture (Aikenhead & Elliot, 2010). The program recognized Indigenous knowledge alongside Eurocentric science as a legitimate way to understand the physical world. The program involved consultation with several stakeholders from the beginning, including representatives from teachers, directors of education, Federation of Saskatchewan Indian Nation, the Northern Teacher Education Program, and the three universities in Saskatchewan, including the First Nations University of Canada (Aikenhead & Elliot, 2010). These stakeholders provided feedback and were essential in establishing the curriculum. Once the curriculum was established, a separate committee was formed to examine how

	<p>educators can present Indigenous science in a respectful way, which included avoiding validating one knowledge system with another, emphasizing common ground between the two knowledge systems, and including Indigenous leaders in the teaching process (Aikenhead &amp; Elliot, 2010). Flashforward to current day, this initiative snowballed into the <i>Inspiring Success</i> initiative that works to guide actions at all levels in the education sector to support reconciliation, treaty education, Indigenous cultures and languages in the classroom, and the infusion of Indigenous perspectives into a renewed curriculum (Province of Saskatchewan, n.d.).</p>
<p><i>Pearson Education Science Textbooks</i></p>	<p>In the early 2000s, Pearson Education Canada and the Ministry of Education collaborated to form an advisory committee with Cree, Dakota, and Nakawe Elders to increase the amount of Indigenous knowledge being weaved into westernized science textbooks (Aikenhead &amp; Elliot, 2010). This process was led by one particular Canadian teacher who had extensive prior experience working with Indigenous communities who worked with Elders to determine how to include Indigenous knowledge. The end result of this relationship was content in each unit of Grade 6 – 9 science textbooks entitled “Ask an Elder” to communicate Indigenous knowledge on the particular subjects to students (Aikenhead &amp; Elliot, 2010). The important part of this initiative is that Elders vetted all the information before the textbooks were subject to ensure that knowledge was presented in an accurate and respectful way.</p>
<p><i>Alberta Initiative for School Improvement</i></p>	<p>In 2000 the Alberta Initiative for School Improvement was introduced to improve student learning and performance in various education jurisdictions across Alberta. Of the 1600 projects that came out of this initiative, half worked to increase cultural awareness in schools, with many of them focusing on educating teachers, staff, and non-Indigenous students about First Nations, Metis, and Inuit culture, history, and language (Gunn et al., 2010). Included in these projects were initiatives such as: (1) coordinating Indigenous awareness day and events to promote a sense of pride and belonging to Indigenous students, (2) hiring an Indigenous officer or counselor in schools, (3) developing Indigenous history, culture, and language courses, (4) infusing Indigenous affairs into existing curricula, and (5) inviting Elders and Indigenous community members to teach at schools.</p> <p>There is one particular success story in the Northern Alberta school division that was proposed to increase Indigenous parent and student satisfaction with education, educating all teachers with best practices of incorporating Indigenous culture and traditions into the curriculum, and increasing attendance and success of Indigenous students (Gunn et al., 2010). In order to do this, the Northern Alberta school developed professional development courses for teachers and administrators regarding Indigenous culture, created partnerships with Indigenous agencies, post-secondary institutions, and Elders, located positive Indigenous role models in the regions, and hired an Indigenous coordinator and facilitator to assist education liaison work with faculty, students, parents and the community (Gunn et al., 2010). Upon completion of the initial 3-year phase of the project, Indigenous students saw a significant increase in grades, attendance, and graduation rates and parents were extremely satisfied with efforts of incorporating cultural awareness events and the curriculum changes (Gunn et al., 2010). However, it was noted that hiring the Indigenous coordinator was the largest part of the success (Gunn et al., 2010).</p>

