Weaving Indigenous and Western ways of knowing in land and water conservation: Synthesis & Recommendations towards effective, mutually respectful and beneficial collaborations

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Executive Summary

Under the growing threat of climate change, the constraints of western scientific frameworks are becoming more apparent in the context of land, water, and resource management. As such, calls for bridging or weaving multiple ways of knowing, such as Indigenous knowledge, have been on the rise. Past interactions between Indigenous knowledge holders and Western scientists and decision-makers have been hampered by concerns regarding philosophical differences, cultural differences, Indigenous rights, and competing objectives. Despite a healthy number of interactions, synthesis of interactions and collaborations between Indigenous knowledge holders and western-counterparts have been scarce. Through a literature review, a synthesis of these interactions, lessons learned, and a set of recommendations are provided in hopes to contribute to having effective, mutually respectful, and beneficial collaborations in the future.

The literature review revealed that Indigenous worldviews and those of western science have differing philosophical roots that translate into how they approach conservation and management. While these philosophical differences can be perceived as incommensurability between the knowledge systems, similarities in how they approach conservation and management planning provides positive building blocks for collaborations. To achieve meaningful collaboration, the impacts of colonialism, cultural and epistemological differences must be addressed. These impacts create key difficulties such as the lack of trust in WS from Indigenous communities, the lack of respect many non-Indigenous counterparts have for Indigenous worldviews and culture, epistemological differences, power imbalances, differing objectives, and limited time and resources.

In addressing these difficulties, I present a set of recommendations to empower Indigenous rights, involvement and voices, the Mi'kmaw Two-Eyed Seeing approach as well as three case studies as examples of effective, meaningful, mutually respectful and beneficial collaborations. The text concludes with an invitation for readers to reflect on their position in this conversation and explore the supplemented reading lists at their interest.

Background

As conservation efforts and focus on sustainability are on the rise, many natural scientists, resource managers, and communities have identified a global need for better management of social-ecological systems. Social-ecological systems-may be defined as an ecological system that is linked and influenced by one or more social systems (Anderies et al., 2004). In this context, ecological systems can be defined as an interdependent system of organisms or biological units and social systems can be thought of as interdependent systems of organisms that tend to form cooperative and interdependent relationships (Anderies et al., 2004). Related disciplines are rooted in Western epistemology and have used western scientific methods and frameworks to study the social-ecological systems around us. However, as the need for greater understandings of such complex systems grows under the pressure of climate change, the constraints of western scientific frameworks become more apparent in this context. Consequently, calls for bridging multiple ways of knowing, such as local and Indigenous knowledge (IK) have been on the rise.

Fikret Berkes postulated that the "growing interest in traditional ecological knowledge (TEK: a type of IK) since the 1980s is perhaps indicative of two things: the need for ecological insights from indigenous practices of resource use, and the need to develop a new ecological ethic in part by learning the wisdom of traditional knowledge holders" (Berkes, 2012 in Johnson et al., 2016). Heated discussions around how best to combine TEK and WS in the context of conservation and sustainability have been around for over 20 years (McGregor, 2004a, b; Agrawal, 2002, Nakata, 2002 in McGregor, 2008). Part of the reason for both the intensity of these discussions and the time required to achieve positive outcomes stems from the fact that these discussions are highly political (McGregor, 2008). The political nature of these discussions is inevitable, particularly in the context of conservation and sustainability, where human-nature interactions will always be tied to questions of social and environmental justice (Johnson et al., 2016).

Despite the United Nation's introduction of the United Nations Declaration of the Rights of Indigenous Peoples (UNDRIP) and governments around the world affirming the application of UNDRIP, conservation and sustainability science has been largely disengaged from questions of Indigenous science, Indigenous knowledges and Indigenous rights (United Nations, 2011; Johnson et al., 2016). The affirmation of UNDRIP across the world in combination with the growing threats

of climate change presents an overdue precedent to bridge different knowledge systems such as IK and Western Science (WS).

