

Traditional Ecological Knowledge and Western Science

by

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Chapter 1

Abstract

This thesis is the exploration of Traditional Ecological Knowledge (TEK), the examination of scholarly perspectives on what TEK is thought to be, how it is employed and how may it be better integrated into the decision-making process of non-Indigenous organizations whose activities may have impacts on the environment. Through a qualitative content analysis of scholarly works and grey literature, this research seeks to understand TEK as an Indigenous knowledge system and its relationship with Western science. This study will examine prior integration of these two knowledge systems to look for a more holistic approach to environmental understanding through ethical integration, while keeping in mind the epistemological differences and responsibilities surrounding knowledge sharing.

Introduction

This thesis presents the findings of my master's research on Traditional ecological knowledge (TEK). This study examines how scholarly perspectives conceptualize TEK, how it is employed, and how it may be better integrated into the decision-making processes employed by non-Indigenous organizations whose activities have environmental impacts. By analyzing the different scholarly positions on these two orientations I will be able to gain better understanding of the implementation of TEK within the field of Environmental sciences for the purposes of better decision-making. This dual lens (Indigenous and non-Indigenous understandings of ecosystems) may offer a more holistic approach; one that could yield enriched results and better understanding of the field of environmental sciences and its relation to Indigenous peoples and

communities. Such a holistic approach could go on to inspire new ideas, and initiatives, challenge existing rules or mores, and encourage diverse processes.

Chapter One will be an introduction of the study that summarizes key aspects of the study. In Chapter two, the literature review will unpack the scholarship related to TEK, its philosophical underpinnings, while also examining its prior integration with Western science and the impacts this integration may have on decision-making processes. Chapter Three will introduce the methodological approach to my research, my “ologies”, and biases. I will be employing a content analysis of the scholarly works on the subject to come to understand what TEK is considered to be, how it is employed, and how its integration may impact non-Indigenous organizations decision-making on the subject of the environment. In Chapter Four I will share the findings or conclusion of my research, before moving into discussing the implications and potential recommendations within Chapter Five.

Background for the Study

When discussing the subject of what some call Indigenous sciences or an Indigenous approach to understanding environment or ecology, one will find that this specific approach, relationship or thought processes has many names. I have chosen to use Traditional Ecological Knowledge (TEK) as the title for this knowledge. There are other names that emerge on the subject that will be resident within my research. For example, the literature explores different terms, Indigenous knowledge (IK), Indigenous science, or Traditional knowledge. I was first introduced to this Indigenous approach to understanding ecosystem(s) under the name TEK. While conducting my research, I came to understand that some scholars distinguish these names

as representing different conceptual understandings, frameworks, or approaches. TEK may be understood as both Indigenous knowledge and Traditional knowledge, it is more centralized on environmental knowledge, relationships, interactions, and reciprocal responsibilities therein. Indigenous knowledge can be understood as a nested system of knowledge in which oral tradition, Indigenous knowledge, and Traditional knowledges, and TEK exist relationally and are interconnected, yet possess unique and distinct conceptualizations. As Berkes (1999) explains, “TEK is a complex cumulative body of knowledge, beliefs and practices developed by Indigenous peoples and communities” (p.5). Although Berkes (1999) later goes on to explain that there is no universally accepted definition of TEK, Menzies (2006) puts forth that “there is some scholarly agreement that it is a form of place-based knowledge that is developed over many generations through a close relationship that Indigenous people have with land, water, plants, animals, and ecosystems” (p.6). These two explanations combined start to work toward developing a foundational understanding of the multifaceted knowledge that is referred to as TEK.

Berkes (1999) seems to be an often-cited source in Western scientific works when attempting to formulate an understanding of the knowledge Indigenous peoples employ to interpret their environment. Many recently published scholarly sources use Berkes (1999) explanation of TEK’s complexity and community ties (Bartlett, 2012; Johnson, et al., 2016; Carter, 2019; Benner, 2023; Bocking, 2023). TEK is a knowledge that is dependent on longevity through multiple generations; this knowledge accumulated over a long period of time means it may be considered to be historical, dynamic and adaptive. Since TEK is in part historical due to its foundational ties to place, culture and relationships through past generations, its integration into everyday life enabled its transmission to subsequent generations and supported it’s

survivance. These everyday practices of TEK emerge from a moral, ethical and spiritual code (Deloria, 1997; Stonechild, 2020 & 2024). The core concepts and principles are thought to have portions moored in overarching practices, while their daily applications remained adaptive and innovative, shaped by each generation's interactions with and their unique understanding of their surrounding environment (Johnson, et al., 2016). Through trial-and-error, observations, understanding, and relationships with the surrounding ecosystem were accumulated, connected and transmitted across generations through cultural practice.

This Indigenous approach to interacting with and understanding one's environment from an integrated multifaceted lens is sometimes described in contrast to some approaches within Western science (Deloria, 1997; Bocking, 2023; Gagnon, et al., 2023). Western Science encompasses a diversity of approaches and purposes, like knowledge creation, conservation and ecological understanding, and in some contexts, it has emphasized the systemic analysis of ecosystems, which has shaped the understanding of the environment within Western science traditions (Reyes-García, 2015; Mistry, 2016; Tengö, et al., 2017). Many TEK- based approaches emphasize relationships among ecosystems, where environmental knowledge can be understood through observation, experience and culture. Western science seeks to understand through the practice of division, compartmentalization or the atomization of the ecosystem into components that are then studied individually from the others (Berkes, 1999; Nadasty, 2003; Menzies, 2006; Tengö, et al., 2017; Turnhout, 2018; Kovach, 2021). Ecological studies may look at population dynamics, habitats, or a species health to understand a specific environmental change, TEK may approach the same inquiry through different means, it may look at relationships and interactions between species, their environment, and human responsibilities and their reciprocal interactions. Often environmental impacts on a single species of flora or fauna are observed separate to that of

any surrounding species within the same ecosystem (Gagnon, et al., 2023). As Berkes (1999) states “this compartmentalization of the components of ecosystems serves the study of environment from Western scientific orientations that do not embody Indigenous peoples’ recognition of their environment being more than physical landscape: it includes the notion of environment as a living entity” (p.6). The differences between the two approaches goes beyond methods but reflect deeper understandings of what environment represents and the relationships that can exist within.

For Indigenous people, land is often thought of as an animate entity that contains or possesses spirit (Deloria, 1997; Kimmerer, 2013; Stonechild, 2020 & 2024). Indigenous understanding does not position the land as a resource but as a living relation within a network of relationships, responsibility, connections, and reciprocity. The land or the earth provides sustenance, and it is thought that through this provision, we have developed a child/mother relationship with land or *mother earth* (Martinez, 2018). The possession of spirit is linked to life, not as in the sense that individual components are understood as living, but that the accumulated relationships between beings and place come together to create an entity known as land or *Mother Earth*. This entity participates in relationship with humans/nonhumans and through this relationship becomes as a relation due to layers of provision and reciprocity.

TEK has been viewed by scholars of Western scientific traditions as a significant departure from some established approaches used to investigate the environment (Hicks, et al., 2010; Bocking, 2023). Nadasty (2003) writes that “for many academics of Western science orientation, situating TEK within a preexisting and accepted Western scientific framework may be difficult due to the perceived differences resident in the respective methodologies” (p. 6). Scholars agree that Western science is thought to be centered around empirical study and can be

seen as a reductionist approach (Gunn, 2024; Edgar-Webkamigad, et al., 2026). These distinctions do not suggest that these knowledge systems are entirely separate, TEK and Western scientific approaches can be seen to exist in relation to one another while remaining their own unique understandings and methodologies. As Kovach (2015) states “since TEK is a place-based observational approach and cultural knowledge-based system, it has been seen as a narrative approach toward understanding one’s environment” (p.55). Traditional systems such as those that inform TEK tend to have large moral and ethical contexts (Deloria, 1997; Kimmerer, 2013; Stonechild, 2020 & 2024). According to Berkes (1999) “TEK is derived from Indigenous Knowledge and thus there is no separation between nature and culture” (p.9). While Western science and TEK can be considered different orientations, they can overlap, interact, and contribute different forms of understanding.

As the scholar Lyotard (1979) writes “Western science is a research driven paradigm that relies on evidentiary insight, verifiability and efficiency” (p. 25). TEK and Western science may have been in some instances placed in opposition to one another intentionally, ignoring some of their similarities. Later Lyotard (1979) puts forth that “these two modes have been traditionally placed into opposition by colonial mechanisms existing within institutions such as universities as well as centralized power structures that place Western science above TEK as a scientific mode of inquiry and investigation” (p.25). The asymmetrical power relationship could be seen to place TEK at a disadvantage long before the knowledge is even interacted with due to its originating language being different than that of Western science. Nadasty (2003) writes about the difference in language:

Aboriginal peoples wish to participate in co-management, land claims negotiations, and processes that go along with this new relationship, then they must engage in dialogue

with wildlife biologists, lawyers, and other government officials. First Nations peoples can of course speak to these officials any way they want, but if they wish to be taken seriously, then their linguistic utterances must conform to the very particular forms and formalities of the official linguistic fields of wildlife management, Canadian property law, so forth (pg5).

Many scholarly sources discuss the surrounding history of Western sciences placing TEK in a marginalized position of authority on the subject of environment (Turnhout, 2018; McElwee, et al., 2020). Authors outline the differences between a narrative or “fable” based approach and empirical data gathering while also observing that the language employed in the discussion of both approaches is a mechanism of dismissal and an active extension of colonial process (Lytard, 1979; Kovach, 2021; Bocking, 2023; Singelton, et al., 2023; Gunn, 2024). As Berkes (1999) states “Indigenous knowledge is treated as a challenge to the dominant positivist-reductionist paradigm in Western science” (p.11). The positivist-reductionist paradigm has been highly influential to many parts of modern society such as in the areas of science, economics and public policy because this approach influences how decisions are made by prioritizing measurable evidence, experiments and data. Though the positivist-reductionist approach can be thought of as being deeply embedded in many modern institutions it is not universally agreed on as the only valid way of making decisions. Different ways of knowing like Indigenous knowledge(s) can be complimentary to other ways of knowing, especially in complex systems such as health, biodiversity and climate change.

In academia in recent years, there have been efforts to more fully, fairly and justly incorporate Indigenous peoples and cultures as distinct groups and nations into various fields of study. The Canadian government has been attempting to support such integration through

encouragement and mandated consultation and ethical involvement (Mantyka-Pringle, et al., 2017; Tengö, 2017; Turnout, 2018; Ekert, et al., 2020; Aporta, et al., 2024). Nadasty (2003) writes about this initiative:

These efforts by government, which include the negotiations of land claims and self-government agreements and the cooperative management (co-management) of local resources (especially wildlife), are intended to improve the position of First Nations peoples by granting them significant roles in their governance and the say in the management of local land and resources. (p.1)

Since the colonial mechanisms existing within non-Indigenous institutions centralized power structure place Western science above TEK, the research will seek to address TEK differently. TEK is its own, complete and epistemologically different approach to environmental understanding (Tengö, 2017; Berner, 2023; Bocking, 2023). TEK and Western science should not be viewed as mutually exclusive systems of knowledge that are in competition with one another. They should be considered complementary approaches, each providing distinct strengths and views of understanding and interacting with one's environment. The recognition of the value of each provides a comprehensive and effective foundation for understanding, uniquely equipped for addressing complex environmental challenges. Since TEK is a generational place-based understanding of an Indigenous knowledge system and relationships with environment, it should be examined within specific region of development due to its longevity and unique understandings before determining how Western scientific approaches may be incorporated (Cajete, 2018; Chen, et al., 2020; Dorji, 2024). Such understandings and subsequent considerations may assist in reducing some of the detrimental social and cultural impacts experienced by Indigenous peoples and communities that have had to learn and navigate Western

colonial processes in order to understand research impacts and governance of their lands (Ataria, et al, 2025). This includes impacts on their respective communities as well as such things as land claims, natural sciences, forestry, water, and resource management (Nadasty, 2009; Menzies, 2006; Ojeda-Zavala, 2026). The recognition of TEK as an autonomous and culturally grounded knowledge system requires moving past questions of scientific validation to consider how, and when should it be engaged with by Western science.

In recent decades, Western science has become more interested in Indigenous knowledge systems, TEK, and their relationships with environment (Berkes, 1999; Carter, 2018; Eckert, et al, 2020; Bocking, 2023). The knowledge contained within TEK, along with its long term adaptive and integrated approach, has the potential to inform and contribute to various fields of scientific study (Drew, 2005; O’Flaherty, et al, 2008; Hicks, et al., 2010; Henri, 2021; Ojeda-Zavala, 2026). Berkes (1999) writes about the growing interest in TEK as comprising of two key factors “the need for ecological insights from Indigenous practices of resource use, and the need to develop a new ecological ethic in part by learning from the wisdom of traditional knowledge holders” (p. 14). These two factors highlight that TEK consists of more than a collection of ecological observations or resource management practises; it reflects relational and place-based system of understanding that has developed through generations of interactions, observations and relationships between Indigenous peoples with their environment. TEK’s significance is more than what it can contribute to environmental research, it challenges assumptions of ecological knowledge is produced, how its validated and applied. TEK provides the opportunity to reconsider environmental decision-making approaches by emphasising relationships, responsibility and long-term ecological relationships between human and nonhumans. The integration of knowledges contained within TEK may inform and assist in the development new

approaches to resource use and environmental health (O’Flaherty, et al, 2008; Miller, et al., 2025; Mashizi, et al., 2025). The growing recognition of the need for a different approach to understand the environment has emerged due to the impacts of economic developments and climate change. The integration of Indigenous knowledges within existing process raises questions and concerns from Indigenous people regarding how these knowledges are understood, represented and applied. Berkes (1999) states:

The questions of the cultural and political significance of traditional ecological knowledge involve a series of linked issues, including worldviews, cultural survival, ownership of knowledge, traditional or intellectual property rights, empowerment, local control of land and resources, cultural revitalization, and self-determination. (p.23)

TEK should not be seen as a knowledge product or resource that is readily accessible; it is an integrated cultural approach to understanding one’s environment (Cajete, 2018). It possesses diverse frameworks and epistemologies. TEK may be understood by some as a subset of Indigenous knowledge (IK) (Eckert, et al., 2020; Henri, et al., 2021; Dorji, et al., 2024). IK is viewed by most colonial legal systems as being part of public domain, which can then be accessed and used by non-Indigenous individuals, corporations or organizations. Ownership is a key component in considerations surrounding the application, access and use of TEK (Batiste & Henderson, 2024).

Context

A critical analysis of the literature surrounding the subject of TEK can bring understanding to interpreting the different intersecting layers of information resident within

Indigenous knowledge systems and how these knowledges pertain to the surrounding environment. The integration of a layered Indigenous understanding and relationship approach could contribute to the development of a new approach with impacts felt across multiple fields of Western science (Benner, 2023; Berkes, et al, 2000; Salomon, et al., 2018; Lertman, 2023). Understanding the place-based knowledge contained within TEK can give a more informed and holistic understanding of the environment (Berkes, 1999; Menzies, 2006; Cajete, 2025). I will seek to provide recommendations of how to approach a more ethical integration or interaction with TEK into the decision-making processes employed by non-Indigenous actors whose initiatives may affect the environment (Bartlett, 2012; Benner, 2023). Additionally, I hope that this approach will contribute to bringing greater understanding of Indigenous perspectives into the field of environmental science. I also hope that this research may go on to assist in the creation of a framework for working in good ways for researchers, thereby restoring Indigenous traditional practices and situating land-based education as a recognized field of study within academia. Menzies (2006) writes “recent efforts to conserve biodiversity and to manage based on the health of entire ecosystems have led to a new valuation of TEK by Western science and colonial governments and institutions” (p.5). The increased recognition of TEK by these institutions shows a growing understanding of TEK’s value as a knowledge system in biodiversity conservation and ecosystem management. This recognition should also acknowledge that TEK is a knowledge system that is rooted in Indigenous relationships, experiences, responsibilities, and reciprocity.

Many authors within Western science write from the hopeful perspective that integration of TEK and Western science will lead to break throughs within their fields of specialization (Benner, 2023; Mashizi, et al., 2025; Miller, et al., 2025). This perspective often values the

potential contribution of TEK to scientific understanding, but it does not consider the cultural political and relational contexts within TEK. Indigenous peoples hope that understanding will lead to empowerment and increased rights on their lands and within their communities (Nadasty, 2003; Menzies, 2006; Battiste and Henderson, 2024). Menzies (2006) cautions that “despite the fact that current TEK research and documentation may contribute positively to a First Nations’ land and resource claims, or might increase the community's involvement in resource management, community members might be reluctant to have their knowledge recorded” (p.12). Although current land claim and co-management initiatives may suggest that Indigenous peoples are gaining greater empowerment and control over their lives, lands and self, these processes do not always result in meaningful authority or decision-making powers. Inclusion of Indigenous knowledge(s) within a colonial governance structure may still reproduce existing asymmetrical power relations if Indigenous communities do not retain control over how their knowledge is accessed, interpreted and or applied.

Throughout the literature explored in this study there is a prevailing concern expressed by Indigenous Elders regarding disruptions in the transmission of TEK to younger generations and reduced participation in traditional subsistence practises (Turner and Clifton, 2006). Often traditional harvesting, subsistence and observational learning means to be out on the land physically within communities and territories (Nadasty, 2003; Menzies, 2006). Many Indigenous community members must balance time spent on the land with indoor institutional spaces in order to participate in governance (their own and the Canadian government), engage in land claims and policy analysis, pursue employment and education opportunities, and children attend formalized schooling much of the year (Menzies, 2006). TEK should not be understood as existing only within a historical traditional practise, it is a living adaptive and continually

developing knowledge. It is developed through contemporary experiences, relationships and responsibilities to community and land. The value of Indigenous knowledge is not determined solely by its traditional origins but by the ways in which it reflects Indigenous relationships, ethics and environmental understanding. Since this knowledge is a living and relational system its loss would mean more than the disappearance of knowledge, it would affect relationships, practises, and culture in which the knowledge is sustained and transmitted. Turner and Clifton (2006) discuss the loss of Indigenous knowledge, stating that “in many ways it is the small details of cultural and environmental knowledge that are most important and they are the most in danger of slipping away in the society-wide rush toward globalization and cultural homogenization” (p.85). The concerns expressed by the Indigenous elders reflect not just the potential loss of TEK but the potential erosion this could create to cultural relationships and community processes that sustain knowledge transmission across generations.

Purpose and Research Questions

The purpose of this qualitative content analysis is to explore what the scholarly position of what TEK is, how it is employed, and what these sources say about its better integration into the decision-making process employed by non-Indigenous organizations whose decisions and activities may have significant consequences to the environment. This work could be viewed as an interdisciplinary approach that brings together Indigenous studies and Environmental science to examine different frameworks of understanding, knowledge systems, and relationships with the environment. This holistic approach to environmental understanding has the potential to be impactful to not only non-Indigenous actors whose initiatives impact environment but also Indigenous peoples and communities. The differences in epistemologies and methodologies have

potential to create an informed holistic approach to understanding environment by bringing together diverse frameworks of knowledge and different ways of knowing. One way in which TEK can inform Western science is through the development of intergenerational, place-based understanding of environmental change. As Menzies (2006) states “since TEK is cumulative and dynamic, it provides historical understanding of environmental realities and change; one that Western science has difficulties achieving” (p.8). TEK provides an intimate understanding of environmental topics and issues that other forms of research and experimentation cannot provide due to a spatial temporal divide. Further Menzies (2006) writes “It is at the local level of community and territory where these understandings are developed through observation, inference, and predication” (p.9). Western science can complement TEK through its diverse methodologies and approaches to examining ecological systems, in knowledge or specialization of individual processes, species interactions, communities and broader ecosystems. These approaches provide different perspectives for understanding environmental relationships and change. When considered along with the place based, intergeneration relationships contained in TEK, can contribute to a more comprehensive approach to environmental decision-making. With this study, I seek to answer the following two research questions:

1. What are the prevailing scholarly views on what TEK is and how might it be employed?
2. How might TEK be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences?

Methodology

Through a qualitative content analysis, this research works towards developing an understanding of how TEK is describe and conceptualized within the literature, identify patterns and concepts, themes, and subthemes that contribute to the broader understandings of TEK. The content sample will consist of scholarly works that seek to understand and explain the Indigenous knowledge system referred to as TEK. Within the academic literature and grey sources, there will be examples of previous integration of TEK within Western scientific approaches to environment, co-management examples and relevant frameworks. A content analysis will allow conceptual clusters or patterns to emerge, which will in turn bring forth themes and subthemes. These themes and subthemes will contribute to a deeper understand of TEK as an Indigenous knowledge system, while informing the development of governance frameworks, and an appropriate Indigenous methodology.