Post-Secondary Institutions	
<i>York University</i>	In 2008, York University began the <i>Infusion</i> project within their Teacher Education Program to develop teacher candidates' knowledge of Indigenous history, culture, perspectives, and contemporary issues to respond to the specific needs and interest of Indigenous students in order to facilitate respectful learning for all students in Ontario classrooms (Vetter et al., 2014). The objectives of the <i>Infusion</i> included placing land, Indigenous people, and relationships central to the development of sound and caring teaching practices and examining what it means to respectfully include Indigenous peoples, lands, and perspectives in development of culturally responsive programs in Ontario schools (Vetter et al., 2014). From these objectives, York University recognized some guiding principles for teaching Indigenous content in a culturally respectful way, including: (1) understanding that not knowing is an opportunity for learning, (2) recognizing diversity of histories and teachings, (3) creating space for alternative perspectives, (4) teaching in context, and (5) moving from inclusion to infusion (Vetter et al., 2014).
<i>Lakehead University</i>	In 2014, Lakehead University made a commitment that starting in the 2016/2017 academic year all students will be required to take an Indigenous studies course regardless of the program (Pidgeon, 2015). This initiative was introduced to deal with systemic racism and lack of awareness from non-Indigenous Canadians about Indigenous history and contemporary affairs (Pidgeon, 2015). A similar initiative was started at the University of Winnipeg in the same academic year (Pidgeon, 2015).
Trent University	Trent University has incorporated traditional teachings and perspectives for more than 50 years and became the first university in Canada to establish an academic department dedicated to the study of Indigenous Knowledge (Trent University, n.d.). Trent has an Indigenous Environmental Studies program that is jointly managed between the Environment and Resource Science Faculty and the Department of Indigenous Studies (Hauser et al., 2009). This program has been successful because it involves direct support from Elders and other Indigenous community members through all stages of the curriculum development. Furthermore, the Director of this program is a citizen of Haudenosaunee and part of the Six Nations Confederacy from Ohsweken (Hauser et al., 2009). The purpose of this program is to develop a working relationship between Eurocentric scientific knowledge and Indigenous scientific knowledge while recognizing the distinctiveness of both knowledge systems (Hauser et al., 2009).
University of Victoria	The University of Victoria worked with the Meadow Lake Tribal Council of Saskatchewan to deliver two years of university accredited education for Early Childhood and Youth Educators in Indigenous communities that involved cultural Elders co-generating the training curricula. This initiative is known as the First Nations Partnership Program that has involved 10 partnerships with 151 Indigenous students from 57 First Nations communities (Ball, n.d.). This program was selected by UNESCO in 2002 as one of the "20 Best Practices" across disciplines from around the world that incorporate Indigenous knowledge. This program became the catalyst for the Generative Curriculum Model to support intergenerational teaching and learning (Ball, n.d.). The guiding principles for this model include: (1) community directed action where First Nations partners play a central role in all aspects of program planning, delivery, and evaluation, (2) bicultural respect where Indigenous ways of knowing are equally as respected as

	Eurocentric ways of knowing, (3) Indigenous and non-Indigenous teachers co-construct the curriculum, (4) the community is able to develop through this partnership, and (5) children work within an ecological context of their community (Ball, 2004). This program has seen huge success where student completion, community capacity, revitalization of intergenerational teaching and learning rolls, and contributions to First Nations' social development goals all increased (Ball, 2004). From this program, the creators noted that there are 5 sectors of success when training and teaching in Indigenous communities, including: (1) including the whole community in the program, (2) program participants rediscovering their cultural heritage, (3) students living and studying in familiar community surroundings, (4) students becoming role models in the community, and (5) the program can benefit the wider community (Ball & Pence, 2001).
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## Healthcare

In the contemporary Canadian health care system, Indigenous medicine has been historically suppressed with Eurocentric medicine since the onset of colonialism. This suppression, along with other factors, contributes greatly to the disconnect in health between Indigenous and non-Indigenous people in Canada. However, the tides are starting to change and there has been movement across the Canadian health care sector to begin to weave Indigenous medicine in order to work towards reconciliation, address health impacts in Indigenous communities, and ultimately bettering the entirety of the health care sector with different ways of knowing.

One of the recent movements in Canada was the adoption of the *United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)*, which helps to target health disparities within Indigenous communities. This declaration included the commitment to provide culturally appropriate health care to Indigenous peoples, which is something that has been suppressed for many centuries (Wilmot, 2018). In 2015, the Truth and Reconciliation Commission of Canada created an urgent need for full health care rights for Indigenous peoples, the elimination of health disparities, antiracist decolonization of the health care sector, and self-determination in the use and access to traditional knowledge, therapies, and healing practices

(Truth and Reconciliation Commission of Canada, 2015). This call for action has begun a systemic change across Canada in many provincial and jurisdictional health care systems, including the onset of many Indigenous-led health care partnerships in Canada. These partnerships have created an opportunity for Indigenous people to regain access to traditional health and healing practices that were previously oppressed through colonization and have resulted in innovative models of collaboration, as well as the creation of community-based healing lodges, remote clinics, or operational changes in urban hospitals (Allen et al., 2020). This section outlines a few of these partnerships in Canada to highlight systemic changes in the health care sector.