As global movements to reinforce Indigenous peoples' rights to self-determination, sovereignty, culture and intellectual property slowly take steps forward, interest and interactions between Indigenous communities and western-based societal constructs are likely to increase. In 2017, the settlement between indigenous Māori communities and the state of New Zealand led to the Te Awa Tupua (Whanganui River Claims Settlement) Act. The Act dictates that the Whanganui River is a living entity and a legal person with rights that can be judicially enforced by appointed guardians (Hsiao, 2012; Shelton, 2015). Through these proceedings, the Whanganui River is recognized as containing both a living "physical" ecosystem and 'spiritual' or 'metaphysical' element involving the surrounding communities, who should work collaboratively for the "environmental, social, cultural and economic 'health' and 'well-being' of the river and its people". Under the 'guardianship' model, management strategies and economic activities are developed for the benefit of the river and mutually enhance humanity and the natural environment (Argyrou & Hummels, 2019). Similarly, organizations such as the Global Alliance for the Rights of Nature have been advocating for universal adoption and implementation of legal systems that recognize, respect and enforce the 'Rights of Nature'. These rights recognize that natural entities and communities have the right to exist, maintain and regenerate their vital cycles, rather than be treated as property under traditional western law (Global Alliance for the Rights of Nature, 2019). As similar management models and legal systems are considered and implemented around the world, a synthesis of past interactions between IK and WS and the lessons learned, would be valuable in providing a set of good practices for the development and application of multi-knowledge system management frameworks.

While such attempts have been plentiful and are still increasing, the efficacy of bridging Indigenous and western knowledge systems has yet to reach its potential due to concerns regarding Indigenous rights, cultural and philosophical differences as well as sometimes competing objectives (Nadasdy, 1999; McGregor, 2008; Johnson et al., 2016; Alexander et al., 2011; Hill et al., 2012; Bohensky and Maru, 2011; Rist and Dahdouh-Guebas, 2006). From an Indigenous point of view, Indigenous and western worldviews can be viewed as generally too disparate to combine into one another (Deloria, 1995 in McGregor, 2008). IK is connected to its holders and loses part of its meaning when disconnected from its original context and applied within a western scientific

setting (Agrawal, 2002). Thus, any use of IK should come with its original holders, who must be given strong (equal in value to non-Indigenous voices) voices in decision-making processes (McGregor, 2008). This is seldom the case in application. Interaction between Indigenous and Western ways of knowing have been dominated by the colonially extractive use of WS, which can have unintended and undesired consequences (Fox et al., 2005 in Bohensky and Maru, 2011). Some scholars have also resisted integration of IK as they deemed IK to be distinct enough from WS to be incommensurable (Atran, 2001, Verran, 2001, Cruikshank, 2005 in Bohensky and Maru, 2011).

Differences between how Indigenous peoples and WS view land and water systems are often central to this notion of incommensurability.

While the knowledge held by each Indigenous community can be distinct in their own right, Indigenous worldviews globally share a number of philosophical and spiritual foundations (Reid et al., 2020; McGregor, 2008; Green Fire Productions, 2018). Perhaps the most commonly utilized type of traditional or IK in the world of WS is, TEK, a subset of IK that is "packaged", distilled and appropriated to fit within WS frameworks (Kim et al., 2017). TEK refers to the vast and diverse holistic knowledge of Indigenous communities that have been gathered and refined over thousands of years (Green Fire Productions, 2018). It can include specific details and features about locations, climates, ecosystems, sustainable use of resources, management strategies and more. Such knowledge depends on relationships and interconnections between living and non-living entities. Indigenous communities view TEK as the process of participating fully and responsibly in such relationships (Reid et al., 2020; Johnson et al., 2016). TEK is something knowledge holders do and participate in, with the land and water systems around them. It is a way of life based on respecting the connections, causal relationships and processes driving all entities. Contrastingly, WS traditionally views natural systems and processes based on causality and does not take into account its contextual relationships with other entities (Johnson et al., 2016; Mazzochi, 2006). Unlike IK, WS views the natural world as materialistic commodities and resources that are independent from any human, social, or spiritual connection and can be used freely (Mazzochi 2006). Through this view, WS also takes a dualist view on man and nature, seeing the two as separate and rather disconnected entities (Rist and Dahdouh-Guebas, 2006).