Kovach (2021) states that “TEK consists of oral transmission of data; within Indigenous epistemes applied to Indigenous methodologies, collecting data is the gifting of another’s story to the researcher” (p.156). The Indigenous methodology of storywork is a methodology that fosters and nurtures relationship, kindles reciprocity, and evokes responsibility. As Kovach (2021) writes “TEK is the orality, storytelling, and transference of place-based knowledge through intergenerational transmission. Arising from oral tradition, both hearing story and sharing story are pivotal considerations within an Indigenous conceptual and methodological framework” (p.156). The cultural principles of relationality and spirituality position the environment as an ecosystem that is made up of “all of my relations,” which is a vastly different thought/approach then Western science. (Deloria, 1997; Kimmerer, 2013; Stonechild, 2020 & 2024; Cajete, 2025). Western science positions humans as external actors possessing powers they can exercise over

the environment (Turnhout, 2018; Berkes, et al., 2000; Lertzman, 2023). The exploration of further differences between these two approaches are examined In *Indigenous Methodologies: Characteristics, Conversations, and contexts*, where Kovach (2021) states:

It is no wonder that narrative, as a form, is the primary means for passing knowledge within Indigenous traditions, for it suits the fluidity and interpretative nature of ancestral ways of knowing based in holism, an intangible animism, and a tangible relationship with community and place. (p.157)

TEK's fluid and interpretive nature means that it treats knowledge not as a static or universally transferable but contextual, relational and responsive to place, community and experience. This adaptive nature possesses some issue for organizations that operate on standardized replicable evidence but provides strength by allowing knowledge to adapt to changing ecological conditions and the implications this has on local contexts.

The subject of knowledge sharing between Indigenous and non-Indigenous is expressed in the writings of Battiste and Henderson (2024) who note that “what is needed is a trans-systemic synthesis that can accommodate the transition from Indigenous Peoples' knowledge to Eurocentric knowledge and vice versa” (p.73). This transitioning or the back-and-forth movement between knowledges may be conceptualized by employing the visualization of braiding. There are different conceptualizations of braiding as an Indigenous methodology, it is important to state that this is the version this research employs. Within this study, braiding functions as the methodological approach through which TEK and Western science may be integrated or brought into relationship while maintaining individual integrity of knowledge(s). Braiding is steeped in Indigenous epistemology and presents an easily understandable visual. Braiding at its core contains the 4 (currently expanded to six) R's identified by Kirkness and

Bernhardt (1991) which are “Respect, Relationship, Reciprocity, Relevance, Responsibility, and Representation, these tenants lead to mutual learning and self-determination” (p.14). These principles are the foundation of the methodological approach to how knowledge is engaged with, shared, interpreted and represented through this research. This version of braiding employs the concept that Indigenous and Western approaches to understanding the environment are important and should be equally represented in the process of integration.

The methodological approach of braiding could be seen in an example such as the combination of community-based observational knowledge acquired over long periods of time, supported by the technical and analytical dimensions of Western science. This co-production could contribute to a more holistic understanding of an ecosystem by bringing together different forms of inquiry and interpretations of environmental relationships. As stated by Kovach (2021) this is “because orally stored and shared stories are born of connections within the world and are recounted relationally, stories braid the past, present, and future generations together” (p.158). This methodology recognizes the intergeneration observations as a legitimate knowledge complimentary to empirical scientific inquiry instead of as supporting evidence. This sharing of intergenerational knowledge can assist to inform Western science through the accessing of long-term observations and experiences, which may assist in guiding empirical data gathering and interpretation. The integrated approach of TEK has potential to also assist Western science in the “zooming out” from one species to see how all the pieces interact within an ecosystem. Braiding as a methodology recognizes barriers that influence sharing and interpreting knowledge across knowledge systems. One such barrier is that of traditional Indigenous languages. Concerns around meanings within language are addressed by Nadasty (2003) who noted that “many of the terms used in relation to land and wildlife management like subsistence, conservation and

traditional use, have no counterparts in the language or cultural practices of Indigenous peoples, the understanding of TEK can inform these Western scientific processes” (p.119). Recognition of linguistic and cultural differences are important methodological considerations when integrating Indigenous and Western knowledge systems.

Researcher Positionality

Within Indigenous studies a positionality statement is often used to make declarations of oneself. A positionality statement in most disciplines is an acknowledgement of the limits and conditions of the researcher’s knowledge. As Kovach (2021) asserts “the self-location of researchers provides an opportunity for the research participant to situate and assess the researchers’ motivations for the research, thus beginning the relationship that is elemental to story- based methodology” (p.159). When conducting research, one should situate themselves in relation to their research and declare biases and concepts of understanding that the researcher brings to their methodology (Wilson, 2008). Kovach (2021) continues by stating that “listening intently to one another’s stories, as a method of knowing, elevates the researcher from an extractive exercise serving the fragmentation of knowledge to a holistic endeavor that situates research firmly within the nest of relationship” (p.160). I acknowledge that my knowledge is incomplete and situated, and that I have responsibilities regarding how I interpret and represent knowledge entrusted to me.

When I was approached by my employer, the previous Dean of Environmental Sciences to review the topic that has since gone on to become the topic of my thesis, I was reminded of my Grandparents on my Father’s side. My Grandfather was born in the city of Warwick in Benson County North Dakota, on the lands of the Dakota Spirit Lake tribe. He resided on the

family farm at Spirit Lake first nations, until he was 1 year of age, after which my great grandparents relocated to Arnaud Manitoba. I have dual citizenship (Canadian and American) from him. My Grandmother was born at St. Elizabeth Manitoba; her family has long standing generational ties to the area. My father is a member of the Manitoba Métis Federation. For many years my Family owned a large farm in Arnaud, and they went on to be employed by the Provincial Government as Weed specialists for the Agricultural sector. As a child I would often accompany them out on the land while they checked for native and invasive species. They would often survey farmers' fields and look at such things as invasive species in ditches along provincial roads. We would travel out on the land in work trucks and when we would get out to walk the fields and ditches, my grandparents would often tell me about the plants, ecosystems and agricultural impacts of the plant life we were observing. They then would discuss aspects of TEK with me; stories and lessons about the medicines and plant life that surrounded us. If there was time or the opportunity, we would also pick berries as there were always pails in the truck. TEK and TEK transference, storying, and braiding are methodologies and epistemologies that are steeped in community relationships that can involve the finding and knowing of oneself. I did not realize as a child that what I was experiencing was a real-life framework of integration of TEK and Western science. I was learning two forms of knowledges and integrating them within myself. Though both of my grandparents have passed on, I hope that my research, my work with TEK, and the development of an integrated framework approach will honor my Elders and their legacy.

Chapter 2

Literature review

The following chapter reviews of the literature related to the area of Traditional Ecological Knowledge (TEK) and serves as a scholarly grounding for this study. This chapter is divided into three sections; Traditional Ecological Knowledge, integration and decision making, and Indigenous storying as Methodology. These sections are intended to support my efforts in responding to the research questions of this study:

- What are the prevailing scholarly views on what TEK is and how might it be employed?
- How might TEK be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences?

Although there is no consensus or pan-Indigenous understanding of TEK, there are many recurring themes resident in the understandings of TEK and how many interact with their respective environments through an Indigenous perspective. Section one will explore the fundamental aspects of TEK including oral storying, nonhuman relations, and reciprocity. The second section explores different ways that TEK has been integrated into the decision-making process of non-Indigenous organizations whose decisions and or activities might have significant environmental consequences. This section is important because it shows the integration of TEK in environmental approaches that yielded promising results in affecting ecosystems yet were later discarded because they did not align with capitalist priorities. This resulted in affecting the decision-making processes in these areas, such as whether endeavour to maintain TEK would

continue or whether Western methods of mass production would be reinstated. The final section will explore literature on approaches to Indigenous methodologies (e.g. braiding and weaving), while building an understanding surrounding the importance of story within these methodologies that will assist in understanding an Indigenous perspective to the integration processes.

Within this literature review, scholarly sources were selected to help survey prevailing conceptions of Traditional Ecological Knowledge or TEK. This survey involved the compilation of scholarly sources reflecting the work of authors with different academic and cultural backgrounds. These sources comprised of such writings as academic monographs, edited editions, journal articles, and grey literature. The literature was explored in depth in order to understand what scholars say around the Indigenous knowledge systems concerning the understanding of ecosystems and how the integration of that knowledge impacted the decision-making process.

Traditional Ecological Knowledge

TEK consists of oral, storying, and narrative approaches to knowledge sharing that focuses upon place-based ecosystems (Deloria, 1997; Stonechild, 2020; Kovach, 2021; Stonechild, 2024; Cajete, 2025; Jacobs, 2025). This high-level overview of TEK is in line with Menzies (2006) who wrote “Traditional Ecological Knowledge is the term used to describe the knowledge and beliefs that Indigenous peoples hold of their environments that is handed down through generations” (p. 6). Indigenous oral traditions, that which is central to TEK, are complex systems of knowledge (Deloria, 1997; Berkes, 1999; Stonechild, 2020 & 2024; Cajete, 2025). As a place-based and spiritual orientation to territory, TEK is passed down from generation to generation and informs how other aspects of Indigenous knowledge such as histories, ecological

knowledge, wisdom, and spiritual values are understood (Deloria, 1997; Nadasty, 2003; Menzies, 2006; Stonechild, 2020 & 2024; Jacobs, 2025). Knowledge transmission is generational, with this knowledge community values, ethics, responsibilities, and cultural obligations that shape relationships between people, lands and living beings are also conveyed. Indigenous epistemologies do not separate knowledge from guiding values, interpretations or applications. These values provide relational context and meaning about the ecological observations that inform the communities. On the differing aspects of Indigenous knowledge Battiste and Henderson (2024) write “Indigenous Peoples' knowledge is often generated and communicated in an indirect manner through dreams, stories, ceremonies, personally or communally activated events, dances, songs, demonstrations, and performances” (p. 74). Indigenous knowledges are stored differently than Western science. The storage of this knowledge is expressed in the writings of Jacobs (2025) who notes:

[O]ur Elders, especially our ceremonial leaders, medicine Peoples, and storytellers store large bodies of our cultural and ecological data and are therefore living bodily libraries of Indigenous Science. As living libraries, Elders play a crucial role in the ways Indigenous data are acquired and shared within our Indigenous communities. (p.22)

Oral discourse and tradition constitute a foundational framework through which observations, metaphors and philosophies are stored, shared and negotiated (Jacobs, et al., 2025). The process of adaptation is described by Pierotti (2011) who wrote that

TEK can be changed by each new generation in the same way that each new generation of graduates in ecology or evolutionary biology go out and make new discoveries that add on to the base of empirical knowledge that currently exists in those fields. (p. 13)

This comparison shows that both knowledge systems may be considered to continue to develop through ongoing observations and experiences. Though this comparison should not be understood to suggest that TEK and Western science evaluate, retain or revise knowledge through the same process. Western science may revise or replace existing theories based on new evidence, while TEK incorporate new observations and understandings within existing relationships to place community and culture. For individuals within oral cultures, an orientation toward cultural transmission allows for cultural expression, integration, adaptation, and the sharing of knowledges through relationships are cultivated for survivance (Stonechild, 2020 & 2024). Through oral tradition, story becomes both a source of content as well as methodology; it becomes the framework of rules and ideas of techniques and principles applied to all aspects of life within that ecosystem (Ives, 2024). Stories may be continually interpreted and retold, this is guided by relationships, community protocols, Elders, lived experience and responsibility. The authority of knowledge is based on its relevance, relational accountability, and through its generational practise and participation within the community.

TEK has an adaptive nature that does not mean that knowledge is individually constructed or without accountability, the knowledge is developed, affirmed, and refined through lived experience, relationships and collective understanding within community and place. These guiding relationships include Elders, community members, land, nonhuman relations, and subsequent generations, each contribute to the continued development and transmission of knowledge. The continuity of TEK is through these relationships that provide context meaning and responsibilities around knowledge application and sharing. This relational understanding central to Indigenous knowledge systems is conveyed by Cajete (2018) who wrote about the importance of relationality, “relationships are the corner stone of tribal communities and the

nature of expression within communities is the foundation of tribal identity” (p. 19). The interpretation and transmission of TEK could be considered to be inseparable from human, nonhuman, community and spiritual relationships that sustain these knowledge systems through generations.

Oral teachings can contain within them deeper meanings that strengthen communal identity, maintain and develop relationships with the land, and ensures cultural continuity (Johnson, et al, 2024; Thorton, et al., 2024). Oral teachings not only strengthen relationships but begin to develop relationality as is expressed by Cajete (2018) who writes “It is the participation with the communal tribal landscape that evolved directly from relationship to a place or places in their historic past and in their present that defines them as a people” (p. 17). It is the development of communal intimacy that emerges from sharing of, and existence within, ancestral knowledge (Thorton, et al., 2024). It is *intimacy plus* (Martinez, 2008), the concept that knowledge is more than a cultural construct that creates intimacy between individuals and the group community but also with the ancestors. This knowledge is an intimate linkage amongst all the people who occupied a region (Stoffle, et al., 2024). Intimacy plus represents the connections between all living and non-living ancestors and the generations whose experiences and teachings contributed to TEK as a knowledge system (Martinez, 2008; Jacobs, 2025). Stories and oral narratives inform and reflect social norms, responsibilities, and protocols often acting as foundational law. Deloria (2003) states that “tribal religions are actually complexes of attitudes, beliefs, and practices that are fine-tuned to harmonize with the lands on which the people live” (p. 69). These stories can contain within them complex encoded geographical information (Ives, 2024). The naming of geographical formations is resident within narratives and behaviours that link human and nonhuman entities to their environment, transforming the landscape into a living record of

relationship and knowledge (Stoffle, et al., 2024; Thorton, et al., 2024). Indigenous religion, spirituality, animism, and philosophy teach that all things are connected, and all things are related (Deloria, 1997; Stonechild, 2020 & 2024; Johnson, et al., 2024; Thorton, et al., 2024). Building upon this philosophy Cajete (2018) states “Traditional Indigenous teachings express symbolic representations of culture through the continuous telling and retelling of the myth-dreams that concern their deepest connections within nature” (p. 20). Through the process of sharing these stories the knowledge remains connected to relationships, responsibilities and place. Oral traditions provide both continuity and adaptability, TEK can respond to change while still being moored within ancestral teachings, relationship and responsibility.

Oral storying reflects a diverse and intricate web of relationships that extend from nuclear family, extended family, clan, and tribe to the natural environment (Jacobs, et al., 2025). The web of relationality is expanded on by Cajete (2018) who wrote that

The Native community conveys a message about a human society interacting with nonhuman life in a neighbourly world. In this sense, community itself becomes a story, a collection of individual stories that unfold through the lives of the people of that community. This large community of story becomes an animate entity visualized through the special attention given it by its tellers and those who listen. (p.20)

Knowledge keepers and story tellers review tribal oral history, ensuring the validity of generational transmission in retelling of the collective memory; this accuracy control assists in the validation of the historical record through shared accountability (Stonechild, 2024; Jacobs, et al., 2025). This point is clarified by Martinez (2008) who writes “Indigenous peoples have cultural knowledge, a sense of self rooted in their ancestry, a knowingness of being and breathing; an understanding of nation of interdependence, of place and space” (p. 214). Through

storytelling knowledge is not just transferred between generations it is a mechanism or reaffirming relationships, responsibilities and the recognition of existence within a wider community of beings.

Storying, sharing and speech function not only as mechanisms of human-to-human relationships but also as practises of intimacy, bonding and reciprocity that extend through communal relationships with nonhuman relatives (Thorton, et al., 2024; Turner, 2024). This relationality manifests through how stories and teachings guide relationships with lands, water, plants, animals, and spiritual beings. Oral practises share knowledge along with the responsibility protocols that shape human participation within the surrounding environment and community. Another way of illustrating the importance of relatedness and connectedness between human and nonhuman beings can be found in the stories that appear in most Indigenous cultures regarding how in earlier times animals were considered equivalent to people. One reason this may have been explained by Pierotti (2011) who writes that “both spoke the same language” (p. 18). Human and animals were capable of a shared language. Humans did not just converse with animals but also spoke to plants, trees, sky, land, water, rock, and mountains and those beings had the capacity and autonomy to speak back (Deloria, 1997; Stonechild, 2020 & 2024). Along with the ability to communicate comes the capacity to develop relationships and understanding between nonhuman and human beings; this understanding extends to what Pierotti (2011) explains as “TEK is set up to understand the functioning of animal societies and dynamics of animal and plant populations in a detailed manner” (p. 22). Pierotti’s understanding is saying that through generational observation and relationship with place patterns based on animal behaviours, migration, seasonal changes, population and interspecies relationships are observed, remembered and passed on through stories, teachings and experience.

On the topic of human interactions with plants Kimmerer (2013) opens her book with a version of the story of the arrival of *Sky Woman*, who falls to earth gripping a handful of seeds. She interacts and speaks to animals, builds relationships with them and teaches them the tilling of the soil and the planting of seeds. Through the teachings and stories of Sky Woman, we learn our relatedness to the land, and through that relationship, our roles, responsibilities, and reciprocal relationships with the land that Sky Woman becomes. Deloria (1999) wrote about the importance of humans arriving last:

The primary focus of creation stories of many tribes placed human beings as among the last creatures who were created and the youngest of the living families. We were given the ability to do many things but not specific wisdom about the world. So, our job was to learn from other beings and to pattern ourselves after their behavior. (p. 224)

Sky Woman arrived after the animals; the animals already understand how the world functioned and their place within it. The animals used this knowledge to assist Sky Woman, demonstrating that nonhuman beings are recognized as active participants within the world and its relationships. These stories extend the concepts of relationships, community, responsibility, and relationality beyond the human to include nonhuman. Nonhuman relations are thus understood as beings who possess and demonstrate autonomy, community, ethics, politics and law (Deloria, 1997). Another illustration of how Indigenous peoples recognize other living beings as members of their broader community can be observed through clan names and totems, which reflect the existence of covenants and relationships between certain human families and specific animals (Deloria, 1990; Stonechild, 2020 & 2024; Jacobs, 2025). These relationships are not only symbolic, but they also establish responsibilities, protocols, and reciprocal obligations between human and nonhuman relations.

Within a clan system, relationships between human and nonhuman create responsibilities and restrictions including protocols surrounding the harvesting of that animal, which in some communities may be understood as a nonhuman sibling. The extension of ethics and values to nonhuman is explored by Pierotti (2011) who notes that “recognition of the value and meaning of nonhuman lives extends the social world to include nonhumans and generates an ethical system that requires proper treatment for those nonhuman creatures” (p. 33). Nonhuman relations also have a role within the community (Kimmerer, 2013). These beings are understood as possessing thought, agency, individuality and unique characteristics that position them as teachers and relations, particularly within relationships where they are designated as ones spirit animal. Some of these beliefs about nonhuman entities have been captured within the writings of Erdoes, et al., (1985) in the book *American Indian Myths and Legends*. Stories of animal spiritual guides describe relationships in which these beings were connected with or encountered by clan, may impart wisdom and teachings, much like an Elder. The relationship was reciprocal and ethical, which can be seen when Nelson (2018) wrote

Within these diverse and complex cosmologies, epic narratives convey ethics, obligations, as well as specific directions or metaphoric “instructions” showing how to care for particular ecological features, such as rivers, medicine plants, and totem animals. (p.254)

Building on this understanding of relationships within an ecosystem Kimmerer (2018) describes plants as participating within reciprocal relationships, writing that “they unite the earth and sky and exemplify the virtues of generosity, providing us with all that we need to live” (p. 28). Within this understanding plants hold significance as relations within an ethical framework of reciprocity, they provide gifts which are accompanied by responsibility of care, respect and

relationships between humans and the nonhuman world. Plants provide nourishment, medicine, materials, teachings and relationships as active participants. Their ethical role is not based on human concepts of morality but the responsibility that comes from recognizing plants as active participants.

Human/non-human relations are complex. The generational development of a spiritual approach to environmental understanding is explained by Stoffle, et al. (2025) who writes:

With time, the knowledge of specific fauna and flora will combine with integrated topographic understandings and recognition of ecological zones. Importantly, the ecological services of keystone species will be understood, and they will be celebrated and protected. Places that call down the rain, like the largest mountains, will become perceived as origin mountains. Species knowledge will become integrated with observations of trophic levels and biodiversity and biocomplexity interactions. Most importantly, however, Paiutes learned from their environment because all elements of their homelands were perceived as living and sentient, with needs and feelings and with the agency to conduct their own affairs. (p.131)

The recognition of autonomy and agency among nonhuman relations provides Indigenous people a framework for understanding the complex, interconnected relationships that exist between human and nonhuman within a place-based ecosystem. Within the framework of relationships animals and plants must provide for humans and humans in turn take care of them (sometimes this meant harvesting only what was needed), respect them, and give thanks for what has been provided.