Since Canada's signing of the *United Nations Declaration on the Rights of Indigenous People*, there has been a national movement in weaving Indigenous knowledge into health care. While some of these initiatives have been created in large hospitals, a lot of the creation involved Indigenous-led initiatives that ensured that cultural practices of health and healing were at the root. Since there is a significant disparity between Indigenous and non-Indigenous people in the Canadian health care sector, the weaving of traditional medicinal practices is so important to break down barriers that Indigenous people face. By providing more culturally specific health care, Indigenous people are able to achieve more holistic health outcomes, where healing the mind, body, emotion, and spirit are all essential in the process. This weaving of knowledge has already and will bring further significant benefits to both Indigenous and non-Indigenous communities. Already, some of the initiatives taking place across the country have shown to increase dialogue between Indigenous peoples and health care providers, create a more culturally relevant environment in health care practices for Indigenous peoples, and incorporate different ways of viewing health care in large institutions, such as St. Michael's Hospital in Toronto,

Ontario. By approaching health care through a holistic manner, the Canadian health care system has the potential to provide better care to all citizens and create a more equitable space for Indigenous peoples.

**Cases reviewed by TRI's student intern Ms. Brooklyn Ruston:**

<p><i>Aboriginal Healing and Wellness Strategies in Health Care Centres in Ontario</i></p>	<p>The Aboriginal Healing and Wellness Strategies (AHWS) paired up with the Ontario Ministry of Health and Long-Term Care, Ontario Native Affairs Secretariat, Ontario Women's Directorate, and the Ministry of Community and Social Services to incorporate Indigenous culture and beliefs into the healing process at various Health Care Centres around the province (Lemchuk-Favel, 2004). Since this initiative recognized the diversity of Indigenous culture, each Health Care Centre's approach has been designed to reflect the needs and culture of the Indigenous community. This program's approach is based on four components: (1) to provide a support environment with a sense of trust and accessibility to Indigenous people, (2) weave cultural teachings and spiritual development and seek to achieve a balance in the physical, mental, spiritual, and emotional aspects of patients, (3) weave traditional and western approaches to health care and respect patient's choice of medicine, and (4) empower communities through the use of centres as community resources (Lemchuk-Favel, 2004). Since the creation of this strategy in 1994, 460 community-based health and healing projects have been developed across the country to increase accessibility and cultural-appropriateness of health care to First Nations, Metis, and Inuit communities (Government of Ontario, n.d.). This strategy holds holistic medicine practices at the root by recognizing that the spirit, body, and mind are all interconnected.</p>
<p><i>Indigenous Wellness Services in Ontario Health Institutions</i></p>	<p>In the Thunder Bay Regional Health Sciences Centre, Sudbury's Health Sciences North, Toronto's St. Michaels Hospital, and Sioux Lookout Meno Ya Win Health Centre Indigenous culture and perspectives have begun to weave traditional healing into mainstream services (Redvers et al., 2019). All of these centres have full-time Indigenous Patient Navigators and have policies that enable the use of smudging ceremonies (Redvers et al., 2019). Furthermore, all institutions have an Indigenous advisory council and board to provide direction to staff on how to provide culturally respectful, safe, and holistic services to Indigenous patients and their families (Redvers et al., 2019). The St. Michael's Aboriginal Community Advisory Panel was recognized to be first of its kind and has shown significant results in improving dialogue between Indigenous and non-Indigenous people regarding delivery of health services (Redvers et al., 2019). All of the institutions have interpretation and translation services, provide access to Elders in the community, employ traditional healers, and ensure all staff complete cultural competency and sensitivity training (Redvers et al., 2019). Lastly, St. Michaels Hospital in Toronto developed the Well Living House, which is a research centre that focuses on Indigenous infant, children, and family health (O'Brien, 2017). The vision of this centre is to ensure that every Indigenous child is born into a culturally relevant health care system by improving health care policies, services, and programs through an approach that recognizes both Indigenous and non-Indigenous ways of knowing (O'Brien, 2017).</p>
<p><i>Indigenous Health in British Columbia</i></p>	<p>The province of British Columbia can be seen as a leader in weaving Indigenous knowledge into health care and increasing accessibility of health care to Indigenous communities. The British Columbia Ministry of Health, health care authorities, and health regulators made two commitments to Indigenous communities to provide culturally safe</p>

	<p>and relevant care through the <i>Declaration of Commitment on Cultural Safety and Humility in Health Services</i> and <i>BC Health Regulators Declaration of Commitment</i> (Government of British Columbia, n.d.). Through these commitments, the Government of British Columbia has partnered with the First Nations Health Authority to work to eliminate disparities and inequalities in health status between Indigenous and non-Indigenous people residing in British Columbia (Government of British Columbia, n.d.). This partnership is guided by an underlying framework set in various First Nations Health Plans to ensure respectful incorporation of Indigenous knowledge (Government of British Columbia, n.d.). Through the establishment of the BC First Nations Health Authority, there is an existence of self-government and ownership over decision-making in the health care system. While this initiative is relatively recent, there is not a lot of data showing results of incorporating Indigenous knowledge. However, since the Government of British Columbia has recognized the decision making power of Indigenous communities over health care through the signing of the <i>BC Health Regulators Declaration of Commitment</i>, it is likely that Indigenous knowledge will begin to be incorporated into British Columbia’s health care system in a more intensive manner in the coming years.</p>
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### **Conservation**