Some scholars have noted that generalizing the diversity of disciplines in WS into a monolithic term such as "Western Science" can be problematic (Phillips and Ruitenberg, 2012;

Siegel 2006). However, there is a wealth of literature that documents prevailing colonial patterns throughout WS, conservation science and its origins (Cannon, 2019; See Supplementary Reading Lists). The author recognizes the internal diversity and strides made toward decolonization within WS. However, it would be extremely difficult to encompass all of the diversity and uniqueness in each corner of IK or WS in a single conversation. As such, some generalizations are needed to address and speak on the prevailing colonial patterns. Furthermore, other scholars point out that such generalizations of Western knowledge may be appropriate in response to the ease with which Western scholars have generalized "non-Western knowledge" throughout history (Alcoff 2007; Stein 2017). It is within this context with which the author speaks to the prevailing colonial patterns throughout WS herein.

These fundamental differences in philosophy and values translate into differing approaches to managing and interacting with the natural world. Through its materialistic and dualist view of land and water systems, western scientific management approaches focus on maximizing the extraction of natural entities as resources. Such approaches struggle to encompass the complexities of inter-relationships and often result in shortcomings outside of the scope of the management projects. Contrastingly, IK engages in more holistic approaches focusing on respecting relationships with other entities that have been built over thousands of years. Due to these relationships, human extraction of other entities generally stems from a need-basis (e.g. sustenance, tools, housing). This is not to say that Indigenous communities do not utilize resources for purposes other than subsistence. But rather that traditional and IK have developed a lifestyle and culture that emphasizes the symbiotic relationship between human and nature (Mazzochi, 2006). These approaches are based on the co-evolution of humans with the environment by respecting the carrying capacity of ecosystems (Mazzochi, 2006). While WS may be able to adapt more quickly, it lacks understanding of the vast contextual relationships that are required to successfully manage our natural systems. On the other hand, while IK contains 'high context' information, holistic management methods, and ways of individual and communal coexistence with land and water systems, it may lack the flexibility and adaptiveness of WS under a rapidly changing climate. By bridging different knowledge systems, multi-knowledge system frameworks that allow complementarity are likely to provide us with deeper understanding of the interconnections between entities, causal relationships at micro and macro scales, as well as, adaptive and flexible holistic management strategies and frameworks.

Against this backdrop, this text aims to review interactions and collaborations between IK, WS ,and their respective knowledge holders and communities and provide a synthesis of philosophical differences, key difficulties faced during interactions, and a set of recommendations or good practices to work towards meaningful, effective, mutually respectful and beneficial collaborations.

Methods:

Literature Review

A systematic literature review was conducted using online databases, Google Scholar, and the University of British Columbia Library. The search terms contained a combination of: "bridging", "collaborate", "Indigenous knowledge" or "Aboriginal knowledge" or "traditional ecological knowledge", "land and water", "management", "conservation", "Canada" and "case study". There was a particular focus on publications that included case studies or examples of bridging IK and WS in conservation management settings in Canada. All literature reviewed were peer-reviewed publications.

Through the literature review, synthesis and discussion of philosophical differences between IK and WS, differences and similarities in management, key difficulties faced in the context of bridging and collaboration between IK and WS as well as a set of recommendations, or suggested, good practices for holistic approaches are provided.

Results and discussion

Philosophical differences

As mentioned above, philosophical differences between how Indigenous peoples and WS view nature or land and water systems are central to a notion of incommensurability between the two. These differences derive into differing management or stewardship strategies and decisions as well as conflicts between IK and WS.