These responsibilities are reflected in harvesting practises which are accompanied by relationships, protocols and obligations. Prey animals present themselves to the hunter and enter into a contract or the “first compact”, whereby the animal gives its life to the hunter to sustain them and the community (Cajete, 2018 & 2025). By actively participating in the hunt, the hunter is a participant within the first compact; they are asking an animal prey to come forward, which is the first step in this agreement (Nadasty, 2003). When the prey chooses to present itself, it is offering its life as a gift which establishes a bond and responsibility between animal and hunter. Failing to follow through with the act of harvesting after the offering would be considered a great offence (Martinez, 2018; Nadasty, 2003). The hunter honors the life debt by giving of themselves in the form of ceremonial practises, gifts, and most importantly gratitude for the life that was provided. Humans must tend to animal kin in life and in death; hunters must treat the animal’s body with respect through the process of harvesting and employ a prescribed practises for the treatment of the animal’s remains (Martinez, 2018). This give and take relationship is reciprocity and obligation in equal parts. The first compact is entered into with plants and other nonhuman features of ecosystem referred to by Kimmerer (2018) as the honorable harvest. The honorable harvest is the agreement that we must first ask permission from the plant to cultivate the plant and use the plant for our needs. Kimmerer (2013) wrote that “when we braid sweetgrass, we are braiding the hair of Mother Earth showing her our loving attention, our care for her beauty and well-being, in gratitude for all she has given” (p. 5). The plant gives us medicine, its life to nourish us, and its spirit.

Humans entered into the first compact understanding that maintaining reciprocity and honouring the relationship agreement were essential; failure to do so meant that culturally appropriate forms of ‘remuneration’ were not provided (Menzies, 2006; Gagnon, et al., 2023). In

this situation, there would be severe and immediate action taken against the humans by the nonhuman relations. This could come in the form of a mild admonishing, a life lesson, great hardship, and even death of a community. The offended animal could even enlist its entire animal clan to assist in teaching the community a lesson in spiritual, physical or material ways. This is sometimes thought to be the reason behind why herds migrate, disappear, and come back in the way that they do (Gagnon, et al., 2023). The teachings convey generational observation and experience with animals, nonhuman relations, their behaviours, movements and ecological relationships. Through generational occupation and collection of place-based knowledge(s) communities develop pattern recognition and notice changes within their ecosystems that can be interpreted through cultural, spiritual and relational frameworks. The first compact is a relational framework which can be used to view ecological observations, culture and ethics as being interconnected. These interactions between human, animal and the environment are guided by responsibilities and relationships. The responsibilities within relationship impact harvest, conservation and resource use by reinforcing expectations of respect, reciprocity, restraint and accountability. Sustainability can be considered to be more than just the management of resources but that maintaining of relationships between humans and what occupies their ecosystem.

What emerged from this section of the literature review, is that TEK is thought to be a complex, place-based, cumulative, and dynamic knowledge system that is based on or dependent upon the practices, beliefs, and ecosystem of the Indigenous people and nonhumans of a region or community. This knowledge is linked to multiple approaches or layers of cultural nuance such as kinship, clan, ethics, spirituality, geography, and law. TEK can inform environmental resource development and sustainability practices. It is a holistic approach and often loses efficacy when it

is compartmentalized, sterilized and applied to environmental issues external to the place of origin. TEK is a knowledge form that is stored differently than Western science. As Jacobs (2025) explains “Our knowledge storage practices also differ from western scientific practices, which typically house knowledge in scientific journals, textbooks, and libraries” (p.21). The difference in storage does not mean TEK is static, it remains dynamic through continued renewal and application of knowledge within specific places and communities. This knowledge can be seen to be connected to multiple layers of cultural understanding, such as kinship, clan, ethics, spirituality, geography, and law. Through these interconnected relationships TEK can inform decision-making processes that include environmental resource development and impact sustainable practices.

Integration and Decision-Making

This second section explores different ways that TEK has been integrated into environmental initiatives and examines how these integrations may have influenced environmental decision-making processes. Calls for the inclusion of TEK within environmental understanding have emerged from both Indigenous peoples and Western scientific communities (Mantyka-Pringle, et al., 2017; Tengö, 2017; Turnout, 2018; Ekert, et al., 2020; Aporta, et al., 2024). Some environmental scientists who have sought to integrate TEK into research and management endeavors have been critiqued for their approaches to this endeavour. These critiques range from the fact that they feel that the representation of TEK is homogenizing Indigenous cultures (Sidorova, 2020; Chua et al., 2020) or it is frozen (making the knowledge no longer adaptable, placed in a state of stasis) which in turn may be thought to distort the knowledge (Berkes, 2004), this distortion could be thought of as “distilled TEK artefacts”

(Molnár and Babai, 2021; Singleton, et al., 2023). These critiques identify concerns in which TEK may be interpreted or integrated, but they also reinforce continued attention toward developing approaches that respect the integrity, adaptability and relational foundation of this Indigenous knowledge. There is support for environmental scientists to continue to turn their attention to TEK and seek to improve scientific practice through the initiatives of non-Indigenous actors whose actions impact environment (Chua, et al., 2020; Davies, et al., 2020; DiPrete Brown, et al., 2020; Eckert, et al., 2020; Hall, et al., 2021; Malmer et al., 2020; McElwee, et al., 2020; Molnár and Babai, 2021; Weiskopf, 2020; Wheeler, et al., 2020). Continued engagement with TEK requires approaches that recognize its contributions and the responsibilities associated with integration.

In this literature review, multiple scholarly approaches to the integration or incorporation of TEK within Western scientific approaches were surveyed to better understand such initiatives and their impacts upon decision making processes. As Edgar-Webkamigad et al., (2026) writes “This perspective explores and calls for the integration of Indigenous knowledge systems within sustainability science to address urgent environmental, social and economic challenges” (p.1). The integration process outcomes would directly impact decision making processes in the areas of application. TEK is considered to be an integral component of the Intergovernmental Science-Policy Platform on biodiversity and Ecosystem Services (IPBES) (Hill, et al., 2020; McElwee, et al., 2020). Though some scholars feel that the TEK present was not adequately represented, it was instead reduced or distorted to assist in the integration (Löfmarck and Lidskog, 2017). These criticisms exist for TEK’s inclusion in the Arctic council’s environmental management and climate change impact assessments (Sidorova, 2020; Wheeler, et al., 2020) and Canadian environmental co-management with Indigenous groups (Nadasty, 2003; Buell, et al., 2020;

Schott, et al., 2020). Meaningful engagement with TEK requires consideration not only of its contributions to the environmental decision-making processes but also to the relational, legal, and ethical frameworks that govern how knowledge(s) are shared and applied.

Understanding Indigenous knowledge within a colonial legal system interpreted from an Indigenous perspective can be seen within the writings of Battiste and Henderson (2024). They discuss the relationships between Indigenous knowledges and the legal frameworks of Canadian law. Their understanding of the Canadian legal system adds an interesting perspective and an additional component that to the decision-making process that must be taken into consideration when working with Indigenous knowledges. Battiste and Hendersen (2024) write that “Indigenous conceptions of ‘sacred ecology’ have five major legal corollaries, which must be respected in any framework for the protection of Indigenous peoples’ intellectual and cultural rights” (p.123). The summary of these five corollaries does not adequately relate their complexities, but they are essentially in broad terms; relationship and responsibility, tutelage and training, kinship, choice in sharing with outsiders, misuse of Indigenous knowledges and ramifications (Battiste and Henderson, 2024, p.123). These corollaries are important to the decision-making process because they identify responsibilities and conditions that shape Indigenous knowledge(s) creation, sharing, interpretation and application. These principles could impact legislation and governance frameworks by guiding relationships, responsibility and the protocols that dictate appropriate knowledge sharing, use and interpretation.

An interesting example of TEK integration and impacts on decision-making can be seen within the work of Langdon (2006) who examined traditional fishing practices employed by the Tlingit on the coast of British Colombia. His work looked at the archaeological remains at Fern point and reviews Tlingit intertidal salmon fishing technologies (Langdon, 2006). These

technologies, which are intricate tidal pool catch and release enclosures, demonstrate the detailed understanding of salmon behaviour, tidal processes, and relationships between humans and harvesting practises within this ecosystem. This place-based knowledge could contribute to fisheries conservation by providing an additional perspective on this species interactions, harvesting mechanisms and ecological changes to this specific location. TEK often contains in-depth species knowledge and knowledge of environmental linkages (Drew, 2005). Fisheries in this location are influenced by natural resource use as well as human habitation, changing relationships between communities and ecosystems, may need a multilayered approach (Langdon, 2006). These approaches may benefit from multiple knowledge systems, TEK could contribute place based relational understanding with Western science contributing analytical tools for assessment of ecological patterns and management outcomes. Decision-making in this context would need to consider jurisdictional responsibilities as well as Indigenous treaty rights to ensure knowledge integrations happens within an appropriate governance framework.

Multilayered federal department and agency involvement often leads to new strategies of development for Indigenous engagement consultation and involvement (Aporta, et al., 2024). As with applied frameworks their implementation involves multiple considerations that influence Indigenous engagement, consultation, and involvement in an effective and meaningful way. Tlingit fishing practices were developed for community sustainability prior to large scale globalization and demand of salmon on a global market (Langdon, 2006). The Tlingit approach makes the sustainable practice impractical to meet the needs of a global market; thus, it would not generate the amount of capital current practices do. These differences illustrate that sustainability can be seen through different values and outcomes. Commercial approaches may prioritize economic production where TEK may focus on relationships, responsibility and long-

term ecological occupation. Though it proved to be a successful sustainable practice, its application is too limiting to be implemented. This example is dependent on understanding context, values and purpose that supports the practice.

TEK can be, and often is, expressed through subsistence practises that sustain oneself, family, clan, and wider community relationships through responsibilities to the nonhuman, land, and place. Though TEK is not only a hunter gather practises it is a knowledge system developed through relationship within an ecosystem. Turner and Clifton (2006) explore Gitga'at TEK and seaweed harvesting. This not only included harvesting but also the preparing and consumption of seaweed. They observed how this traditional mode relates to the community and its continued survival (Turner and Clifton, 2006); survival not just in continued existence of the people, but the survivance of the Gitga'at culture and the communal understanding of the multiple layers of cultural interactions and social structures passed on to subsequent generations. This example shows that TEK contributes not only knowledge of harvesting but also cultural values that influence resource assessment and use. On the issue of survivance Turner and Clifton (2006) write

[I]n terms of community survival under new and changing economic and cultural regimes, the Gitga'at seaweed harvest represents hope and inspiration for maintenance of cultural integrity and provides a model for sustainable resource use based on principals of respect, reciprocity and cooperation. (p.66)

The seaweed harvest within the Gitga'at traditional territory is dependent on not just the growth and cultivation of a sensitive sea plant but is also intertwined with the understanding of weather, oceanic systems, and tidal navigation (Turner, et al, 2006). The relationships and ecological knowledge contained within TEK assist to guide interactions like harvesting, to

broader considerations like responsibility appropriate use and community continuity. All of these are severely impacted by climate change and the rising of oceanic levels and temperature, which creates unknown weather anomalies and a change in plant growth patterns. Though Indigenous knowledge is thought to perhaps be adaptive enough to meet the new challenges presented by climate change (Carter, 2019; Chen, et al., 2020; Dorji, et al, 2024). Turner, et al. (2006) discovered that the seaweed harvest is dependent on a mode of transportation, not just rock climbing, but the creation and utilization of the redwood canoe, which adds another knowledge 'product'. The Gitga'at in turn must understand harvesting of redwoods and applied knowledge of boat creation and subsequent oceanic navigation. Adaptation shows that TEKs continual generation through ecological observation, cultural practises and material knowledge which occurs within an existing framework of values and responsibility that influence harvesting. TEK for the Gitga'at is integrating changes to the way the harvest is conducted, due to changing economics the typical group participant has shifted (Turner, et al., 2006). The new partitioners of this form of subsistence practice are much older and more diverse than those who traditionally participated.

In the absences of young peoples' representation within community, due to education and economic prospects elsewhere, the harvest is now conducted by elders and allows the inclusion of men who traditionally did not participate in this harvest. This adaptability will allow for the continued participation and observance of this component of TEK and traditional subsistence. Turner and Clifton (2006) convey the communities concerns in rising global interests in seaweed products. The application of traditional harvesting methods in an extremely sensitive ecosystem would be the gentlest approach but would not make seaweed collection the new cash crop for which big business is hoping. TEK contributes more than a way to resource extract but provides

ethical considerations around why this resource is harvested, for whom, and what responsibilities exist within that relationship. Changes to commodification and natural resource extraction would need to be reviewed to utilize TEK in this industry. Turner and Clifton (2006) write that “In many ways it is the small details of cultural and environmental knowledge that are the most important, and they are the most in danger of slipping away in the society- wide rush toward globalization and cultural homogenization” (p.85). This example shows that TEK contribution is not only in how resources are used but how decisions about that resource usage is shaped through values and responsibility.

Shifting from examples of TEK in subsistence practices, cases of co-management between Indigenous peoples, Western academics, and the Canadian government, can also show the impacts of TEK integration. Such as in the case of when the Ruby ridge ram herd in the Yukon was surveyed. In 2003 Nadasty wrote that if “Indigenous peoples wish to participate in co-management, land claims negotiations and process that go along with new relationship, they then must engage in dialogue with wildlife biologists, lawyers, and other government officials” (p. 5). Herd population numbers of the local rams were of concern. In order to assess the health of the ram herd and its fluctuating numbers, they first had to figure out how to count, care and cull the herd for overall herd health. Both TEK of the local Kluane peoples and Western scientific methods were reviewed and a co-management system was developed (Nadasty, 2003). As Nadasty (2003) explains about concerns surrounding this endeavour

Kluane people conceive of animals as intelligent, social, and spiritually powerful other-than-human persons, and they see themselves as embed in a complex web of reciprocal relations with animals. They see their relationships with animal persons as social in nature and as vital to their physical and cultural survival. As a result, most Kluane people

negotiate these relationships delicately, taking care not to act in ways that might offend animals and so jeopardize their relationship with them. It almost goes without saying that Kluane people's notions about animals and animal-human relations are profoundly different from those held by most Euro-North Americans. (pg 109)

For the Kluane peoples, concerns about the herd were reflected not just human interests but also their responsibilities from their relationships with the nonhuman world, their spiritual beliefs, culture and roles within that ecosystem.

Resource managers counted the herd using areal methods and hand counting. Although these approaches provided population estimates, they did not reflect the Kluane people's relational understanding. The process reduced the herd to numbers or data sets, which the Kluane people felt did not adequately represent the herd, spirit or lives of the individual rams (Nadasty, 2003). The information on the page could not convey in the Kluane's opinion their relational understanding of the herd that was developed through lived experience, relationships, and responsibilities to the animals. The difference in approaches to herd health and management consisted of Western scientific approach emphasizing measurable population indicators and TEK incorporating a broader relations and cultural understanding. Management of the herd population was then situated around the age of ram, and which season was best to cull the population. Both metrics (the age of the ram and timing of culling) are the preferred methods of management employed by Western wildlife managers. Both approaches contributed important information about population management but did not fully address Kluane perspectives about responsibility and relationships with the herd. These metrics go against the fundamental principles within Kluane TEK. They also were developed with the intent to still allow for the trophy hunting of the rams by the paying Eurocentric business that is a fundamental staple to the local economy

(Nadasty, 2003). Trophy hunting was not an economic driver at the time of this publication though now it can be seen to be in this area.

The Kluane method of TEK herd management already had mechanisms in place for sustainable herd health but did not integrate well into the chosen methods employed within this co-management endeavor. These mechanisms were dependent on the recognition of the culturally developed relationships between Kluane (human) and nonhuman (herd). The Kluane and Hunting and wildlife managers disagreed about placing age restrictions on the rams. The Kluane felt that young rams needed elder rams to teach them ram culture, so placing an age restriction (easily observed based on the size of the ram's horns) on the hunting of rams went against sustainable practice within TEK. The local Kluane people believed that the killing off the elder rams would mean the rams as a society would eventually lose their culture. According to the Kluane perspectives described by Nadasty (2003), rams were thought to share their culture through oral stories and generational cultural transference in ways that reflected the same practises, relationships and understandings that the Kluane people also participated in. These teachings are conveyed through the work of Nadasty (2003) on this specific topic, though they may not represent all Kluane teachings and perspectives. The discussion may not include the perspectives of other community members including but not limited to women, female knowledge keepers, female elders, and LGBTQ2+, and children, whose experiences and relationships may contribute additional understanding.

Eventually the Department of Hunting & Fisheries, wildlife biologists and the Canadian government concluded how to sustainably manage the Ruby ridge ram herd. This example of co-management of the Ruby ridge rams was viewed as successful from the point of Western resource managers and Canadian government because it took into consideration and included the

Kluane people and TEK (Nadasty, 2003). The Kluane Elders in contrast did not feel this initiative to integrate TEK was successful. The Kluane felt their concerns, TEK, relationships, and responsibility to the herd were not adequately represented within the final management approach. The differing perceptions of success influenced the decision-making processes through different understandings of sustainability and relationship development and responsibilities to the herd.

Integrating TEK into decision-making processes have also contributed to co-production of knowledge (CPK), is a term used to describe doing research with an Indigenous community instead of on the community (Rudolf, 2025). CPK is said to have been utilized within the Arctic in the National Science Foundations (NSF) Navigating the New Arctic (NNA) program. The CPK approach is advocated for by Indigenous leaders in the Arctic (Inuit Circumpolar Council, 2022). As Rudolf (2025) describes “While the NSF’s definition of CPK aligned with the broader literature, the progressive concepts were new and confusing to the research community” (p.109). Indigenous leaders wrote to the NSF about the lack of meaningful engagement, of Indigenous communities within the proposals of the NNA (Bahnke, et al., 2020). The request for changes in engagement approaches within the first letter, as well as other shifts to a more ethical approach went unmet, which led to a secondary letter (Bahnke, et al., 2021). The secondary letter called for more explicit recommendations of change and called to pause the programs initiatives (Rudolf, 2025). As Rudolf (2025) writes “The perception of the NNA is colonial extraction of the Arctic and Arctic Indigenous Peoples through research and the inequitable funding distribution” (p.120). Free and prior consent was not an ethical research practice initiated in these cases, as researchers were approaching Indigenous community with fully completed research proposals, budgets, and signatory lines ready (Bahnke, et al., 2020). The amount of money offered for

participating within research endeavours greatly influences the decision-making processes, engagement and participation. Some Indigenous communities chose not to participate in the research due to concerns regarding its unethical nature, while neighbouring communities chose to participate due to different economic conditions and the financial supports available through involvement. As Rudolf (2025) describes some of the broader concerns:

Additionally, NNA and funded projects established a situation of coercion due to the limited time frame and competition of proposals. It creates a situation wherein Indigenous leaders would feel pressured to sign on to proposals to gain access to funding or potentially lose it to another project or different community that is more willing to sign on. If NNA Had a slower rollout that centered and required Indigenous Peoples' engagement and that planned for projects being granted directly to Indigenous communities, it would follow EPIC ethics and prevent harm and conflict. (p 121)

It seems that this case shows that meaningful TEK integration requires more than consultation, it requires funding structures and research processes that consist of sufficient time frames, capacity building and authority for Indigenous communities to choose to participate as equitable partners in the decision-making processes.

Indigenous Storying as Methodology

The final section of the literature review will explore research literature on approaches to Indigenous methodologies. In this section, focus will be made on *storying* as metaphor which can also be found within the concepts of *braiding* and *weaving*. Indigenous researchers employ storying to look at relationships. Both Braiding and storywork are utilized as methodology within

the work of Kimmerer (2018) who presents her thoughts around her orientation to the world. She offers a view of the world as an ongoing gift exchange between the human and more-than-human world; a foundational belief resident in Indigenous environmental philosophy. The first compact and honorable harvest, which is the understanding that both plants and animals must be asked for permission to be harvested or utilized by humans is a key concept utilized within the methodologies employed by Kimmerer. The relationships within the honorable harvest are described by Kovach (2021) writes “Indigenous informed ethics on research and finds commonalities of shared values of respect for relationship with the human and natural world” (p.98). Indigenous ethical frameworks are the cornerstone of Indigenous research, they establish guidelines for respecting knowledges, peoples and places.

The methodology of storywork employed by Kimmerer (2013; 2018) uses metaphor, traditional story, and TEK to develop a methodological framework. This methodological framework was important to this literature review for its contribution to the understanding of storywork and how the themes and subthemes that emerged from the research explain relationality. Story is thought to be resident within datasets, Kovach (2021) wrote “contemplated within an Indigenous episteme and applied to Indigenous methodologies, collecting data is the gifting of another’s story to a researcher: data are more than things; they are living connections animated through the exchange of story’ (p. 156). Two stories Kimmerer presents were of specific interest for the research. One: The *Mishkos Kenomagwen*, (the lessons of Grass) and two: *The Three Sister Plants*. In these stories there is metaphor applied to scientific understanding that suggests an ethical approach to integration.