Outcomes from a case study that examined negotiations between the Xáxli’p First Nation (XCF) community and the Ministry of Forests in British Columbia (B.C.) on Indigenous knowledge production processes that link local Indigenous knowledge and western science could provide good guidance for the Organization in how it proceeds. The case “exemplifies how Indigenous communities are engaging with science to create new kinds of knowledge constructions” (Diver, 2017). The framework for understanding the co-production of knowledge is provided for reference.

Broader implications: A framework for understanding the co-production of Indigenous knowledge and environmental politics.

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How is Indigenous knowledge shaping environmental science-policy negotiations?

The XCF demonstrates shows how Indigenous communities are using Indigenous knowledge to:

- improve agency understanding of core community interests.
- justify policy adjustments that accommodate community needs within existing legal frameworks.
- redefine the problem space in environmental policy negotiations to include social justice issues.
- legitimize and operationalize Indigenous land-use values through legally binding agreements.
- identify and mobilize champions within government agencies.
- encourage greater creativity in developing sustainable land management policies.
- compel agencies to acknowledge differences in cultures and worldviews, thereby unsettling dominant value structures.

How are environmental science-policy negotiations shaping Indigenous knowledge?

In response to ongoing science-policy negotiations, XCF leaders adopted strategic knowledge production strategies to:

- document and quantify specific components of Indigenous knowledge.
  - bring diverse community members together with respected elders to develop a collective vision.
  - generate strategic knowledge linkages between TEK and western science.
  - determine how and when to privilege TEK over dominant scientific formats.
  - train community members in scientific methods and technologies (alongside cultural training).
  - develop conservative information-sharing policies to help protect Indigenous knowledge.
  - establish community-driven planning processes, which enabled Indigenous self-determination of community identities and interests.
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### Lessons learned from a recent research study on Braiding Indigenous and Western

Knowledge Systems to Understand Freshwater Mussel Health in the Lower Athabasca Region of Alberta include a guiding framework to help find common ground by presenting methods in a story narrative (Hopkins et al., 2019):

1. The beginning of Our Story – Building Knowledge, Trust, and Relationships;
2. The Middle of Our Story – Being on the Land and the Water;
3. Sharing our Story – Collaborative Dissemination.

The steps this project team took were similar to how the TRI team works with communities in that the initiative commenced with a community meeting to:

1. learn more about each other;
2. Share what we knew about the topic through the both perspectives
3. Exchange ideas
4. Discussion how to move forward together

The Resilience Institute's approach differs in that it does not research communities, but rather codesigns approaches for capacity building towards adaptation and resilience.

The Dagupan City flood warning system in the Philippines exemplifies how a combination of Indigenous and scientific knowledge can be an effective response to flooding in the city. In establishing the system, the project team realized the following lessons that might be applicable to this work:

1. The use of their Indigenous knowledge helped mobilized local capacity while reviving and maintaining a local practice which is now used in disaster preparedness.
2. It is important to involve the community in risk assessment and designing of the early warning system.<sup>2</sup>
3. Learning occurred by visits to the community which encouraged citizens as well as local government officials to continue the good work and for improvements to be made (iterative learning) (Victoria, n.d.).