For WS, there is traditionally a dualist dichotomy between human and nature. Through this view, nature is seen as expendable resources. Western scientific knowledge, in this context, is viewed as valuable in itself and for controlling or manipulating the world around us for human material gain (Nelson and Vucetich, 2018; Reid et al., 2021). As such, management strategies derived from WS are often rooted in the maximization of resource extraction. WS focuses on short-term observations in micro-scale settings in an attempt to establish causal relationships (Nelson and Vucetich, 2018). While this approach has its benefits, it can fall under the "illusion of certainty" assuming that nature is predictable and controllable with the right knowledge (Charles 2001 in Reid et al., 2021). WS has a deterministic nature stemming from the requirement of scientific unity that is based on repeatability and falsification. WS methods aim to produce the same results with each repetition to solidify theories to be accepted as facts of nature (Watson, 2013). WS favors analytical and reductionist methods by removing and isolating entities from their natural environment or contexts. WS places entities in simplified and controlled experimental environments in hopes to observe a causal relationship(s). In turn, WS attempts to interpret the reality based on linear conception of cause and effect.

For Indigenous peoples and IK, the human-nature relationship is seen as a sacred trust. Indigenous peoples see nature as being powerful and unpredictable but provides important aspects to their livelihood (Nelson and Vucetich, 2018). As such, there is a sense of humility amongst Indigenous peoples to relate to non-human entities as if they *are* people. An example of this can be seen in the *Anishnaabek* view of the order of creation, where the world was created first, then non-humans, then humans to follow. In this context, "people are therefore considered younger siblings to the rest of creation, and are expected to respect and care for all of creation, much like youth are expected to respect their elders" (Larbsen & Johnson 2016 in Reo et al., 2017). Although,

Indigenous communities around the world all have their distinctive cultures, practices and beliefs, they generally share similar philosophical roots and responsibilities in being stewards of their lands and waters for many millennia. Through this humility and their relationship with nature, IK is born through long tenure in a specific place (Reo et al., 2017). The requirement of time for such knowledge to be born makes it highly contextual, continuous and historically rich. IK, then, is based on long-term empirical observations adapted to local conditions. Local conditions provide vital context that connects the knowledge holder to the local environment. At its core, IK perceives reality as a world made up of constantly forming and reforming multi-dimensional cycles where all elements are part of an entangled and complex web of interactions (Watson, 2013).

These philosophical differences and views can influence how IK holders and WS holders react to changes in nature. For example, water with levels of chemical contamination may be considered safe to drink if the contamination remains below a certain threshold by WS. In this case, no other recognition or attention on the matter may take place. However, for IK, any deviation from a previously known baseline or state is noted by Elders or stewards. This difference shows IK to potentially have a higher sensitivity to perturbation, making them early detectors of ecological change (Reid et al., 2021). IK and its worldviews often come from creation stories such as the *Anishnaabek* view of the order of creation mentioned above or similar conceptual frameworks. The nature of IK and its focus on creation, relationships and the interconnectedness of all entities develops a knowledge holders connection with nature. Contrastingly, not only is this relationship with creation missing in WS, WS removes entities from its context (i.e. natural environment into a laboratory) to scrutinize objects of study, furthering the separation between human and nature (Alkholy et al., 2017). As helpful as it has been in the past, WS's reductionist approach may no longer be sufficient to analyze and understand higher levels of complexity in nature. This may be particularly the case in the context of climate change, where there is a growing requirement to understand larger, more complex social-ecological systems (Mazzochi, 2006). As IK is better suited to deal with complexity, it may also handle unpredictability and uncertainty in complex systems more gracefully than WS (Mazzochi, 2006).