Indigenous storying methodology present in Kovach’s (2021) also provides the methodological foundation through which stories are interpreted as knowledge within this

research. It contributes to an understanding of how Indigenous storytelling is used across both qualitative and quantitative approaches. Kovach develops a framework of Indigenous epistemology, ethics, and axiology that is necessary for understanding the importance of Indigenous storying as a form of methodology within in this research. The importance is expressed by Kovach (2021) who writes that “arising from oral tradition, both hearing story and sharing story are pivotal considerations within an Indigenous conceptual and methodological framework” (p. 156). Storywork is considered not just a means of knowledge transmission but a methodological approach for understanding how relationships, ethics, and decision-making processes are embedded in Indigenous knowledge systems. Together both Kovach and Kimmerer, present story as knowledge and methodology which can interpret relationships, ethics and ecological understanding.

When examining Kimmerer’s (2018) work, it can be seen as is a mixture of Indigenous storying anchored in her positionality and theory on the honorable harvest, which is informed by her background in Western science as a botanist. Her work on sweetgrass and the three sisters (squash, beans, corn) holds potential for the creation of an ethical framework of integration of TEK and Western science. Kimmerer and many Indigenous peoples believe that sweetgrass is sacred and that it is medicine that supports healing and brings peace. Sweetgrass is also understood to represent the connection between humanity and the Creator. The three sister’s plants symbolize harmony, balance, reciprocity and the interdependence of life. When utilized within mound agriculture; corn is the trellis that bean vines utilize to grow skyward and squash grows along the ground insulating the roots of the plants which assists in water retention. When eaten together they provide a high protein-base diet. These plants work together and support each other like community. Both examples allow for each separate approach, TEK and Western

Science, to work together to inform each other, while maintaining their individuality and not one knowledge subsuming the other. Kimmerer's story could be utilized in the integration process as a metaphor, which involves different strands of knowledge being braided together. In this process, TEK and Western science would remain independent, equally represented as streams of knowledge. Through the 'braiding' process involving the 'crossing over' or 'weaving' of each, the two orientations would 'borrow' from or inform each other from their separate unique perspectives to create a holistic framework which each knowledge system would be resident within.

When viewing TEK and Western science as different ways of understanding environment, Kimmerer (2018) explains her perspective on how western science may view an ecosystem: "A landscape of streams and lakes, mountains and rich valleys, shared by thousands of species plants and animals, is understood through the lens of western materialist worldview as a wealth of ecosystem services or natural resources" (p. 27). Kimmerer's description of a materialistic commodification of ecosystems suggests that, from her perspective, a Western materialist worldview understands ecosystems primarily through the natural resources they provide, rather than through the relationships that sustain them. The authorship of Martinez (2018) builds on this idea by stating that "constant growth requires a constant supply of raw material regardless of their known or unknown rates of depletion, as well as a strong faith that either resource substitutions and/or more efficient future technological "fixes" will save us" (p. 147). What can be seen here is the critique that certain resource based and capitalist orientations may influence some relationships with ecosystems. Both TEK and Western science seek to understand and engage with environmental systems, though the way they conceptualize

relationships, responsibilities and the use of resources may be different depending on the framework of understanding.

These differing frameworks show how ecosystems may be conceptualized through relationships, responsibilities and meanings. Kimmerer (2018) articulates that, through the lens of traditional Indigenous philosophy, that the living world should not be understood as a collection of exploited resources, but as a set of relationships and responsibilities. Kimmerer (2018) writes that “we inhabit a landscape of gifts peopled by nonhuman relatives, the sovereign beings who sustain us, including the plants” (p. 27). She positions Indigenous philosophy as being rooted in a more moral and gentler relational understanding, with responsibilities through kinship networks inherent within Indigenous approaches. Humans would not be external to and exploitive of the ecosystem but imbedded inside of it as an equal part of it. This equality between humans and nonhumans is often considered to be an epistemological difference from that of a western approach. Some dominant approaches within Western environmental management have conceptualized that humans as separate from nature are responsible for managing ecological systems through their interventions. Here, one must be cautioned around the issues of placing Indigenous knowledges in the position of moral supremacy and painting Indigenous peoples as a “nature’s child” inherently attuned with nature an idealistic ‘ecological native’ (Berkes, 1999; Nadasty, 2003; Nelson and Shilling, 2018). The relational principals within TEK are not innate characteristics of Indigenous peoples but are a culturally transmitted place-based understanding developed through observation, experience and intergenerational learning.

Exploring the concept of epistemologies and how they intersect with metaphysics resulting in a framework of ethics, Nelson and Vucetich (2018) muse that “interest in TEK likely has far less to do with epistemology and even metaphysics, and far more to do with perceptions

about the ethical shift or the overall worldview we believe is necessary for healing our relationship with nature” (p. 130). Western scientific ecological knowledge referred to as scientific ecology knowledge or SEK by Nelson and Vucetich (2018) who write “the central focus of SEK is taken to be that knowledge is valuable for its own sake and for manipulating the world around us for the purpose of material gain for humans” (p.131). SEK often relies on data collection over shorter and defined research times while TEK accumulates understanding through repeated observations, lived experience, storying and intergenerational transmission within a place. TEK is adapted, interpreted, and refined in response to changing ecological and social scenarios. These approaches are not competing knowledge generation methods but different temporal scales that reflect complementary ways of understanding ecological changes. Understanding the contrast between modes of knowledge accumulation allows for consideration of the timeframes required when selecting a methodological approach for research involving TEK.

Due to the metaphoric features contained within the narrative approach of Indigenous storying and Indigenous methodology it can be a bit challenging for the Western scientist to interpret these methodological approaches within a scientific framework. This is not because story lacks methodological rigor but because the evidence, validation and communication is different between the knowledge systems. Western scientists may disregard what they hear as a useful insight into an approach or concept that could be utilized as a framework of integration when narratives are seen as individual experience instead of an expression of the communities developed culturally transmitted knowledge. TEK is situated within broader systems which allow for knowledge interpretation and refinement through relationships. The scientific method is dependent on replication; TEK is rooted in continuity, relationships, accountability and repeated

observations through generations which provides a different yet complementary process for knowledge evaluation. The braiding and weaving approach will be discussed more in depth in chapter 3.

Conclusion

TEK is a complex, holistic, cumulative, and generationally adaptive, body of knowledge, within which beliefs and practices have been developed by Indigenous peoples and their human non-human relatives within their place-based ecosystems and communities (Menzies, 2006; Johnson, 2024; Jacobs, 2025). TEK is situated within orally stored and shared stories that reflect experientially acquired knowledge (Jacobs, 2025). These stories function not just as mechanisms of knowledge transmission but as frameworks through relationships, responsibilities and ethical understandings of the human nonhuman world is maintained and interpreted. These stories from which Indigenous methodologies emerge, contain important place based and metaphorical knowledge(s), that share ecological observations, cultural values and protocols developed through relationships.

Chapter 3

Methods & Methodology

This chapter includes the methodologies and methods I employed in conducting my research, as well as outlines ethical considerations associated with it. The purpose of this qualitative content analysis is to explore the scholarly position of what TEK is and what these sources say about its better integration into the decision-making process employed by non-Indigenous organizations. These non-Indigenous organizations' decisions and/or activities might have significant consequences on the environment, including those territories for which Indigenous people occupy and serve as stewards.

Introduction

The first section of this chapter outlines my methodology and articulates the philosophical underpinnings of this study. The second section explains the methods that were employed as well as a description of the procedures. This step is crucial for transparency and allows others to follow or reproduce the qualitative research process at every stage, from development, execution, through to findings. The third section outlines any research biases or ethical considerations that need to be presented in order to ensure reliability and transparency of researcher positionality to the research they are conducting.

This study uses qualitative content analysis to examine how academic scholarship conceptualizes what Traditional Ecological Knowledge or (TEK) is and how scholars discuss the better integration of TEK into the decision-making process employed by non-Indigenous organizations. The importance of this research is related to how decisions and activities of non-

Indigenous organizations might have significant environmental consequences. This study explored conceptual themes, as well as subthemes that arose during the qualitative content analysis process, I also explored a variety of definitions and patterns within the literature on TEK as well as various approaches for integrating TEK with Western science.

Methodology

Prior to discussing the methods employed within this qualitative content analysis, I will first discuss my ontological, epistemological, axiological positioning. Within this section, I will seek to explain the research paradigm and philosophical framework in which this study is situated. This research employs Indigenous methodologies- a category of methodology that Walter and Anderson (2013) regards as, “the theoretical lens or worldview through which research is understood, designed, and conducted” (p. 42). As Wilson (2008) suggested in his work on Indigenous research methodologies, rather than placing myself external to my research to create distance between myself and my work and to maintain a perceived level of objective analysis, I position myself within my work. Kovach (2021) elaborates on this orientation by stating “... from my perspective, who can do Indigenous methodologies is less about identity then it’s about relationship and responsibility” (p. 39). This described relationship is the relationship between the researcher and their research as well as with Indigenous community. It also discusses the responsibility that falls on the researcher to share their research with the community the research impacts.

The positioning of oneself to their research is considered to be the researcher’s orientation. Orientation situates oneself and their epistemologies. Walter and Anderson (2013) describe epistemology “as the study of knowledge or theory of knowledge or more

pragmatically, ways of knowing” (p. 47). Ways of knowing are an accumulation of personal experiences and thoughts compiled throughout an individual’s life journey. Epistemology is the specific lens through which to examine data. The study of knowledge can sometimes be problematic, as it can cause different values to be placed on different ways of doing things or forms of knowledge. This can result in the hierarchal positioning of different knowledges (Lyotard, 1979; Kovach, 2021). Many authors state that power imbalance negatively affects researchers’ engagements with TEK (Eckert, et al., 2020; Hill, et al., 2020; Malmer, et al., 2020; Matuk, et al., 2020; Schott, et al., 2020; Wheeler, et al., 2020; Singleton, 2021). The empowered ways of knowing become a language of power that diminish other ways of being and knowing in comparison. TEK is often viewed through a Western lens that creates an asymmetrical power structure (Singleton, 2021), where it is thought to be practical, and empirical (Joa and Schraml, 2020).

Axiology refers to one’s own value system. The researcher must consider or evaluate what role their personal biases, ethics and values play within the research project. Despite researchers supposedly maintaining neutrality, Wilson and Anderson (2013) state that, “all researchers make choices within their research, and these choices not only have integral values base, but they also influence how the data are interpreted and presented” (p. 51). Researchers as individuals come with orientations and biases that are internalized. Researchers can choose to discuss these biases, utilize them or set them aside to maintain objectivity. For full transparency a researcher should admit that said biases exist within the formulation of their “ologies” which has potential to impact their research outcomes. The last component to building what may be conceived as being a conceptual framework is ontology. Ontology is described by Wilson and

Anderson (2013) as being “concerned with the nature of being and the categories that we use to make sense of social reality” (p. 52).

This research was conducted through the application of an Indigenous lens or world view that directly relates to the Indigenous theoretical framework. Theoretical framework selection as stated by Wilson and Anderson (2013) “is thus an ontological, axiological, and epistemologically driven task” (p. 54). Theoretical framework selection determines the approach the researcher will take conducting the research. A researcher who is situated within an Indigenous methodological frame can recognize knowledge as grounded in Indigenous ways of being, knowing and doing in everyday life (Porsanger, 2004). Indigenous approaches to research, Porsanger (2004) states “are based on Indigenous knowledge, and ethics that determine the means of access to knowledge, the selection and use of ‘theoretical’ approaches, and determine in addition the tools (methods) for conducting research” (p. 109). In regard to Indigenous methodology, cultural and ethical protocols, values, and behaviours Smith (1999) writes in her book *Decolonizing Methodologies*:

To be built into research explicitly, to be thought about reflexively, to be declared openly as part of the research design, to be discussed as part of the final results of a study and to be disseminated back to people in culturally appropriate ways and in a language that can be understood. (p. 16)

Giving back the knowledge and sharing what is found within the culturally appropriate group or one’s own community is an Indigenous practice moored in relationship, gifting, storytelling and reciprocity.

Qualitative research relies on words, observations and narratives to apprehend meaning, context, and nuances that may emerge from acquired data. Qualitative data collection, according to Kovach (2021), is “contemplated within an Indigenous episteme and applied to Indigenous

methodologies, collecting data is the gifting of another's story to the researcher: data are more than things; they are living connections animated through the exchange of story" (p. 156). Storying is a key cultural component embedded within TEK. Kovach (2021) goes on to say that "story weaves together the multifold threads forming the tapestry of Indigenous culture" (p. 156). Indigenous qualitative methodologies and methods may be regarded as data storywork; the data acquired in a study communicates and conveys knowledge. Sometimes this knowledge may be regarded as traditional knowledge (Wilson, 2008; Kovach, 2021). Storytelling is at the centre of transmitting Indigenous epistemologies and knowledge. Kovach (2021) notes that "methodologically speaking, evoking story in Indigenous methodologies starts by accepting that the thinking (epistemology and the theory) and doing (methods and axiology that informs them) of research are firmly fastened together" (p. 159). Though this qualitative research study does not have a direct human component of interviews or participation, it will still utilize data and narrative inquiry approach that is an Indigenous methodology of storying or story work. Storying is the living relational practice of conveying deep meaning of knowledges. Storying is a method of creating and maintaining relational accountability between the listener, the speaker and the universe. As Kovach (2021) proposes "story provides insight from observations, experience, interactions, and intuitions that assist in developing a theory about a phenomenon. In qualitative research there is an openness to subjectivity and to the truth of one's story" (p. 161).

Methods

This study employed qualitative content analysis, which involved the interpretive coding of scholarly literature and manual data organization and coding. Content analysis is a research method used to evaluate and interpret communicative data, in this case texts, through the coding,

categorizing, and quantifying patterns. To reach the goal of understanding Berg and Lune (2012) state that what is necessary is a “careful, detailed, systematic examination of a particular body of material in an effort to identify patterns, themes, biases and meanings” (p. 349). An analysis of the data led to the identification of patterns within the qualitative data being utilized. Qualitative analysis is thought to be devoid of a particular epistemological or theoretical perspective, though Indigenous research methodologies state otherwise. The researcher bears their own epistemological and theoretical perspectives from which they cannot be separated. Through the utilization and implementation of Indigenous frameworks, viewing and identifying themes resident within the data could become quite dependant on one’s epistemology. Themes may become apparent and arise from the interpretation of the research within an Indigenous lens or through an Indigenous worldview that would not be apparent otherwise. Themes that arise from the research are then utilized to make inference and recommendations on the chosen research topic.

The design of this study involves search terms or coding. Coding relies on words, phrases or whole sentences being reduced and segmented into a manageable quantity (Weber, 1990). This allows for researchers to see patterns and themes to develop theories and recommendations. The procedural organization of this analysis follows Braun and Clarke (2006) six-step framework because it can provide a structure for qualitative analysis, it supplies a useful, transparent, easy to follow framework. The way the information is interpreted remains that of a latent qualitative content analysis informed by Indigenous methodology.

Step 1. Selection of Materials

The first step of the study involved establishing the sample of scholarly and grey literature selected for the qualitative content analysis. The study analyzed peer-reviewed academic sources, including journal articles, scholarly books, chapters, review articles and grey literature. During the selection of scholarly literature to include within my research, I identified works based on the presence of pre-established search terms within their titles or abstracts. These search terms will guide the sampling process by identifying literature relevant to developing an understanding of and ultimately answering my two research questions.

If I determined that a scholarly work may contain some information on the research topic, I will include it in the initial sample. Selected sources will discuss Traditional Ecological Knowledge (TEK) and address environmental or ecological issues. The literature may examine TEK on its own, a methodology or explore TEK alongside Western science through frameworks of integration that utilize or employ Indigenous methodologies. These methodologies may include approaches such as Story, Braiding, and Weaving. If this initial selection of methodologies proves too narrow, I will expand the search to include additional approaches, such as Two eyed seeing and Yarning.

The scholarly literature will be selected based on several criteria: These include whether the title contains relevant search terms or themes; the author's established body of work, the body of scholarship that provides the most relevant foundation for analysis; previously read sections or contents of various books; chapter titles or chapter descriptions that contain relevant search terms; and indexes that reference the selected search terms. I will determine a database(s) where to find additional documents as needed utilizing such online data bases or libraries such as JSTOR, Web of Science, Google Scholar, University of Manitoba Library services.

Step 2. Code Development

This study employed the use of codes. Codes are defined by Saldna (2015) as being “a word or short phrase that symbolically assigns a summative, salient, essence- capturing, and/or evocative attribute for a portion of language- based or visual data” (p. 3). This study utilized a latent qualitative content analysis informed by Indigenous methodology. A qualitative content analysis provided a systematic approach to coding literature, while interpretation of the codes was grounded in relationality, story and context. Coded passages did not become isolated units of analysis; the meanings of the codes were interpreted through relationships between concepts within the broader context of the document.

I read and analysed the documents by coding for the underlying meanings, concepts, relationships and patterns relevant to the research questions rather than the frequency or appearance of particular words or phrases. This latent qualitative content analysis allowed concepts and meanings to emerge through interpretation while remaining grounded in the context of each document selected.

Since I included books and edited materials available in paper format rather than PDF, the coding process had to be completed through manual character recognition. This process allowed each coded passage to be viewed within the broader context of the document, enabling me to evaluate how these concepts were expressed and what relationships existed between ideas, and how their relationality contributed to the overall meaning of the codes. Manual coding provided flexibility to remain attentive to context rather than isolating pieces from the surrounding narrative.

The idea of isolating knowledge, analyzing and understanding it outside of its context, is seen as a Western practice (Wilson, 2008). Within Indigenous methodologies, knowledge is

shared through story, gifting, and relationship. Story is a teaching that cannot be and should not be segmented. To segment and separate story from its relationship and relationality may strip it of context. This act can be considered to be dangerous as this changes and alters the cultural mechanisms and relationality resident within a topic. Although the content analysis requires the identification of concepts and themes within the selected literature, these concepts were interpreted within the context of each text rather than as an isolated piece. Within Indigenous methodology frameworks, Wilson (2008) discusses the atomization of knowledge and states that “an Indigenous style of analysis has to look at all of those relations as a whole instead of breaking it down, because it just won’t work” (p. 119). This understanding informed the coding process by focusing on relationships, context and the meanings that emerged from the literature selected.

Codebooks are sometimes created to provide clarity and structure to the coding process as they can provide clear concise guidance regarding what the code means, when and when not to use the code, and provide steps to follow when codes overlap. When there is an overlapping code, these codebooks outline the criteria for the preferred code to be used in a specified narrative (Guest et al. 2012). In this study, a codebook was developed, which is presented as Table 2 within chapter 4. This coding table was developed to promote consistency in coding while ensuring coded passages continued to be interpreted within their broader relationships.

Step 3. Emergence of Themes

This was the stage where I read and reread the data set chosen. The first reading provided a general cursory overview to ensure that the scholarly literature selected was directly relevant to the two research questions. During the second reading, I undertook a more methodical review of

the literature, examining the texts closely to identify concepts, meanings, and relationships relevant to the study while allowing themes to emerge through the analysis. This in-depth review led to the sorting and organizing of the literature into coherent clusters based on conceptual similarities, relationships and patterns identified within the coding process.

I then examined the relationships between the codes and interpreted how they worked together to convey underlying meanings and narratives presented by the author(s)/researcher(s) within the area of focus. Instead of relying on the reoccurrence of chosen words or phrases, the analysis considered how concepts were expressed, connected and situated within the context of each piece of literature. This approach allowed themes to emerge from the relationships within the codes and the meanings they conveyed across the literature.

A theme was dependent on the researcher finding it significant. I could find no rules defining what constituted a theme and what did not. I interpreted this to mean that themes were dependent on where the researcher's interests lay in answering the proposed research question (Braun and Clarke, 2006). Themes were developed through the relationships among codes, their conceptual significance, and their ability to explain their underlying meaning or story within the data (Braun et al. 2006). There was no numerical amount assigned to determine when a code became a theme. A code might contribute to the development of a theme if the theme was central to understanding the phenomenon being investigated. Themes that emerged might be overarching and encompass other themes that developed beneath them, which are called subthemes (Braun, et al., 2006). For example, the previous chapter explored three subthemes that were identified within TEK.

Step 4. Exploration of Story and Relationships

This was the step that reviewed the themes that had emerged from the analysis. All coding, data and preliminary themes were brought together and reviewed to ensure coherence across the data and to assess how well the themes reflected the underlying meaning contained within the literature. As Maguire and Delahurt (2017) suggest, “The next step is to think about whether the themes work in the context of the entire data set” (p. 8). In this step I also considered how the themes and subthemes responded to the research questions.

This process involved examining the relationships and story between themes throughout the dataset in order to identify subthemes and refine the overall thematic structure. I paid close attention to how themes related to one another and how they contributed to an integrated understanding of the literature, instead of isolating the themes. In order to proceed toward theorisation and understanding the data, I also examined the themes within the theoretical knowledge and frameworks (Timmermans and Tavory, 2012).

Where certain themes did not align clearly with the developing interpretive frameworks, these ‘outliers’ or anomalies were not be excluded but were revisited to determine if they could be better understood as a subtheme or as an alternative expression of an existing conceptual pattern. For example, the term Indian science was used interchangeably by some for Indigenous knowledge. This allows for refinement of the thematic structure rather than the removal of meaning. When applying theory, Maguire and Delahurt (2017) state, “it may become clear at this stage that theory can be refined, changed, adapted or even consolidated with another conceptual idea so that it can better account for the empirical data” (p. 8).