### Cases reviewed by TRI's student intern Ms. Brooklyn Ruston:

<p><i>Climate Change and Health Adaptation Program</i></p>	<p>The Climate Change and Health Adaptation Program (CCHAP) was developed in 2008 with the First Nations Inuit Health Branch of Indigenous Services Canada to support Inuit and First Nation communities to mitigate and adapt to health impacts caused by climate change (Richards et al., 2019). This program recognizes that Indigenous Knowledge is a key component to build resiliency against climate change, with a particular emphasis on the strength of cultural and kinship systems that work to build place specific adaptive capacity in communities (Richards et al., 2019). This program embraces First Nation leadership and governance structure and transfers the decision-making power to First Nation community representatives to ensure that community needs are met. A particular project that came out of this program was in the 6 Mi'kmaw communities in Nova Scotia that looked to address emergency management to climate change impacts (Richards et al., 2019). The approach to developing emergency management strategies involved conducting research, engaging community members, developing vulnerability assessment, and incorporating Indigenous Knowledge into all aspects of the strategies. This project looked particularly at the physical, mental, emotional, and spiritual impacts of climate change on health of community members (Richards et al., 2019). At various workshops, the project brought together Elders and youth to share Indigenous knowledge and pass along skills that can build capacity and increase resiliency to the next generation (Richards et al., 2019). By connecting Indigenous youth and elders, community resiliency is strengthened by building capacity of the next generation and strengthening community connections.</p>
<p><i>Indigenous Community-Based Climate Monitoring Program</i></p>	<p>In 2017, The National Indigenous Organizations identified the need to support Indigenous peoples in monitoring the effects of climate change in their communities to the Pan-Canadian Framework on Clean Growth and Climate Change (Government of Canada, 2019). This created the Indigenous Community-Based Climate Monitoring Program, which also aims to connect Indigenous Knowledge with science-based climate information to better inform adaptation actions (Government of Canada, 2019). This program has a budget of \$31.4 million dollars from 2017 – 2022 and has already funded 53 initiatives across all provinces and territories in Canada (Government of Canada, n.d.). Examples of projects that were funding in the 2017/2018 funding period included; (1) documenting local ecological and Indigenous Knowledge related to extreme weather events in various Indigenous communities in the Yukon, (2) establishing a community-led climate change research, analysis, and monitoring program with Indigenous perspectives in the Tsay Keh Dene Nation and Carcross Tagish First Nation, and (3) developing a youth-led climate monitoring program to collect</p>

<sup>2</sup> TRI has also learned the effectiveness of this strategy in the development of Local Early Action Plans with First Nations in Alberta.

	<p>Indigenous Knowledge about climatic and environmental changes with water quality in the Star Blanket Cree Nation in Saskatchewan (Government of Canada, n.d.). Since this program is recent there is no published outcomes from any of the projects, however, it is evident the Government of Canada recognizes the importance of Indigenous Knowledge in climate action.</p>
<p><i>2030 Northwest Territories Climate Change Strategic Framework</i></p>	<p>In 2016, the Government of the Northwest Territories started developing the 2030 Climate Change Strategic Framework to outline how the territory plans to respond to challenges presented by climate change (Government of Northwest Territories, 2016). It is recognized from the beginning of the framework document that traditional knowledge is going to be an important tool to understand and adapt to climate change. Throughout the document, the phrase ‘traditional knowledge’ is used 20 times and outlines that traditional knowledge and traditional knowledge-based research methods play a key role in understanding how climate change influences the landscape and what the implications will be for wildlife, traditional activities, and human health (Government of Northwest Territories, 2016). Furthermore, the framework makes it clear that traditional knowledge will only be used in appropriate and respectful ways, where traditional knowledge holders and Indigenous governments are involved and agree upon the use of the knowledge (Government of Northwest Territories, 2016). Traditional knowledge is also highlighted as a tool to identify resiliency and adaptation strategies in northern communities (Government of Northwest Territories, 2016). Furthermore, the framework identifies the partnerships with Indigenous communities to help document traditional knowledge in a culturally appropriate way, involving youth and elders, to ensure traditional knowledge and Indigenous languages are passed on to future generations (Government of Northwest Territories, 2016). Compared to other territories with a high population of Indigenous peoples, the Northwest Territories are a leader in weaving Indigenous knowledge into climate change action. However, since this framework will not entirely be implemented until 2030, the true scope of weaving will not be fully understood.</p>
<p><i>Inuit Traditional Knowledge and Adaptation to Climate Change in the Arctic</i></p>	<p>Inuit traditional knowledge has been studied by researchers from various universities across Canada to bring its importance to climate change adaptation in the Arctic (Pearce et al., 2015). With the arctic ecosystems changing at a more rapid rate than a lot of the world, adaptation has become a huge priority in these regions. Inuit have experienced environmental change for thousands of years in the arctic, however, Inuit now live in permanent settlements whereas they were previously nomadic, which brings different challenges to their way of life (Pearce et al., 2015). The work by Pearce et al. (2015) highlights that even if Inuit way of life is different than it historically was, traditional ecological knowledge still plays a very important role in flexibility and innovation in hunting, hazard avoidance, and emergency preparedness with current climate change projections. Pearce et al. (2015) notes that learned experiences, oral traditions, and group memory of past situations in regard to extreme weather events play a key role in this process. From this case study, it was recommended that the importance of Inuit traditional knowledge be recognized by policymakers when trying to increase resiliency in Indigenous communities.</p>