Comparisons in management and conservation planning

These philosophical differences also translate into how conservation or stewardship is practiced by knowledge holders. WS focuses on systematic approaches, where steps are taken to achieve a pre-determined objective(s). IK, on the other hand, is more likely to focus on community engagement and ad-hoc approaches to address specific community concerns. Examples of such differences are presented by Buscher et al. (2021) in their case study, review and comparison of the Songhees Nation (BC, Canada) marine conservation planning process and the Systematic Conservation Planning (SCP) process.

SCP objectives are typically focused on quantitative biodiversity and conservation metrics set by stakeholders. Differing from this, the Songhees approach was focused on achieving long-term qualitative ecocultural goals with additional focuses to increase community engagement, capacity building, and Indigenous stewardship over *Tl'ches* (Chatham and Discovery Islands). These focuses strongly reflect those of many Indigenous peoples and communities' who seek the continuation of their traditional cultural practices (e.g. harvesting) and stewardship for generations to come. This is not to say that SCP projects do not include community engagement, as the number of SCP projects with early and prolonged local community engagement is increasing. However, local communities tend to be much more involved in Indigenous-led projects. This is further evident in the case of the Songhees Nations marine conservation planning process. For the Songhees team, conservation goals for the project were determined after data collection and without any preconceived notion of what the conservation goal(s) would be. This preliminary data was then presented to the community for feedback and further scoping. This allowed data collection to be utilized to clarify the vision and goals of the project with the community as well as inform and direct further data collection and conservation efforts. On the other hand, conservation goals are determined prior to data collection in most SCP projects. Data collection and conservation efforts are then planned and carried forward to achieve the initial conservation goals. Contrasting to the SCP process, by having the local community involved in almost every step of the conservation process, the Songhees minimize the chances of conflicts arising from miscommunication, differing objectives and unwanted deliverables (a common difficulty that occurs during collaborations between Indigenous peoples and non-Indigenous stakeholders, see section **Key Difficulties**).

In addition, data collection of ecological and social data was carried out as one step in the Songhees marine conservation planning process compared to separate steps in SCP projects. By collecting both ecological and socio-cultural data in one step, the Songhees team was able to holistically account for and prioritize the entire social-ecological system. In contrast, the SCP approach is more consistent with the traditional focus of WS and tends to pay more attention to bio-ecological systems. The additional focuses of the Songhees Nation's marine conservation planning process for capacity building (i.e. increasing and building personnel and professional capacity amongst the Songhees planning team) further illustrate deeper levels of community engagement. Through their grant, the Songhees Nation was able to employ and train additional members in a variety of technical skills including training for softwares used such as NVivo or QGIS. Capacity building and maintaining personnel are essential to ensuring the continuance of any conservation plan. The Songhees additional focus on community engagement and capacity building helps solidify the continuation of their traditional cultural practices for the generations to come. This is not to say there are no examples of SCP projects where capacity development is part of the goals. However, there is generally a lack of SCP or WS-based examples that focus on cultural goals.

Although the aforementioned philosophical differences and their application in conservation planning or stewardship strategies have created a notion of incommensurability for some, there are many important similarities between the general IK and WS approaches. These similarities provide opportunities for which future collaborations can be built upon. In the Songhees marine conservation planning case, most of the steps involved in the planning process had similar counterparts that exist in SCP processes. For example, similar to the SCP's scoping and cost planning step (i.e. decisions on the boundaries of the project area, the composition and required skills of the planning team, available budget and how each step in the process will be addressed), the Songhees Nation's scoping process stressed the importance of multidisciplinary teams that involved key people affected as well as a well-developed list of tasks to be considered when adapting approaches to particular land or seascapes. In addition, in terms of a bio-ecological focus, both the SCP and Songhees Nation's approach focused on focal species that were culturally significant to the local community and ecology. Furthermore, the Songhees Nations approach also included a step to identify existing socio-economic threats and barriers to conservation efforts. A similar step is taken in SCP processes to collect socio-economic data and identify costs of

conservation, culturally important areas, as well as constraints, threats and opportunities that the planning team may respond to. Not only do these similarities dispel the notion of incommensurability between IK and WS, they also illustrate that Indigenous-led approaches are systematic and effective in their own right.