Themes were considered coherent when they expressed a distinct conceptual pattern but stayed meaningfully connected to the supporting data. Where themes were not sufficiently distinct, they might be subsumed or integrated into broader overarching themes or subthemes inside a larger concept.

Step 5. Refining Themes and Subthemes

This step was where I defined the final refinement of the themes and sub themes that arose from the coding and analysis process. Subthemes or the themes that were nested within broader overarching themes, informed the development of a final thematic map that showed the relationships of identified themes. As Thompson (2022) states “this is an important part of abductive thematic analysis, making it distinct from other guides to qualitative analysis” (p. 8).

The theorisation of data began by revisiting the theoretical knowledge and frameworks to assess the extent to which they could account for and explain the relationship between the themes (Timmermans and Tavory, 2012). In this abductive process, theory formulation was not fixed or imposed on the data, it was refined, adapted or reworked in response to the emerging thematic structure. In some instances, existing theory could fully account for and explain the empirical findings, in which case the study may have confirmed and extended existing theoretical understandings rather than created new theory.

Within this step, I drew on my own interpretive engagement with theory and the data in parallel to develop theoretical conclusions (Reichert, 2013). This included revisiting of existing frameworks of integration and considering how they might reflect a Western academic perspective, Indigenous community perspectives or a combined approach. This allowed for the

theorisation of how a framework could be understood as both a success or a failure from different perspectives. This process supported a broader interpretation of the patterns within the data and enabled a more subtle theorisation of the relationships between themes.

If theoretical frameworks did not fully account for the relationships and story present within the themes, they might be refined, reinterpreted or expanded to better align with the narrative. The analysis might include attention to patterns of emphasis across the literature; no numerical amount will be used as a basis for determining the thematic importance. The importance was interpreted through concepts, relational significance and the role of themes within the broader narrative structure of the data. Within a latent qualitative analysis, themes might exist and be present even when not explicitly or frequently stated within the literature.

Concerns sometimes arise regarding abductive analysis and the risk of overextension in theoretical interpretation. As Thompson (2012) notes, “when abductively analysing data, often reviewers will question if an academic has over-reached and whether theoretical contributions are truly representative of the raw data” (p. 9). This study addressed these concerns through transparency, I showed my engagement with the data, grounding interpretations in the thematic structure and iterative movement between data and theory.

To support this, I utilized the Attride-Stirlings (2001) thematic network analysis to illustrate the relationships among basic themes, organizing themes and global themes. This framework was used to visually and conceptually show how themes emerged from the coding process and how they are interconnected within the thematic structure of analysis.

Step 6. Underlying Meanings

The final step within the six-step method was where I wrote up the findings. In chapter four, the themes and subthemes generated through analysis were listed and discussed in relation to the research questions.

Each theme and subtheme was discussed in terms of the underlying meanings, relationships and patterns identified within the data. I provided supporting quotes and citations from the literature to illustrate how these interpretations were developed and to show how the themes emerged from the analytical process. These excerpts were used to provide contextual grounding for the interpretation instead of to prove the validity of a theme in a positivist sense.

The chapter sought to situate the qualitative analysis within existing knowledge in a coherent, transparent and methodological way. The analysis was guided by a set of initial codes and concepts, and the process remained open to the emergence of unexpected meanings, patterns, and thematic developments that were not previously anticipated. This demonstrated the iterative and abductive nature of analysis, where interpretation evolved through engagement with the data and theoretical frameworks instead of following a fixed deductive structure.

Ethical Considerations and Transparency

As previously stated, I am, as the researcher, situated within my research, and I come with my own developed ontological, epistemological, axiological and methodological orientations. This research was conducted with the view that Western science and TEK are equal, as some Indigenous authors suggest they are (Deloria, 1990; Stonechild, 2024). This does not mean all knowledge claims within either approach will be automatically accepted, just that each

knowledge system will be recognized as containing its own processes for knowledge generation, interpretation and evaluation. TEK is often more reliant on a narrative of observation because of its longevity and survivance in situ. This gives the data collected within the place-based narrative a tried, tested, and true quality of multiple generations, through the longevity of time. This perspective can be much more informative as it sees the multifaceted interconnectedness of ecosystems. Western science sometimes referred to as Scientific Ecological Knowledge (SEK) is often exercised within shorter research timeframes (Cajete, 2018). The situating of these approaches to understanding one's ecosystem as equal is not the typical researcher approach. Often the narrative approach contained within TEK is viewed to be a lesser form of knowledge or science (if it is considered science at all) as it is most often seen to be a form of storytelling (Kovach, 2021). TEK is not simply ecological information but can be seen as a living epistemology with ties to Indigenous communities, histories and land relationships. As Batiste and Henderson (2024) state in *Protecting Indigenous Knowledge*:

Eurocentric concepts of culture need to be demystified and decolonized and reconnected holistically with Indigenous world views and spiritual foundations. The Eurocentric conceptions of culture need to be both comprehended and inclusive of Indigenous Peoples' perspectives on their knowledge and heritage (p. 13).

Both Lyotard (1979) and later Kovach (2021) discuss the imbalance of these two knowledges, that TEK is often viewed as the primitive knowledge. This diminishment of TEK is shown through the actions of Western scientists who attempt to prove or verify TEK through a western science lens. Critical examination of knowledge is necessary within the decision-making process, TEK validation through a Western scientific framework may reinforce an asymmetrical relationship between the knowledge systems. This action aids in the reinforcement of the

perceived asymmetrical relationship dynamics between the knowledge systems, where TEK requires validation from Western scientific knowledge instead of TEK being recognized as a valid knowledge system; though this positionality does not remove responsibility for critical analysis. It requires consideration of the processes which TEK is generated, maintained, transmitted and applied within Indigenous communities. It would be contrary to my values as well as my praxis to position TEK as an incomplete knowledge dependent upon an external lens to view or interpret it, recognizing TEK as valid also does not eliminate the need to understand how knowledge is responsibly applied within a specific context and decision-making processes.

I also hold the belief, shared with Indigenous Peoples within Indigenous knowledge systems, that all parts of nature are inseparable and interconnected with humans and our nonhuman relations. As Battiste and Henderson, (2024) wrote “the land cannot be considered separately from air, water, and the complex biodiversity that make up nature. The biosphere generates holistic knowledge and cannot be separated into different categories” (p. 75). This perspective emphasizes ecosystems being understood through relationships between human, nonhumans, and the environment. Western scientific approach may examine specific components of ecosystems to develop detailed understandings while these components remain situated within the broader ecological systems and relationships. From an Indigenous viewpoint, the steps or process of understanding becomes more important than the atomization of classification. As can be seen when Battiste and Henderson, (2024) wrote “Indigenous thought classifies ecological phenomena based on characteristics observed through experience; such classifications rely on a high degree of intuitive thought” (p. 81). This experiential classification emerges through multigenerational observation, experience and relationships with place or their environment. TEK possessors understand multiple ecological relationships because wellbeing of communities

are dependent on recognizing changes within an ecosystem and how they may impact or influence another part. Academic research requires specialization within specific fields, TEK requires understanding through interconnected ecological relationships that support survivance, responsibility and relationships within an ecosystem.

I reminded myself throughout conducting this research that TEK is based in a traditional language. When some of this knowledge was appropriated and translated into the language of the current colonial structure for dissemination within academia, some words, themes, or relationships may have been lost in translation. Some concepts within TEK may not have direct counterparts within Western scientific framework (Battiste and Henderson, 2024). Indigenous peoples do not lack concepts related to stewardship, governance or responsibility but that the meaning behind these concepts may be situated within different relationships between humans, land, and nonhumans. In the writings of Battise and Henderson (2024) they give the example of “the concept of conservation is articulated as healing or caring the holistic effort to save an ecosystem” (p. 194). Though on the surface this definition could be thought to be the same or like that of Western science, it is the application, the underlying responsibilities and relationships that guide the action may be different. Within and Indigenous framework conservation is not the management of resources but the maintenance of relationships, responsibilities and reciprocity within an ecosystem. In translation relationship can be lost or diminished, TEK may be reduced to ecological information while excluding ethical and cultural frameworks that guide it’s application. This could result in a decision-making policy that recognizes Indigenous knowledge but not the responsibilities, authority or relationships within that place.

Chapter 4

Findings

This chapter includes the findings that emerged from employing my methods process. The purpose of this qualitative content analysis is to explore the scholarly position of what TEK is and what these sources say about its better integration into the decision-making process employed by non-Indigenous organizations. These non-Indigenous organizations' decisions and/or activities might have significant consequences on the environment, including those territories for which Indigenous people occupy and serve as stewards.

1. What are the prevailing scholarly views on what TEK is and how it is employed?
2. How might TEK be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences?

Introduction

The themes and subthemes that emerged through this study were interpreted relationally within the context of the literature. This means that the themes and subthemes were not examined in isolation rather they appeared connected and their connections were examined to see if they influenced and interacted with one another. This approach recognizes that understanding was gained from the connections within the literature and not from frequency of the search terms usage. These themes are presented as broad concepts; themes gain specificity within specific subthemes. The themes work toward identifying what TEK is and also work toward revealing the conditions needed for TEK's meaningful integration into environmental decision-making. Through relationship TEK can be understood to be more than ecological

observations or practises. The themes show that TEK is situated in relationships, responsibilities, ethics and governance that influence knowledge application, sharing and creation. Understanding this is necessary when reviewing how TEK may be engaged with by non-Indigenous organizations whose decision-making impacts the environment. I will provide a list of search terms, conceptual clusters, and a thematic break down of themes and subthemes. I will include tables and a thematic relationship graphic to assist in summarizing and visualizing the relationships between themes.

Data Breakdown

The scholarly literature (academic sources and those that are regarded as “grey literature”) utilized within this qualitative content analysis were selected based on several different criteria such as the title of the piece of scholarly literature containing relevant search terms from here on referred to as codes. This study analyzed peer-reviewed academic sources, including journal articles, scholarly books, chapters, review articles as well as grey literature. The criteria for item selection were:

- TEK works that are presented from an Indigenous perspective
- The abstract or executive summary contains information germane to this study
- The reference and bibliography contain works that are germane to this study
- Individual chapters within edited editions that are germane to this study
- Monographs with content that is germane to this study
- Chapter titles or chapter descriptions that contain or point to relevant codes
- Indexes that reference the selected codes
- Grey literature that reflects topics, issues, or initiatives that are germane to this study.

Table 1

Number and types of sources used within the content analysis

Scholarly sources	
Source	Number of
Books	16
Edited editions	10
Journal articles	113
Theses	14
Grey literature	10

Many of the publications reviewed were published within the last decade. Due to the topic, the geographical scope focused on Canada and North America. Some of the journal articles did take a broader geographical scope, reviewing TEK integration in other countries to compare how its integration impacted the decision-making processes elsewhere. The scope was slightly broadened to determine if the integration of TEK impacted the decision-making processes in the same way in other countries or if the treatment of integration was unique to Canada. These examples could have been considered to distort patterns within the dataset or to become outliers; but they did not, as they were consistent with the Canadian and North American examples. The combined selected literature established the dataset from which codes and eventual concept

clusters were developed. The concept clusters then allowed themes and subthemes to emerge and be explored. For the full list of source material by author and type used within this analysis please see the Appendix.

Search Terms or Coding

The following codes were selected to identify literature that may be included in the study. I chose initial search terms that were directly related to the two research questions:

1. What are the prevailing scholarly views on what TEK is and how it is employed?
2. How might TEK be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences?

The codes that were created from the questions were Traditional Ecological Knowledge, TEK, and Western science. I then broadened my search by breaking down key terms that contained multiple words into individual terms, explored synonyms, and identified related concepts and terms (e.g., TEK was separated into Traditional, Ecological, and Knowledge). From that breakdown, further exploration led to additional codes that reflected and expanded on the meanings and concepts represented in the initial set of codes. All of the selected codes (see Table 2) appeared to become interconnected and related; they shared meaning through story rather than becoming isolated.

Codes such as Braiding, Two-Eyed Seeing, environmental assessment, and co-production were important for working towards an answer on the decision-making process, they were not just examples of methodologies used for combining knowledge systems but were representative

of approaches identified within the literature for changing how environmental decisions may be made. The approaches of integration were present throughout the literature within the research as potential ways for developing relationships between TEK and Western science while still maintaining their distinct foundational approaches.

Table 2

Codes selected for the analysis

Coding table	
Traditional Ecological Knowledge	Indigenous Traditional Knowledge
Ecological Knowledge	Indigenous Science
Traditional Knowledge	Indian Science
Ecological/Ecology	Aboriginal Science Knowledge
Traditional	Traditional Wisdom/ Wisdom
Sacred Knowledge	Western Scientific Tradition
Historical Indigenous Knowledge	Conservation
Indigenous Sustainability	Natural Science
Local Knowledge	Evolutionary Ecology
Environmental Sustainability	Ecological Indian
Environmental Assessment	Natural Resource Management
Law/Codes/Informal Practices	Resource Management
Science and Ethics	Traditional Landscape
Theoretical Framework	Culture (Indigenous)

Empirical	Hunting/Trapping/Fishing
Narrative	Reciprocity
Story/ing	Survival/Survivance (Indigenous community)
Place-based	Knowledge Transmission
Ethics	Myth
Integration	Generational
Practises	Oral
Land: Nature/Spirit	Co-Production
Kinship	Indigenous Practices
Subsistence Practices	Ceremony
Harvest	Kincentric
Burning	Kincentric Ecology
Place names	Spirituality
Reclaiming	Braiding
Relationship	Two eyed seeing
Sovereignty	

Emergence of Themes

This qualitative content analysis was guided by Indigenous methodologies such as storying. Indigenous methodology provided a systematic and relational approach to coding the literature. Codes were used repeatedly to move beyond surface understanding and progress

toward latent meanings. The concepts expressed by the codes showed a relationality or relationship, from these expressed relationships, themes and subthemes emerged. Instead of treating coded passages as isolated units, the analysis focused on how meanings emerge through relationships and shared concepts within the texts. The codes were left situated in their broader narrative and contextual placement. These codes were continually compared, grouped, and refined to develop themes, with attention paid to relationality, story, and context throughout the analytic process. An Indigenous approach or an Indigenous methodology centralizes connection and relational understanding. This Indigenous methodology recognizes that meaning comes from the interconnection of ideas rather than the frequency of their use. A way to visualize this progression is:

Search terms → Coding → Conceptual Clusters → Organizing Themes

Conceptual Clusters

When reviewing the codes in Table 2, conceptual clusters and patterns of conveyed meaning became apparent. The codes, or words that were selected to represent concepts, expressed meanings that were also represented by other codes. These meanings or conceptual clusters combined to create or reveal themes and subsequently related subthemes. A conceptual cluster in this instance is used to explain the grouping of codes based on their shared meaning or relationship. Through this meaning the codes began to appear to possess a shared story. The apparent relationships resonant within the groupings informed the patterns used to develop themes and subthemes. Some terms overlapped across categories, for example; Reciprocity could

have fit within ethics, relationships or knowledge systems, amongst others, I assigned it to Indigenous world view. Below is the list of conceptual clusters:

- 1) *Indigenous knowledge System's*- these terms describe what I consider to be Indigenous ways of knowing, knowledge, traditions and epistemologies.
 - Traditional Ecological
 - Indigenous Traditional Knowledge
 - Traditional Knowledge, Ecological Knowledge
 - Indigenous science
 - Indian science
 - Aboriginal Science knowledge
 - Historical Indigenous knowledge
 - Local knowledge
 - Traditional Wisdom/Wisdom
 - Sacred Knowledge
 - Indigenous Practises
- 2) *Knowledge Creation, Transmission and Integration*- how knowledge is produced, shared, or brought together/developed
 - Co- Production
 - Integration
 - Braiding
 - Two-eyed Seeing
 - Knowledge Transmission
 - Oral
 - Story/ing
 - Generational
- 3) *Indigenous Worldview, Values and Ethics*- philosophical foundations that shape Indigenous knowledge
 - Reciprocity
 - Ethics
 - Kincentric Ethics
 - Kinship
 - Relationship
 - Spirituality
 - Ceremony
 - Culture
- 4) *Land, Place and Relational Ecology*- relationship with land and place, caring for land and managing natural resources
 - Place-based
 - Place names
 - Land: Nature/ Spirit
 - Traditional Landscape
 - Kinship ecology

- Natural Resource management
 - Resource Management
 - Environmental Assessment
- 5) *Environmental and Ecological Concepts*- ecosystem, ecological process and sustainability
- Ecology
 - Evolutionary ecology
 - Natural Science
 - Conservation
 - Environmental Sustainability
 - Indigenous Sustainability
- 6) *Indigenous Livelihoods and Land Based Practices*- everyday practices connected to land
- Burning
 - Harvest
 - Hunting/ Trapping/ Fishing
 - Subsistence Practices
 - Practices
- 7) *Governance, Self-determination, Law*- concerns Indigenous legal systems, governance, authority
- Sovereignty
 - Law/ Codes/ Informal Practices
 - Reclaiming
- 8) *Cultural Narratives*- narrative traditions and Indigenous identity
- Myth
 - Survival/ Survivance (Indigenous community)
- 9) *Research and Analytical Concepts*
- Science and Ethics
 - Theoretical Framework
 - Western scientific tradition
 - Ecological Indian

Once the codes were organized into these conceptual clusters, their linkages through story and relationality determined the themes.

TEK integration into a Western scientific approach to inform decision-making processes cannot only transfer information into existing decision-making processes it must also take into consideration that TEK is a relational and embedded within communities, integration must also consider the relationships, voices of authority and responsibilities as is expressed within Cluster

2 Knowledge Creation, Transmission and Integration. Meaningful integration of TEK recognizes Indigenous governance structures, relationships, responsibilities and knowledge systems.

Theme Development

The themes and subsequent subthemes emerged because of their relationships, relationship structures, patterns/meaning, narratives, and conceptual tensions that consistently reoccurred within the conceptual cluster. The recurring elements and their interconnectedness contributed to the formation and development of the identified themes. The themes and subthemes conveyed stories of relationality. These stories seemed to align within the Indigenous methodology of Storywork, which views storytelling as a legitimate and important way of creating, comprehending, and sharing knowledge. The components of Storywork contained within the themes and subthemes seemed to inform or point towards the development of a framework. This framework could be considered an Indigenous ecological governance framework, a guiding understanding of Indigenous governance based on Indigenous ecological knowledge. An Indigenous ecological governance framework provides insight on how non-Indigenous organizations might approach decisions differently. The framework that emerged from the themes shows that environmental decisions may not have been considered to involve relationships, responsibilities, governance and ethics. The themes suggest environmental decision-making may have been seen as a way of managing ecological components instead of as a process of relationships or responsibility within an ecosystem. Indigenous ecological governance frameworks show that decisions that affect the environment are also decisions that will affect relationships between humans, non-human, community and future generations.

These stories and the framework establish a way that could be used for clear analytical distinction between Indigenous epistemologies and the interface between Indigenous and Western scientific approaches or paradigms. These themes are situated around TEK, an Indigenous knowledge employed when one interacts with, examines or wants to come to understand their environment or ecosystem. The themes also express the relationship between TEK and Western scientific approach. This relationship between the two epistemologies informs the understanding of decision-making processes employed by non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences. Please see Table 3, *Themes and Subthemes*, where the themes and subthemes are listed, and their meanings are expressed.

Table 3

Themes and Subthemes

Themes and Subthemes			
#	Theme	Subthemes	Meaning
1	Indigenous Knowledge Systems	• Knowledge as Epistemology, • Produced through Experience and Observation, • Knowledge is Ethical, Spiritual and Integrated	Indigenous knowledge is complete, rigorous and holistic, epistemology grounded in lived experience, ethics, spirituality, and observation
2	Relationality, Land, Responsibility, and Reciprocity	• Kinship and Relational Worldviews, • Land as Relative, Teacher, Identity, • Responsibility to Human/Nonhuman Communities	Relationship with land, non-human beings, founded on kinship, reciprocity and mutual responsibility

3	Stewardship, Sustainability, Environmental Governance	• Stewardship as cultural responsibility, • Governance through Indigenous Laws and Practices, • Ecological Stewardship in Practice or Sustaining ecological relationships across time	Environmental care is cultural, ethical and governance responsibility that sustains ecosystems, communities, non-human communities, time
4	Knowledge Transmission, Cultural Continuity, and Resilience	• Intergenerational knowledge transmission, • Ceremony and Cultural Practice as Pedagogy, • Resilience through Continuity and Adaptation	Indigenous knowledge(s) are maintained and renewed through oral traditions, ceremony, cultural practice and intergenerational transmission
5	Western Science	• Distinct Epistemology, • Colonial Histories and Power Relations, • Navigating relationships between knowledge systems	Distinct epistemology that intersects, interacts, and attempts to integrate with Indigenous knowledge, relationship with Indigenous knowledge, Colonial Structures, time

Theme 1: Indigenous Knowledge Systems

Indigenous knowledge Systems was the first theme explored, as Indigenous knowledge is situated as the foundational framework necessary for approaching and understanding the research questions guiding this study. Indigenous knowledge(s) are a comprehensive epistemology that integrates empirical observation, spirituality, ethics, history and lived experience (Deloria, 1997; Stonechild, 2023; Battiste and Henderson, 2024). As an epistemology, Indigenous knowledge shapes how knowledge is understood, created, and shared. These

epistemologies impact Indigenous ways of knowing, being and doing (Nelson, et al., 2018). Knowledge as epistemology emerged as the first subtheme because it underpins Indigenous knowledge systems. One way of understanding this sort of knowledge system was explored by Stonechild (2020) who wrote, “Traditional knowledge is based upon years of rigorous and disciplined training of the mind and body” (p.17). In the spirit of Stonechild, Indigenous knowledge(s) are understood as holistic epistemologies that guide interacting with the ecosystem or environment. An epistemology that is grounded in ethical responsibility, spirituality and relationships that shape how knowledge(s) are understood and enacted. This belief of Indigenous knowledge is represented within the literature (Kimmerer, 2018; Battiste and Henderson, 2024). As an epistemology, this knowledge is generated through observation, relationships, spirituality and experience (Johnson, et al., 2024). Indigenous knowledge as being experience and observed acts as subtheme two.

TEK is expressed through these approaches as well as through empirical inquiry (Arlidge, 2024). Through the application of TEK within an ecosystem prior to colonization, Stonechild (2020) states, “The relative lack of environmental degradation and social discord is a tribute to the success of Indigenous methodology that included, among other things, ceremony and prayer” (p.176). TEK and its approach to understanding one’s ecosystem or the environment as ethical, spiritual, and relational does not seem to be unique to the Americas as Ataria, et al. (2025) writes of the Maori concept of whakapapa:

This cultural taxonomic framework comprising of a corpus of knowledge that provides the theoretical or epistemological basis for a Māori ‘way of knowing,’ maps temporal and spatial connections, relationships, and activities between animate and inanimate, physical and metaphysical objects and phenomena. (p.1)

Whakapapa similarly reflects an Indigenous philosophical and epistemological underpinning grounded in relationships and ways of knowing. When discussing how TEK is observed and expressed Battiste and Henderson, (2024) write: “we carry the mysteries of our ecologies and their diversity in our oral traditions, in our ceremonies, and in our understanding and expressions of them, we unite these mysteries in the structure of our language and our ways of knowing (p.1).

There is an intersect of terms and synonyms, that can all be used interchangeably to describe Indigenous science, Indian science, Aboriginal science or Native science. The description of Native science by Cajete (2025) develops into the third subtheme,

To gain a sense for the essence of Native science, one must also participate with the natural world; to understand the foundations of Native science, one must become open to the roles of sensation, perception, imagination, emotion, symbols, and spirit, as well as concepts, logic, and rational empiricism. (p.10)

Native science can then be seen as the third subtheme which also expresses another Indigenous epistemology which is ethical, spiritual, and experiential. Native science is considered by some to be the name of this knowledge that is considered to be ethical, spiritual and integrated into everyday life and permeated throughout cultural expression. Understanding Indigenous knowledge(s) is integral to understanding TEK. Native science is another name for knowing and interacting with one’s environment, due to this knowledge containing other components it is further examined within additional themes, though it is not cross listed, it is used here only because it is the preferred name of this knowledge system by the author cited and the citation describes a spiritual component.

Subthemes: Knowledge as Epistemology, produced through Experience and Observation, Knowledge is Ethical, Spiritual and Integrated

Associated Codes: Traditional Ecological Knowledge TEK, Indigenous Traditional Knowledge, Ecological Knowledge, Traditional Knowledge, Sacred Knowledge, Historical Indigenous Knowledge, Local Knowledge, Indigenous Science, Indian Science, Aboriginal Science Knowledge, Traditional Wisdom/Wisdom, Empirical, Place- based, Ecology/Ecological, Theoretical Framework, Ethics.

Theme 2: Relationality, Land, Responsibility and Reciprocity

Relationality, Land, Responsibility and Reciprocity is the second theme. This theme emerged because it seems to centralize or focus on the concepts of Indigenous value systems which are components of Indigenous knowledge. Relationships, reciprocity and responsibility are key values or knowledges contained within TEK (Jacobs, et al., 2025). Relationality is the Indigenous understanding that all things in the world are interconnected this includes our non-human relations. Thus emerged the first subtheme, kinship and relational worldviews. With kinship develops relationship; if there is relationship then there is responsibility and ethics, caring and reciprocity (Jacobs, 2025). Indigenous cultural practices express reciprocal responsibilities that sustain people, non-human relations and ecosystems (Kimmerer, 2013 & 2018). A community or an individual's well-being is inseparable from their relationships with land, water, animals, ancestors, non-human relations and the spiritual world (Thorton, et al., 2024). This inseparable relationship is explored by Stonechild (2020) who notes,

Kinship among animals, reptiles, birds and people, in the Indigenous way, was a conception shared by virtually all tribes. Ironically, of all the creatures, we are among the most vulnerable, being entirely dependent on plants, insects and animals for survival. (p. 18)

TEK as an Indigenous paradigm or an understanding about an ecosystem is explained by Cajete, (2018) who writes, “*Native Science*... includes Indigenous relationship to land, plants, animals, community, self, cosmos, spirit and the creative animating process of life” (p.15). The respectful act of relating to all life as kin, as well as expressing a relation to primal natural forces of the elements and earth as mother is referred to as *Kincentricity* (Martinez, 2018). On this topic Martinez (2018) explains that “this kincentric relationship has evolved over time into what modern Western peoples call ethics: a code, model or standard that guides or regulates our behaviour with the natural world” (p.140).

This understanding of relationality leads to the Indigenous worldview that land is a living relation rather than an object of ownership (Delroia, 1997). Land as a living teacher emerged as the second subtheme. Land as relative is explained in one of two ways; one: the total and encapsulating title of the living entity known as *Mother earth* and two: the components, plants, soil, rocks and minerals that make up the earth. Indigenous understanding links the earth to motherhood, like a mother who births a child, the earth sustains humans and gives them life through subsistence (Ortiz, 2018). The understanding of the individualized components of land coming together to create a living entity is expressed by Kimmerer (2018) when she wrote,

In some Anishinaabek teachings plants are recognized as the second level of creation, on whom all other life forms rely. Rocks, soil, and water, upon whom the plants depend

comprise the first level, animals the third, creating a chain of being that reflects contemporary scientific principles of trophic pyramids of energy flow. (p.28)

It is an interconnected cycle that transfers relationship and interdependency.

The third subtheme is that of responsibility to human/nonhuman communities. Different forms of imperative reciprocity exist. Some of these systems are named or known as: the original instructions (Nelson, 2018), the first compact (Cajete, 2018), and the honorable harvest (Kimmerer, 2018). Responsibility is not just between human and nonhuman entities, there are layers of responsibility we have to one another, the land, and all things contained within an ecosystem. Relations extend to both alive and dead, ancestors and future generations of children. The earth has been inherited from prior generations and will be in turn passed down to subsequent generations of children, the current occupants are stewards (McGregor, 2018). The reason these subthemes are important to explore when attempting to answer what is the prevailing scholarly views on what TEK is and how it is employed is explained by McGregor (2004) who states, “TEK is not just knowledge about the relationship with Creation, it *is* the relationship with Creation” (p.395). Indigenous world view sees the ecosystem and its components as an integrated whole (McGregor, 2004).

Subtheme: Kinship and Relational Worldviews, Land as relative, Teacher, Identity, Responsibility to Human/Nonhuman Communities.

Associated Codes: Relationship, Kinship, Kincentric, Kincentric Ecology, Reciprocity, Land: Nature/ Spirit, Place names, Traditional Landscapes, Place-based, Indigenous Practices, Practices, Harvest, Hunting/Trapping/ Fishing, Subsistence Practices, Sovereignty, Reclaiming.

Theme 3: Stewardship, Sustainability and Environmental Governance

The third theme is that of *Stewardship, Sustainability and Environmental Governance* from an Indigenous worldview. This theme emerged from the relationality expressed by the codes and their story. The act of stewardship is described by Tynan (2021, as cited in Hernandez, et al., 2025) as, “individual responsibilities include caring and stewarding our Lands and communities and serving as actors who uphold the larger scales of responsibilities that are bestowed on our communities” (p.277). Stewardship can be understood within TEK as being seen as a cultural responsibility, which became the topic of the first subtheme. These responsibilities are explained by Hernandez (2025) who states, “Other responsibilities are intertwined with our Lands and communities, and these other responsibilities are rooted in our relatedness and kinship to both our Lands and communities” (p.279). Stewardship appears to extend beyond conservation to include relationship, governance, laws, ethics, and responsibilities to past and future generations as well as non-human relations. This interconnected relationality is described by Stonechild (2020) who writes, “Medicine Persons understood that the gift of ceremony includes the transmission of laws and instructions to humans” (p.19). This unique approach to sustainable management can be understood as maintaining ecological relationships rather than simply managing resources. Developing a more appropriate integration approach would require organizations to engage with TEK as a governance system that influences how decision-making processes are made. For example, the Tlingit fisheries demonstrate that harvesting practices are shaped by Indigenous governance, reciprocity, and relationships with salmon. TEK can inform not only ecological understanding but also the decision-making processes about environment, caring for the ecosystems and culture responsibility that supports long-term ecological and community well-being. Stonechild (2020) writes,

If there were shortages, it was not perceived as being due to over hunting or overuse but as a repercussion for abusing relationships. Imbalances were attributed to some sort of ethereal punishment and would quickly lead to a change of behaviours by the community. (p.19)

Stewardship as a cultural responsibility impacts Indigenous land use within subsistence practises and laws around hunting and gathering. The second subtheme centres around these practices in the form of Indigenous laws or cultural beliefs and practices that inform ecological stewardship. Previously touched on within the last theme and subthemes are the compacts that dictate subsistence practices. These compacts are discussed by Turner (2025) who notes, “These practises have been supported by a host of social and economic traditions that manifest these values in myriad ways; sharing plants and plant knowledge, devising technologies and economic mechanisms to support plant use and distribution” (p.149). Subsistence is an important component of ecological stewardship. Indigenous communities lived in place for multiple generations, this longevity of occupation meant that the impacts of one generation could potentially be felt by the next. This concept of multilayered impacts is explored by Turner (2025) who notes,

Plants and animals are widely regarded as sentient life forms and as generous relatives of humankind who provide their bodies willingly, provided that humans show proper respect. While refracted through a distinctive anthropomorphic lens, it seems clear that this cosmological position was informed by cause-effect relationships observed, for example, during times of overexploitation- when forms of “disrespect” came back to haunt subsequent resource harvesters in future times – and these values had tangible outcomes in the natural resource management traditions of Indigenous peoples. (p.151)

This sentiment is contained within the original instructions (Nelson, 2018), the first compact (Cajete, 2018), and the honorable harvest (Kimmerer, 2018). These ecological protocols that outline complex interrelationships within an ecosystem, determine and outline how to sustain ecological relationships across time, this is the third subtheme. The recognition of these as not only practices but as Indigenous law that informs practice could impact the way that non-Indigenous organizations think of interacting with TEK. The interaction process could change from simply collecting Indigenous knowledge on the environment, to engaging with that knowledge within an Indigenous governance structure that can impact the decision-making processes.

Subtheme: Stewardship as cultural responsibility, Governance through Indigenous Laws and Practices, Ecological Stewardship in Practice or Sustaining ecological relationships across time.

Associated Codes: Indigenous Sustainability, Environmental Sustainability, Conservation, Resource Management, Natural Resource Management, Law/Codes/ Informal Practices, Environmental Assessments, Burning, Harvest, Hunting/Trapping/ Fishing, Traditional Landscape, Evolutionary Ecology.

Theme 4: Knowledge Transmission, Cultural Continuity and Resilience

Theme four emerged from the data related to the intergeneration transmission of Indigenous knowledge, cultural continuity and resilience (of Indigenous knowledges). Indigenous knowledge is not static, it is adaptive and integrative of new and improved upon methods through lived practice, storytelling and community participation (Battiste and

Henderson, 2024). A part of community practice is the belief in and the participation of community and individuals, through the expression of reciprocity. Reciprocity is a relationship tie that is called a promise that holds community together, it is described by Schimmel (2025) as being,

The promise is that my Elders will teach me what was taught to them by their Elders. The promise is that I will use that Knowledge to take care of them. The promise that we will one day, through living by the rules of that Knowledge, become like them in that we too will pass on to our children and grandchildren the knowledge that our Elders passed on to us. This cycle of intergenerational strength and reliance is the reciprocity that our communities are built on. (p.151)

The first subtheme is expressed here as the intergenerational transference of Indigenous knowledges. Indigenous knowledge is housed within living libraries; from amongst others our Elders (Jacobs, 2025). The Elders share their knowledge with subsequent generations. This transference is further explained by Schimmel (2025) who writes, “It’s the steady hum of culture and tradition passed on and improved from each generation to the next but never so inexorably changed as to be unrecognizable” (p.151). The integration between new ways from the young tempered by the wisdom of the Elders means that Indigenous knowledge(s) and culture have the adaptability for continuity (Schimmel, 2025). While reviewing the subject of TEK Turner (2024) explains it as “This knowledge alongside related practises and world views, is passed down through generations verbally and otherwise comprises what have been known as TEK system” (p.141).

Active participation in community practices like the ceremonial giveaway assist with cultural continuity. Ceremony is a cultural practise or pedagogy which is the topic of the second

subtheme. Indigenous Pedagogy seen as a method and learning practise to transfer knowledge generationally that's rooted in Indigenous worldview. An example of such can be seen in the explanation Kimmerer (2013) gives, "In a culture of gratitude, everyone knows that gifts will follow the circle of reciprocity and flow back to you... both the honor of giving and the humility of receiving are necessary halves of the equation" (p.381).

Indigenous knowledge revitalization, its survivance and its reclamation shows its resilience despite colonization and now globalization (Battiste and Henderson, 2024). Resilience through continuity and adaptation is the third subtheme. TEK is a place-based, locally adapted, adaptable, alternative knowledge, and perspective of locally developed Indigenous practises that impact resource usage (Berkes, et al., 2000). This adaptability and continuity are described in the writings of Battiste and Henderson (2024) who note that,

Our Indigenous order, our shared and personal responsibilities, our caring for the ecologies animate our ancestors' legacies and heritages for the present generation with a vision of a sustainable future. It is a form of belonging for the present generation, a manifestation of caring that extends for at least seven generations and beyond.

These heritages create a choice of lifestyles each generation, and the responsibilities that follow from them are the defining characteristics of our collective order and wisdom.

(p.5)

Indigenous knowledge persists through oral traditions, cultural practices and intergenerational learning, preserving languages, histories, values and relationships with the environment.

Intergenerational transmission from Elders to subsequent generations maintains the cultural continuity while adapting knowledges through their experienced learning. The younger generations feel that they are contributing, while the Elders act as temperance and slow down

potential fallout from quick innovations, adding additional thoughtfulness to this process.

Potential integration practices need to allow TEK to remain connected with the communities and the people who hold it, as TEK can be seen as a cultural and relational foundation within community. The Gitga'at seaweed harvest shows that TEK is connected to cultural continuity, governance and responsibilities. Organizations need to engage with the knowledge holders, communities, and governance structures which give TEK its meaning so that these Indigenous ways of being can impact the decision-making processes.

Subtheme: Intergenerational knowledge transmission, Ceremony and Cultural Practice as Pedagogy, Resilience through Continuity and Adaptation

Associated Codes: Knowledge transmission, Generational, Oral, Story/ing, Ceremony, Narrative, Spirituality, Myth, Indigenous Practises, Traditional, Spirituality, Survival/Survivance (Indigenous community), Reclaiming, Culture (Indigenous).

Theme 5: Western Science

The fifth theme that emerged from this study was that of *Western science*. This theme emerged due to the study of TEK, it summons the exploration of its related discipline within a Western understanding. The subthemes that are contained within this theme are:

- the apparent differing epistemologies between Western science and TEK
- historic colonial asymmetric power positioning between the two approaches
- navigating their resulting relationship.

Western Science is recognized as a distinct knowledge system (Johnson, et al., 2015). Western science possesses a different epistemology than TEK (Mantyka-Pringle, et al., 2017). These distinct epistemologies act as the first subtheme. Due to these perceived differences Whyte (2018) notes, “Articles in climate, environment, and sustainability sciences literatures tend to articulate concepts of Indigenous knowledges in ways that stress the value for supplementing scientific methods, or supplemental value” (p.63). There have been tensions between TEK and Western science where TEK has been devalued based on the difference of approaches. These approaches understood to be seen as; TEK is thought to be observational and experiential, where Western science is thought to possess quantifiable measures that can be replicated and analysed (Aporta, 2024). As Stonechild (2020) writes, “Indigenous knowledge has historically been portrayed as primitive and superstitious and inconsistent with secular rational thinking” (p.169).

This second theme colonial histories and power relations has been touched upon previously within Chapter two. Power relations are dominantly examined and resident across the literature utilized within this analysis. So as not to reproduce an area previously discussed, a component of the power dynamic explored here is expressed best as researcher “entitlement” due to power asymmetries, which is articulated within Berkes (1999) who wrote,

The need for Indigenous groups to control their knowledge has to be balanced against the need to share their insights as part of the common heritage of humankind. There are tangible and practical reasons why Traditional ecological knowledge is so important for the rest of the world as well, quite apart from the ethical imperative of conserving cultural diversity. (p.28)

Sentiments like those throughout the process of colonization seem to have been articulated often enough when discussing Indigenous knowledges that it prompted Battiste and Henderson (2024) to write,

Indigenous Peoples have had to exercise and assert our ancient teachings in context of modern Eurocentric thought and legal systems. Through the process of European colonization, Indigenous Peoples have experienced the migratory predators of the world and have been forced to adapt and change. (p.5)

Lastly there are multiple “myth” character categories Indigenous TEK possessors are seemingly sorted into. These categories imply the lack of societal or cultural equivalency and seems to Other or lessen the TEK holder, thus their knowledge should not belong to them. These categories are: The Exotic Other or Ecological Indian – people intrinsically close to the earth, nature spirit, balanced, hippie that does no wrong; Ignorant superstitious savage limited in and by their resources, understanding, beliefs and disorganization, backward; and the Noble savage/fallen Angel duality, should be left to live as primitives or they will threaten their ecosystems where they live (Berkes, 1999).

Science as the cultural equalizer is expressed more gently by Nadasty (2003), who notes,

if all cultures possess science (i.e., practical empirically based knowledge about the world), then the empirical knowledge of one culture should be comparable to that of another. In other words, their practical value should be independent of cultural context. Knowledge about wind and tides, for example, should be of equal to all mariners, whether they be European sailors or members of a Kula expedition. (p.61)

There is a need for Indigenous rights to be recognized, engagement to be ethical and reconciliation; thought of as an act of decolonization to take place (Aporta, 2024). Improving

integration requires organizations to re-examine how decisions are made, including what constitutes as evidence, who possesses authority, and what knowledge systems are viewed as legitimate within an environmental capacity. The Kluane Ruby Ridge example demonstrates tensions where Western scientific methods are prioritized, while TEK sought to understand the rams through relationship, observation and responsibilities. These were two different representations of interpreting ecological relationships, with ethical integration they could have produced a holistic understanding of what was happening to the rams, better informing the decision-making process.

The third subtheme is navigating relationships between knowledges. Ethical opportunities for collaboration exist through approaches like Co production of knowledge (Rudolf, 2025), Braiding (Kimmerer, 2013), and ethical community engagement (Nadasty, 2003). There is increasing recognition that addressing complex environmental issues from a combined approach (Bocking, 2023); being informed by multiple knowledge systems; has benefits, but it must do so while respecting Indigenous sovereignty and while maintaining epistemological integrity. Remembering the mistakes of prior endeavours before undertaking new ones is cautioned by Hernandez (2025) who writes, “When both Western science and Indigenous responsibilities are linked together, there is a need to merge relationality reciprocity and remembering and futurity to ensure that Western science does not harm IWK (Indigenous ways of Knowing).” (p.277)

Two-Eyed Seeing, a framework for integration that has been seen as an emerging theory for transcendent research initiatives, and its utilization has been used increasingly across Canada in recent years (Barlette, 2012). The way that Western Science treats TEK can directly impact the outcomes of joint initiatives (Aporta, 2024). Advocating for engagement of a dual approach can be seen in the authorship of Cajete (2025) who notes, “The development, simultaneous

exploration, and comparison between Native science and Western science can provide foundation for flexibility and creative orientation to thinking and application in science that is essential to the future of human societies” (p.12).

Subtheme: Distinct Epistemology, Colonial Histories and Power Relations, Navigating relationships between knowledge systems.

Associated Codes: Western Scientific Tradition, Natural Science, Science and Ethics, Environmental Assessment, Resource Management, Science and Ethics, Ecological Indian, Integration, Braiding, Two Eyed seeing, Co Production.

Relationship Between Themes

The previous section depicted the meanings, relationships, and interconnectedness of the five themes and subthemes. This was a challenging endeavour to undertake due to the relational nature and interconnectedness of these themes with one another. The deeper into the subject one explores, the more difficult it becomes to discern separation between them. The analytical separation that was created is not necessarily a separation that exists within the knowledge system, but a sorting method employed. An analysis requires that the data or themes be separated to examine them, but the findings show that they cannot be understood as separate components. The themes again are titled:

- 1) *Indigenous Knowledge system*
- 2) *Relationality, Land, Responsibility and Reciprocity*

- 3) *Stewardship, Sustainability and Environmental Governance*
- 4) *Knowledge Transmission, Cultural Continuity and Resilience*
- 5) *Western Science*

Instead of existing separately as discrete categories, these themes are interconnected through Indigenous relationality, the recognition that knowledge is understood as emerging from relationships among people, communities, the land, nonhuman or more than human world (spirit and divine), and responsibilities across generations, both living and deceased. TEK is presented throughout as an integrated knowledge system, Indigenous relationality connects the themes through understanding that the knowledge emerges from relationships and responsibilities across generations. Certain concepts such as reciprocity, responsibility, land, knowledge transmission, stewardship and sustainability are interconnected and move across multiple themes. Theme 1, *Indigenous knowledge Systems*, acted as the foundation to which all others seemed to emerge from or were connected to. The relationality between themes can be seen in the explanation about Indigenous knowledge systems given by Nelson (2014) who notes,

TEK arises out of Indigenous science, which arises out of larger-scale Knowledge systems such as IK [Indigenous knowledge], because of the nested nature of such knowledge systems, Indigenous Peoples may hold IK, NAS [Native American Sciences] IS [Indigenous Science], and TEK. (p.17)

Knowledge systems are nested inside on another, sharing concepts, laws, ethical teachings, and philosophical underpinnings that guide how knowledge is understood and expressed. The encompassing of many different components can be seen in the description of Native science by Cajete (2004) who writes that the knowledge includes such topics as, “philosophy, art, agriculture, ritual, ceremony, technology, astronomy, farming, plant domestication, plant

medicine, hunting, fishing, metallurgy, and geology” (p. xxi). Native science is later expanded on to include concepts like spirituality, community, creativities, sustainability-based technologies and as Cajete (2004) writes,

The exploration of basic questions such as the nature of language, thought, and perception; the movement of time-space; the nature of human knowing and feeling; the nature of proper human relationship to the cosmos; and other such questions related to natural reality. (p.17)

This description shows that Indigenous science is not limited to empirical observation but encompasses philosophy, ethics, spirituality, governance, environmental stewardship and cultural practice. (These concepts are all contained within the conceptual clusters previously explored).

The fifth theme Western Science, did have some thematic overlap where the boundaries between TEK and Western science became more fluid and showed areas of interaction between the different approaches. Both TEK and Western science can be considered approaches to understanding conceptualizing and interacting with the environment or ecosystem. Western science is a point of comparison with the other four themes. It was not outside of the framework developed, instead it existed within the framework as another way of interpreting and engaging with environmental knowledge. Even though the concept clusters were divided into five themes for analysis, these five themes were not expressed as distinct isolated categories. Instead, they represent interconnected expressions relationships, responsibilities and ways of knowing. The themes showed that knowledge, land, responsibility, stewardship, cultural continuity, and ethical engagement with Western science approaches cannot be separated into individual components but can be understood through the relationships that connect them. The thematic relationships seem to suggest meaningful integration would be best suited to understanding and developing a

relational approach to decision-making where multiple knowledge systems can contribute their individual and distinct epistemologies, responsibilities, authorities and where their contexts can be maintained.

Outliers and Alternatives

Within the coding there became an apparent issue in terminology. Some of the codes became interchangeable within the literature and started to express shared if not the same meaning. This issue is described by Jacobs (2025) who writes,

Many terminologies are used to describe Indigenous ways of Knowing: terms such as Indigenous Knowledges (IK), or Indigenous Knowledge Systems (IKS), Traditional Knowledge (TK), Traditional Ecological Knowledge (TEK), Indigenous Science (IS), Native American Science (NAS), and many others are often used interchangeably, especially in academic literature. (p.16)

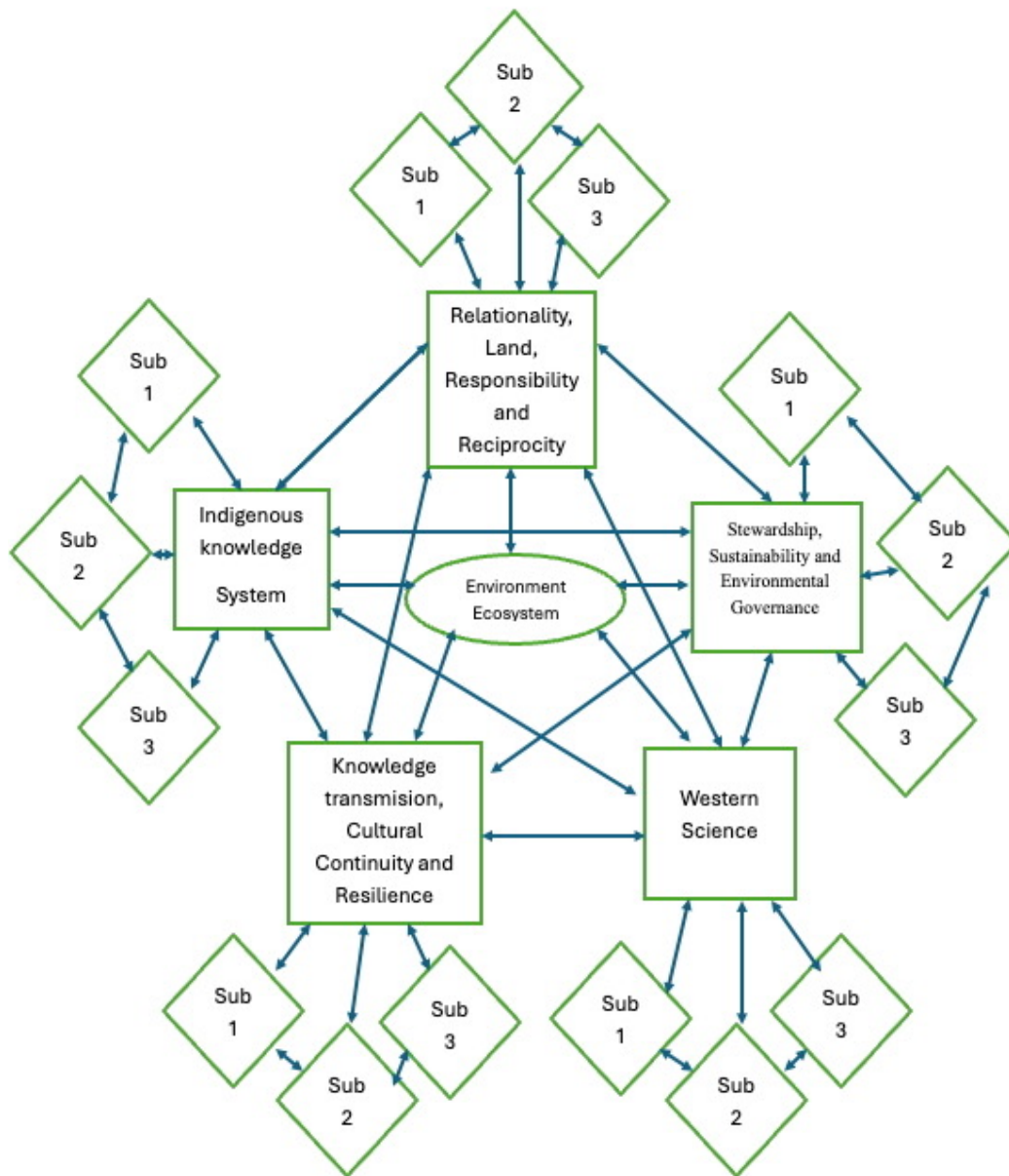
For some scholars, the name of the knowledge system that was being described was interchangeable with others. Some authors think of these knowledges nested inside one another adding layers and depth to the knowledge(s) being expressed. This thought of knowledges being nested within one another expresses an additional understanding of story and relationality between the different ways of knowing; each knowledge contributes to the broader interconnected epistemological framework.

These often interchangeable, alternative expressions did not change the thematic structure developed. They did redefine the interpretation of several themes by again reinforcing relationality, these concepts vary slightly but do not fall into distinct separate categories. They contribute to the overall perspective of the interconnectedness of Indigenous knowledges.

Thematic Relationship Network

Figure 1

Themes and Subthemes relationality



Note. This relationship network conveys the relationship between themes and subthemes.

Figure 1 provides a visual representation of the thematic network that emerged throughout the content analysis. In the center of the network is what is considered to be the global theme; which is the Environment or ecosystem. The global theme acts as an analytical role or the overall broader context that the organizing themes and subthemes can be understood through. The five main themes or organizing themes that emerged from the conceptual clusters identified throughout the analysis, are explained in greater detail in Table 3. The organizing themes are distinct yet interconnected, this is expressed through the dimension of story/stories that they conveyed within the data. The dual arrows that connect the global theme, themes, and subthemes show the reciprocal relationships between them. The arrows communicate that this non-linear sequence continually informs one another, they both inform and are informed by the broader understanding of environment or ecosystem. The themes inform the global theme, environment and ecosystem while understanding of the global theme provides context to the themes through which they can be understood.

Through this visual network, it can be seen that no component is truly isolated. The five themes are analytical distinctions made for organizing the data, in reality these themes do not operate in five separated compartments. They are all interconnected, and through these connections and the sharing of knowledge, they become a part of a larger expression of Indigenous relationality. The themes and subthemes share a collective story that emerges through relationships, responsibilities and connections between knowledge, people, land, and the more than human world. Theme one is foundational, it consists of nested knowledges and relationships. Themes two to four expresses Indigenous knowledge in action, what it does, and it's meaning relationally. From knowing, knowledge generation, relating, responsibility, stewardship, transmission, and sustaining relationships across generations. Western Science is

the theme that is a distinct epistemological system that enters into a relationship with the Indigenous knowledge system.

Please note that though there are no arrows in Figure 1 that connect subthemes to other subthemes. Subthemes are believed to be interconnected as well, for ease of viewing those arrows were not developed as they became too complex to visualize in a 2-dimensional image. The full interconnection between all themes and subthemes would best be displayed as a 3-dimensional model. The themes and subthemes from Table 3 are:

1. *Theme 1: Indigenous Knowledge Systems*

Subtheme

- Knowledge as Epistemology
- Produced through Experience and Observation
- Knowledge is Ethical, Spiritual and Integrated

2. *Theme 2: Relationality, Land, Responsibility and Reciprocity*

Subtheme

- Kinship and Relational Worldviews
- Land as Relative, Teacher, Identity
- Responsibility to Human/Nonhuman Communities

3. *Theme 3: Stewardship, Sustainability and Environmental Governance*

Subtheme

- Stewardship as Cultural Responsibility
- Governance Through Indigenous Laws and Practices
- Ecological Stewardship in Practice or Sustaining Ecological Relationships across time

4. *Theme 4: Knowledge Transmission Cultural Continuity and Resilience*

Subtheme

- Intergenerational Knowledge Transmission
- Ceremony and Cultural Practices as Pedagogy
- Resilience through Continuity and Adaptation

5. *Theme 5: Western Science*

Subtheme

- Distinct Epistemology
- Colonial Histories and Power Relations
- Navigating Relationships Between Knowledge Systems

Conclusion

In this chapter, findings and analysis have been presented. This work could be considered an interdisciplinary approach (Indigenous studies and an Environmental science approach) to understanding the environment through Indigenous and Western science lenses. This holistic approach has the potential to be impactful to not only non-Indigenous actors whose initiatives impact environment but also Indigenous peoples and communities. To reiterate, this study was driven by the following research questions:

1. What are the prevailing scholarly views on what TEK is and how it is employed?
2. How might TEK be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences?

These two research questions were addressed throughout the qualitative content analysis, both in this chapter and through the literature review, by organizing the codes into clusters and the development and exploration of the themes and subthemes. The theme headings were used in the discussion, the subthemes will not be singled out, as the titles may become distracting and they reside within the themes and assist in the understanding of what the theme is.

Responding to Research Question 1

Through this analysis the prevailing scholarly view on what TEK is and how it is employed starts to develop. Within Theme 1: *Indigenous knowledge System's* supported by the literature, TEK consists of oral, storying, and narrative approaches to knowledge sharing that focuses upon place-based ecosystems (Deloria, 1997; Stonechild, 2020; Kovach, 2021; Stonechild, 2024; Cajete, 2025; Jacobs, 2025). This attempts to establish what TEK is; considered to be, a

knowledge system grounded in oral transmission, narrative and place-based ecological understanding.

While grounded in ecological observations or environmental practices, TEK can be understood as a holistic system of knowing that is inseparable from relationships with land, all once living/ currently living things, and with the responsibilities that come with those relationships. This knowledge is not static but develops through the interactions, experiences and the sharing of stories intergenerationally regarding the surrounding environment through observation, practice, and responsibility. Part of this relationship is explained by Menzies (2006) who writes “Traditional Ecological Knowledge is the term used to describe the knowledge and beliefs that Indigenous peoples hold of their environments that is handed down through generations” (p. 6). TEK is passed on through generational transmission and is adaptive to new experiences and observations. This adaptiveness is discussed by Pierotti (2011) who writes that

TEK can be rebuilt or changed by each new generation in the same way that each new generation of graduates in ecology or evolutionary biology go out and make new discoveries that add on to the base of empirical knowledge that currently exists in those fields. (p. 13)

TEK is not static but an adaptive knowledge system. TEK is passed on through oral transmission, oral discourse and tradition constitute a foundational framework through which observations, metaphors and philosophies are stored, shared and negotiated (Jacobs, et al., 2025).

Theme 2: *Relationality, Land, Responsibility and Reciprocity* views TEK grounded in relationships, reciprocity and responsibility (Jacobs, et al., 2025). The theme identifies relationality as a defining component of TEK instead of as separate cultural element. These relationships go beyond environment to include reciprocity, relationships with humans, land,

plants, animals, and nonhuman world. This knowledge is expanded on by McGregor (2004) who writes “TEK is not just knowledge about the relationship with Creation, it is the relationship with Creation” (p.395). This explanation distinguishes TEK by presenting knowledge as inseparable from reciprocal relationships and the responsibilities to these relationships. Indigenous understanding of earth as mother who gives life, through motherhood sustains humans and gives them life through subsistence (Ortiz, 2018). Relationships within TEK are expressed also in Theme 3: *Stewardship, Sustainability and Environmental Governance*. As expressed within the literature review and supported through the theme definition, TEK may be explored as an Indigenous environmental governance framework, not merely ecological data. TEK can be understood as maintaining ecological relationships rather than simply managing resources. There are 4 previously elaborated on examples of this within the literature review in the section called *Integration and Decision Making* they are:

- The five major legal corollaries, that act as a framework for protecting Indigenous peoples’ intellectual and cultural rights
- The examination of Tlingit intertidal salmon fishing
- The exploration of Gitga’at TEK and seaweed harvesting
- Kluane at Ruby Ridge

Theme 4: *Knowledge Transmission, Cultural Continuity and Resilience* support the view that TEK is dynamic and continuously in a state of development through lived practice, storytelling and community participation (Battiste and Henderson, 2024). Though adaptive, TEK is transmitted ethically relationally and through cultural foundations that provide continuity throughout generations. This form of adaptable yet enduring knowledge developed Indigenous practises and impact resource use (Berkes, et al., 2000).

The prevailing scholarly view seems to characterize TEK as a complex, dynamic, place-based knowledge system that integrates ecological observation, lived experience, spirituality, ethics, relationships, and intergenerational transmission. TEK is employed not merely as a collection of ecological information packets, but as a framework for understanding relationships between humans, non-humans, and their surrounding ecosystem. TEK's application is strongest when its relational, cultural, and ethical foundations are maintained rather than extracted as isolated data.

Responding to Research Question 2

The second question regarding a better integration of TEK into the decision-making process of non-Indigenous organizations' decisions and/or activities might have significant environmental consequences was also examined through the themes and subthemes developed in this analysis. One needs to understand TEK as a complete knowledge system, recognize Indigenous governance and authority that is moored in relational and ethical foundations, and is reliant on the creation of equitable relationships between TEK and Western science.

In approaching this question, the understanding one gains through the exploration of the first question is necessary. As the literature and data shows, meaningful integration starts with an understanding of what TEK is. Theme 3: *Stewardship, Sustainability and Environmental Governance*, demonstrates that TEK contains governance systems and practises grounded in relationality, reciprocity, responsibility and stewardship. These governance systems and practices are discussed by Turner (2025) who notes "These practises have been supported by a host of social and economic traditions that manifest these values in myriad ways; sharing plants and plant knowledge, devising technologies and economic mechanisms to support plant use and distribution" (p.149). Integration may require recognizing these systems as governance

frameworks rather than supplemental ecological knowledge. This can be seen within the Tlingit fisheries example, where tidal pool catch and release enclosures act as a part of the Indigenous governance framework. The release enclosure act as a mechanism of relational accountability within Tlingit governance, reflecting laws embedded within reciprocal relationships between humans, ecosystems, and non-human relations. It is an example of TEK directly informing environmental decision making through sustainable fisheries practices. The external impacts to the fisheries in this location, provided a case where TEK was integrated but required organizations to address larger political, economic and institutional systems that influenced environmental decisions in this area (as was discussed in Chapter two). Economic priorities can influence whether TEK continues to be utilized when market demands and resources conflict with relational responsibilities, ecological health and TEK governance practices.

When reviewing the Gitga'at seaweed harvest TEK integration supported both ecological sustainability and maintained cultural continuity. Despite this, decisions on integration were shaped and impacted by economic priorities that conflicted with the sustainability-based Indigenous approaches. The Indigenous communities' concerns were to provide sustenance in a traditional fashion at a scale that the community needed but not so large as to negatively impact the seaweeds continued propagation. The community also wanted to be able to practice this traditional knowledge and exercise all others surrounding the harvesting of seaweed, e.g. harvesting trees for boat making and so on, in order to pass on these traditions to subsequent generations to ensure cultural continuity and survival. Non-Indigenous organizations interested in seaweed consumption recognized that the seaweed could not be harvested in a traditional fashion while meeting the economic demands of a Global market. Adaptation of this harvesting practice does not mean it would conflict with TEK but could create meaningful adaptation which

maintains ecological relationships, responsibilities and the limitations set on the harvest through the Indigenous approach to resource usage. Traditional seaweed harvest is also weather and climate dependent. In a Global fast paced market with quick timelines having to take these extenuating factors into consideration made the seaweed crop much less desirable.

Within Theme 5: *Western Science* there is a suggestion that successful integration requires reviewing prior assumptions of what knowledge holds legitimacy, what is considered evidence and who holds authority. This can be seen in the Klune Ruby Ridge ram herd. Herd counting through areal means, a Western scientific approach. Which views the ram herd population counts and measurable indicators as legitimate evidence, whereas the Kluane through TEK understood the herd relationally, culturally and spiritually. This shows the different knowledges, emphasizes different forms of evidence and authority to interpret the ecological relationships. Consideration should be given to recognizing how knowledge is evaluated, by whom and for what purpose. This situation seems to also be present in the co-production of knowledge example given as well. This reoccurring scenario is also present within the co-production of knowledge example. The NNA and Arctic Indigenous peoples demonstrate that again assumptions need to be addressed, who produces relevant knowledge, who controls research process, and whose authority can determine an acceptable approach.

TEK can be meaningfully integrated into non-Indigenous environmental decision-making processes when organizations shift away from treating TEK as supplemental knowledge and instead view it as a complete knowledge system grounded in relationships, responsibilities, and ethics. This requires the recognition of Indigenous governance systems, authority, and responsibilities, which would allow TEK to inform not just an ecological understanding but also decision-making processes and express Indigenous priorities. Such as the Tlingit example where

TEK acted as an Indigenous governance framework. Non-Indigenous organizations need to review or integrate different knowledge(s) being considered in the place of authority for decision-making, but also, they need to look at how decisions are structured, who is participating in the discussions, and who bears the responsibilities and relationships to the environment. Successful integration requires Indigenous authority over their territory, knowledge, and sovereignty to be recognized while also addressing the broader governance structures that shape environmental decision-making. Ethical engagement and Indigenous led partnerships should take place through respect for Indigenous knowledge sovereignty, shared decision-making and recognition of Indigenous priorities and responsibilities. Approaches such as co-production, braiding/weaving, and two-eyed seeing that allow TEK and Western science to inform one another when they are practised within relationships of respect and not reduction. An integrated holistic approach is a shift in environmental decision-making, these considerations limit risks of Indigenous knowledge extraction, external framework interpretation while working to ensure recognition of Indigenous authority and accountability.

Chapter 5

This chapter presents the analysis and discussion related to the current research study; a qualitative content analysis that explored what was thought to be the scholarly understanding of Traditional Ecological Knowledge (TEK), including what TEK was thought to be and how it was expressed. The study also explored how TEK might be better integrated into the decision-making processes of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences.

The findings are explained within a theoretical and conceptual framework. The discussion is focused on the themes and subthemes identified in the research expressed in Chapter four: *Indigenous knowledge systems; Relationality, Land, Responsibility and Reciprocity; Stewardship, Sustainability and Environmental Governance; Knowledge Transmission, Cultural Continuity and Resilience; Western science.*

The following section is a summary of the themes, followed by an explanation of their connections, relationships and story. From the findings of this research, I was able to develop recommendations based on the implications I identified throughout the analysis.

Summary of Themes

Below is a quick summary of the themes that emerged from this content analysis. These themes and subthemes are not described in great detail as this is a high-level review before examining their connections and stories.

Theme 1: Indigenous Knowledge Systems

Indigenous knowledge is a holistic epistemology grounded in relationships, observation, spirituality, ethics history and lived experience that shapes Indigenous ways of knowing, being and doing. Knowledge as epistemology emerges as the first subtheme, while observation and experience form the second, positioning Indigenous knowledge as a legitimate system for understanding and interacting with the environment.

TEK applies these approaches through empirical inquiry, ceremony, prayer, oral traditions, language and relationships with the environment. Interchangeable terms can encapsulate the same knowledge and be used interchangeably by some scholars or be recognized to have distinct meanings by others. Native science formed the third subtheme, emphasizing that Indigenous knowledge is ethical, spiritual, integrated into everyday life, and permeated throughout cultural expression.

Theme 2: Relationality, Land, Responsibility and Reciprocity

Indigenous value systems emphasize relationships, reciprocity and responsibility as key components of TEK. Relationality emerged as the first subtheme, reflecting the interconnectedness of all beings, including non-human relations. Through kinship ties, develops a sense of responsibility, ethics, and reciprocity. Where well-being is inseparable from relationships with land, water, animals, ancestors and the supernatural.

Land as a living teacher forms the second subtheme, positioning land as a living relation rather than an object of ownership. Indigenous values recognize earth as a sustaining, interconnected entity where all of the land's components exist through relationships and interdependency.

The third subtheme focuses on responsibility to human(s) and nonhuman(s) communities. Concepts like the Original instructions, first compact, the honourable harvest express these responsibilities to ecosystems, ancestors, and the future generations. TEK is understood as knowledge of and a relationship with creation.

Theme 3: Stewardship, Sustainability and Environmental Governance

This theme emphasized the Indigenous understanding of responsibility, relationships, and ecological care. Stewardship, the first subtheme is understood within TEK as a cultural responsibility rooted in kinship with land, communities, and non-human relations. This responsibility extends beyond conservation to include governance, laws, ethics, and obligations to past and future generations, emphasizing the maintenance of ecological relationships rather than resource management.

The second subtheme focuses on Indigenous laws, cultural beliefs, and practices that guide ecological stewardship through hunting, gathering and subsistence practises. Intergenerational responsibilities embedded within these practices form the third subtheme. These responsibilities developed over long-term multigenerational relationships with place and, through respect, reciprocity and balance, influence the sustainability of the community and the ecosystem.

Theme 4: Knowledge Transmission, Cultural Continuity and Resilience

Indigenous knowledge is understood as dynamic and adaptable, continuity maintained through lived practice, storytelling and community participation. Intergenerational transference of this knowledge is the first subtheme. Elders serve as living libraries of this knowledge,

passing teachings down to subsequent generations while allowing adaptation and continuity through the contributions of each generation.

The second subtheme focuses on ceremony and Indigenous pedagogy as practices that support cultural continuity and the transmission of knowledge through participation and reciprocal relationship. The third subtheme highlights resilience through continuity and adaptation, demonstrating how Indigenous knowledge persists through revitalization, reclamation, oral traditions and intergenerational learning despite colonization and globalization.

Theme 5: Western Science

This theme focused on the differing epistemologies between Western science and TEK, historical colonial power relations, and the navigation of their relationship. The first subtheme examined the distinct epistemologies of these two knowledge systems; TEK is characterized as observational and experiential, while Western science is associated with quantifiable and replicable methods. These differences have contributed to tensions and the historical devaluation of Indigenous knowledge systems.

The second subtheme focused on the colonial histories and power relations, including the impacts of asymmetrical relationships and the need for Indigenous control, ethical engagement, and recognition of Indigenous knowledge sovereignty. The third subtheme explores the navigation of relationships between the different knowledge systems through approaches like co-production, Braiding, ethical management, and Two-Eyed Seeing. These approaches centralize collaboration while maintaining Indigenous sovereignty and epistemological integrity, while also recognize the importance of engaging multiple knowledge systems.

Significance of the Study's findings

In Chapter four, I made the statement that the themes and subthemes conveyed a story. These stories conveyed a framework for clear analytical distinctions between Indigenous epistemologies and the interface between Indigenous and Western scientific approaches or paradigms. Below I explain how these themes and subthemes convey a story.

The Themes Stories

Throughout the themes and subthemes that emerged in this study, stories were being shared. The foundational aspects of these stories are Indigenous knowledge systems, relationships, responsibilities, continuity and interactions. Indigenous knowledge systems are a holistic epistemology grounded in relationships, observation, spirituality, ethics, history and lived experience. Indigenous value systems and stewardship extend this story by showing how relationality, reciprocity, responsibility, and ecological governance are embedded within Indigenous ways of knowing, being, and doing.

Intergenerational transmission further develops this story by showing how Indigenous knowledges are maintained, adapted, and revitalized through ceremony, community participation, and lived experience. These themes suggest that Indigenous methodologies and story are inseparable from relationships and responsibilities because they exist within these connections.

Western science represents the interface between distinct epistemologies and examines past, present, and future relationships between Indigenous and Western scientific paradigms. These relationships were examined within the themes and the literature review. This story conveys and recognizes the importance of maintaining and respecting Indigenous knowledges,

recognizing Indigenous sovereignty and epistemological integrity while exploring collaborative approaches between knowledge systems. By having TEK and Western science separated into distinct themes, the analysis avoids conflating Indigenous knowledge with its interactions with Western science, allowing for each to be examined on its own before considering points of dialogue, collaboration and tensions. This story can now become a story of a hopeful future built through ethical and meaningful relationship building.

Throughout this research study, the prevailing scholarly view on what TEK is thought to be and how it is employed became apparent. TEK and its employment revealed a story of how Indigenous knowledge is grounded in Indigenous worldviews, relationality and lived experience. Through storying, the themes and subthemes support the notion that TEK is not simply a collection of ecological observations or environmental practices but can be seen as a holistic system of knowing. This way of knowing about the surrounding ecosystem is inseparable from the relationships we maintain with family, community and ancestors. The stories conveyed through the analysis follow the relationships between Indigenous knowledge, the Land, all once living/ currently living things, and with the responsibilities that come with those relationships. TEK is a living knowledge system maintained through relationships, experience and responsibilities.

The second research question regarding the better integration of TEK into the decision-making process of non-Indigenous organizations whose decisions and/or activities might have significant environmental consequences was also answered throughout the literature review and the themes and subthemes that developed within the analysis. This story began with coming to understand what TEK is. As the literature and data shows, meaningful integration starts with an understanding of what TEK is. Without this understanding, integration efforts risks reducing it to

information that is added to existing decision-making processes. These findings show that meaningful integration requires recognizing TEK as a holistic knowledge system grounded in Indigenous world views, relationality and responsibility. It is through this understanding that opportunities for more respectful, reciprocal, ethical, and effective decision-making can begin to start.

The themes collectively tell a story of what TEK is, how it functions, why it has been historically misunderstood, and what is needed for meaningful engagement between Indigenous and Western scientific approaches. The story serves as the analytical framework because it traces the relationship between knowledge, people environments and decision-making systems instead of treating TEK as a set of ecological data. The way that TEK can be better integrated into the decision-making processes of non-Indigenous organizations is through understanding the manifestation of Indigenous knowledge that lend to a peoples' view on TEK. By building understanding of TEK throughout one's educational and professional lifetime, respecting existing policy, procedures, ethics and laws, and enforcing and creating new ones, TEK can be better integrated into the decision-making process.

Recommendations

This section includes recommendations which were informed by the findings of this research. The findings are directed toward some of the subjects touched upon within Chapter four's conclusion. These recommendations are centralized around what is required for future conditions for meaningful integration. Meaningful integration consisting of ethics and responsibility.

The findings of this content analysis seem to suggest that responsibility is one of the more significant relationship outcomes or understandings within TEK as a holistic relational Indigenous knowledge system. Knowledge and relationships are intertwined understanding within TEK. This fundamental dualistic understanding informs one of how to treat and interact with Land, people, non-human relations, ancestors and future generations. This means that non-Indigenous organizations interactions with TEK need to recognize and engage this Indigenous knowledge system as an epistemologically sound holistic knowledge. Doing so means to not reduce TEK to its environmental knowledge, consult with knowledge holders, or to incorporate TEK into an existing decision-making framework after the development of said framework, but to recognize the relationships contained within TEK prior to development. Responsibility needs to be understood as an ongoing relationship that extends to how knowledge is created, requested of Indigenous peoples, who holds authority, knowledge interpretation and utilization, and what relationships are maintained and hold meaning. Also, recognition of who holds responsibility for the consequences and participates within reciprocity, the individual(s) or organization in cases of environmental harms incurred during the decision-making process. This approach ensures that ethics and responsibility are not external to TEK applied after the fact, but they are an outworking of the knowledge system, an expression of the relationships through which knowledge is created, maintained and transmitted.

Non-indigenous organizations should take on these responsibilities by shifting from extraction or transactional engagements and move toward relationships created and understood through the Indigenous lens of reciprocity, accountability, respect, and recognition of Indigenous sovereignty. They will have to abandon assumptions about what is considered to be legitimate knowledge, what constitutes as evidence, develop processes in support of Indigenous authority

and consent, while also considering the responsibilities contained within the knowledge they wish to obtain and use. The organization needs to be held accountable for their treatment and application of the knowledge they are given, within the objectives of the projects its applied to but also beyond. Meaningful integrations of TEK is not shown through the presence of Indigenous knowledge within the decision-making process but through the presence and expression of recognizing relationships, responsibilities, ethics, and extending these principles to the contexts of where this knowledge emerges.

Recommendation 1: TEK as an Indigenous Governance Framework

Non-Indigenous organizations whose decision-making processes impact Indigenous territories should recognize TEK as a place-based knowledge system that includes ecological understanding, relationships, responsibilities and decision-making practises. Through this recognition, integration efforts would value that TEK contains ethical considerations and responsibilities developed and dependent on place-based, long term, relationships with ecosystems.

Non-Indigenous organizations should review the internal process used for determining what is seen as legitimate evidence and examine how knowledge is evaluated, interpreted and taken into consideration in the decision-making processes. This includes the recognition of who is considered a voice of authority, who informs the decision-making processes, how knowledge holders participate and are engaged, and how the context and responsibilities within TEK are considered when applied. Recognition of Indigenous sovereignty is integral. These organizations should explore and ensure the long-term ethical engagement of Indigenous communities for as

long as the Indigenous community is interested in working with the organization. Organizations should develop relationship-based approaches that are more aware and move closer to relationships represented within Indigenous knowledge systems rather than utilizing shorter consultation processes.

The meaningful integration of TEK into decision-making is dependent on the recognition of TEK as a complete knowledge system grounded in relationships, responsibilities, ethics and lived experience. Integration is not about the inclusion of different knowledge(s) but how they are examined, evidence defined, voices of authority determined and how these decisions impact or are connected to responsibilities for the environment. Different integration modes such as Braiding, two-eyed seeing and co-production provide ways for TEK and Western science to inform one another while maintain integrity. Ingetration requires the consideration of the relationships, responsibilities and contexts that TEK emerges from. Knowledge systems are not to be treated identical, but within the decision-making process their individual strengths, limitations and applications as ways of knowing and interacting with ecosystem(s) should be recognized.

Recommendation 2: Ethical Knowledge Stewardship

Non-Indigenous organizations engaging with Indigenous knowledge(s) should recognize that the sharing of Indigenous knowledge(s) involves responsibilities that move beyond the collection and the application of information. Indigenous knowledge(s) and systems, TEK, and Traditional teachings are connected to relationships, places, and communities. These relationships impact responsibilities and cannot be separated from the context in which they are

shared and created or experienced. Organizations should consider if existing access to “public” Indigenous knowledge(s) are sufficient to meet project objectives before requesting further access to community held or culturally sensitive knowledge. This approach can help minimize potential harms while supporting ethical engagement and respecting Indigenous knowledge and Indigenous data sovereignty. It reduces unnecessary requests for sensitive knowledge(s) while respecting relationality, Indigenous authority, and Indigenous knowledge sovereignty.

Non-Indigenous organizations engagement with Indigenous knowledge(s) and technologies that are new and innovative like AI and online data bases, should consider the relationships and responsibilities surrounding the collection, storage and use of Indigenous knowledge(s). When looking at the examples of working with Indigenous community and fresh water, many Indigenous communities continue to experience challenges accessing safe drinking water despite its classification as a human right, as well as its importance within Indigenous knowledge(s), and relationship with place. The proposed insertion of technologies that utilize freshwater usage within Indigenous communities should be reviewed and heavily weighed before suggested. Considerations should move beyond the main concerns of what information can be collected and analyzed but also ethically engage with how different forms of knowledge(s) are understood, represented and applied. It considers potential benefits, risks, and responsibilities associated with collection, use and how potential harms can be mitigated should technologies fail to achieve their intended purpose.

Indigenous knowledge(s), including TEK, are developed through relationship, responsibilities, and experience within a place. Non-Indigenous organizations need to consider how to maintain context in which Indigenous knowledge(s) is generated, as well as seeking out appropriate consent, access, storage and use when intending to incorporate this knowledge(s)

within new environmental technologies. Consent is an ongoing relationship which allows Indigenous communities to guide how their knowledge(s) are used during the projects time and beyond it. These technologies can create new opportunities to analyze environmental information while also keeping in consideration issues regarding data governance, interpretation, and respectful involvement of Indigenous knowledge holders. Where AI is used to generate, interpret, summarize, review, or manage knowledge(s), it's the Organizations responsibility to ensure that its use aligns with community expectations, respects Indigenous knowledge sovereignty and maintains the relationships, responsibilities and contexts through which the knowledge is shared.

New technologies may potentially provide opportunities to support environmental understandings and decision-making, they should also recognize environmental information may hold different meanings depending on the knowledge system that it emerges from.

Understanding the ecological, cultural, and community context prior to engagement can support in building a more ethical knowledge sharing practises and strengthen relationships between Indigenous communities and non-Indigenous organizations. Ethical engagement requires reciprocal relationships, where organizations consider what knowledge(s) are requested access to from communities, but what benefits, responsibilities and accountability mechanisms the organization maintains throughout the project, even when project objectives may not be achieved.

Limitations

This qualitative content analysis was conducted using manual coding rather than qualitative data analysis software. One such program, NVivo, can assist the researcher by

organizing, coding, categorizing, and analyzing large volumes of qualitative data, it may have been easier to identify patterns, themes, and relationships within the data. However, by conducting the analysis manually, or what is referred to as manual character recognition or MCR required a deeper and more iterative engagement with the literature.

Although MCR was a time-intensive process for the conducting of this content analysis, I would recommend it for a latent qualitative content analysis that employs Indigenous methodologies. The immersive nature of this approach allowed for a deeper exploration of the themes, subthemes and relationships expressed throughout the literature that may have been overlooked or missed through an automated approach. This approach required attention to the research questions and the coding framework to ensure that the analysis remained on point and focused with engaging with the complexity within the data set.

The manual approach also introduced unforeseen considerations within the research process. Accessing some scholarly literature required additional personal resources, and development of a system to visually track the codes, concepts, and relationships within the data. Using colour coded flags within the documents assisted in organizing emerging themes and supported memory recall throughout the analysis. I would consider using MCR for a latent qualitative content analysis informed by Indigenous methodologies in future because of its immersive nature, but I would also carefully consider the time commitment required.

The immersive nature of the manual coding created opportunities to identify a deeper connection between themes and subthemes, including a temporal spatial relationship between TEK development, expression, and distinctions from Western science. Not all deeper connections could be explored or expressed within the parameters of the study. This temporal spatial reality was touched upon, but its deeper connections, differences, and expressions could

potentially yield a study of its own. Maintaining focus on the research questions was necessary when navigating the data to ensure the analysis remained aligned with the purpose of the study.

Areas of Future Study

More expanded research on this topic of TEK may allow researchers to take my recommendations into consideration by implementing applications of ethical integration and co-management projects of TEK and Western science within the field of environmental science. Future research could explore how ethical integration may occur in a specific environmental context by developing collaborative approaches that recognize strengths, limitations and appropriate applications of both TEK and Western science. TEK and Western science integration could be explored from a freshwater aspect within environmental sciences. Freshwater systems provide a unique context for exploration because water is not only ecological but also a place where relationships, responsibilities, experiences and observations are created, maintained and developed. There are Indigenous communities directly impacted by freshwater quality in the Winnipeg “Great Lakes” watershed area within Manitoba. Fresh water is a natural resource that we have human rights informing our abilities to access, utilize and maintain cultural relationships with but as is observable within Indigenous communities these human rights are not always granted in the same aspects as they are in other communities. Ethical community engagement would involve the discipline known as social sciences and would require community participation. My life has been lived on the banks of the Red River a freshwater river that has informed my identity and culture. This personal relationship with water has influenced my understanding of the importance of place, relationships and responsibilities to freshwater systems. This qualitative content analysis has laid the groundwork for a truly ethical and

respectful co-management project. Further research would need to determine what ethical co-management frameworks may look like within specific communities and contexts.

Within the Winnipeg “Great Lakes” water basin area, there has been approximately 100 years between the first applications of Western scientific methods and recent retesting. This span of time where Western methods were not employed presents an interesting and unique scenario. Métis and Indigenous communities have continued to maintain and develop relationships with these freshwater systems during this time, accumulating TEK through lived experience, observation, and interactions with these environments. The long-term relationships Indigenous communities have maintained with these freshwater systems may provide important insights into environmental change, including observations that may not be captured through Western scientific monitoring alone. Examining freshwater systems through TEK provides opportunity to explore environmental knowledge development, how it is maintained and expressed through relationships with place. This context provides an opportunity to explore how TEK and Western science may contribute to a more comprehensive understanding of these freshwater systems while also maintaining individual integrity within both knowledge systems. This unique scenario could yield interesting results within a potential framework of integration.

Indigenous communities have already shared their concerns, needs and hopes for this potential research endeavour. Indigenous communities are seeing changes within freshwater; these changes have direct impacts on their communities, and they have asked to expand the research initiatives in their Territories. This research would start with community priorities, establish appropriate relationships, responsibilities, and governance processes before starting knowledge collection. This approach recognizes TEK is not simply information to access but a knowledge that is steeped in connection, relationships, places and responsibilities.

Closing Thoughts

This chapter reviews the findings of this qualitative content analysis by exploring the stories resident within the themes and subthemes that emerged from this research. These findings support the notion that TEK is regarded as a holistic system of Indigenous knowledge that is grounded in relationships, responsibilities, and lived experience. Essential to how TEK is understood are those Indigenous ways of knowing, being, and doing that are associated with the Indigenous people for who a particular manifestation of TEK exists. The findings of this study also show that meaningful integration of TEK requires more than incorporating ecological knowledge into existing decision-making processes; it requires recognition of Indigenous governance, sovereignty, ethics, and relationships with the Land.

The recommendations section focuses on the respectful and meaningful integration of TEK. The approach of integrating TEK and Western scientific approaches must be grounded in Indigenous-led engagement, ethical relationships, and recognition of Indigenous authority over Indigenous knowledge systems. The findings and recommendations may be understood to support greater understanding of how the relationships between Indigenous knowledge systems and Western science can be approached while maintaining each approach's respective epistemologies.

Completing this research has also shaped my understanding as an Indigenous Studies student and researcher. This research influenced my understanding of Indigenous knowledge, which I had not previously viewed as a nested knowledge system. The explanation of Indigenous knowledge being a nested system given by Jacobs, et al., (2025) was extremely impactful as it assisted me in visualizing the relationship between knowledges and how their conceptualization, shared relationships, and relationality may be articulated.

This research contributes to the field of Indigenous Studies by reinforcing the legitimacy of Indigenous knowledge systems. Indigenous knowledge, on their own terms demonstrate the importance of relationality, responsibility, and Indigenous sovereignty in shaping discussions of environmental governance. I also believe that this research contributes to the field of environmental sciences – a field that is (ostensibly) attempting to improve in the areas of Indigenous engagement and related issues. It is my hope that this research contributes to future dialogue and supports more respectful, ethical, and meaningful relationships between Indigenous communities and non-Indigenous organizations.

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