While IK and WS approaches have their respective benefits, differences and similarities, both sets of conservation approaches are hindered by a lack of funding and resources for long-term maintenance and monitoring. In many WS cases, conservation initiatives never achieve their potential outcomes due to a lack of funding to maintain and monitor conservation areas (Eckert et al., 2021). Similarly, for the Songhees Nation and other Indigenous communities, the ongoing effects of colonialism and colonial power structures are significant barriers that limit access to resources, employment, education and funding (Truth and Reconciliation Commission of Canada, 2015). In recent years, the number of conservation projects and initiatives that involve capacity building for Indigenous peoples and local communities has been rising with the global trend to respect Indigenous rights to self-determination, sovereignty, cultural and intellectual property. However, much work still needs to be done to decolonize and address the underlying reasons for the aforementioned barriers in the first place.

Key difficulties faced during weaving and collaborating

As the impacts of global warming and subsequent biodiversity loss and ecosystem failures intensify, better management and stronger conservation efforts are crucial to the survival of human society as a whole. Accompanying this, the affirmation and application of UNDRIP around the world present opportunities and motivations to encourage the bridging of IK and WS as well as future collaborations. As mentioned above, there have been numerous attempts at collaboration and bridging of the two knowledge systems. However, there is a lack of conservation projects and initiatives that have not been hindered by the impacts of colonialism, cultural and epistemological differences (Eckert et al., 2021; Reid et al., 2021). In this next section, I present and discuss key difficulties that are faced during collaboration and bridging of IK and WS. Without properly addressing these key difficulties, conservation efforts may be unrulily constrained in reaching their full potential and efficacy.

Lack of trust and respect

One of the most damaging and lasting impacts of colonialism is the lack of respect that some non-Indigenous scientists have towards Indigenous rights, worldviews, and IK. This lack of respect has led to the extraction of IK by WS and failure to involve Indigenous voices and address Indigenous concerns in both contemporary and historic examples (Eckert et al., 2020; Reid et al., 2021; Kadykalo et al., 2021; Reo et al., 2017; Berkes, 2009). To start, non-Indigenous partners generally fail to fully respect and view Indigenous partners as sovereign nations or understand their unique land rights and responsibilities as stewards (von der Porten & de Loë, 2013). In Canada, some non-Indigenous partners will disregard meaningful engagement with Indigenous partners as there is no legal requirement to do so (Watson et al., 2012; Eckert et al., 2020; Kadykalo et al., 2021). Consequently, while some Indigenous communities may be consulted at certain points of a planning process, western counterparts have often "struggled [to understand] what was really important to First Nations" and incorporate those concerns (Interview #53 in Kadykalo et al., 2021). In addition, as colonial atrocities (such as the Indian residential school system and the unmarked graves of thousands of Indigenous children (Milloy et al., 1999) used by non-Indigenous governments to erase Indigenous culture, livelihoods, communities and peoples have ongoing socio-economic impacts, there exists a general lack of trust from some Indigenous peoples and communities to engage with non-Indigenous governments, WS and its knowledge holders. In interviews with parliamentary government employees and stakeholders from BC, Canada, interviewees cited the confidentiality of IK and the lack of trust Indigenous peoples can have in their western counterparts as key difficulties to collaboration (Kadykalo et al., 2021). One respondent in the study noted that First Nations may be "more reluctant to divulge anything on net fisheries because they're going to be afraid that [their quotas] are going to be cut back" (Interview #59 in Kadykalo et al., 2021). This response points to the Canadian government's history of criminalizing and constraining Indigenous cultural and sustenance fishing practices to give way to commercial fisheries (Supreme Court of Canada: R. v. Sparrow, 1990; R. v. Guerin, 1984; R. v. Van der Peet, 1996; R. v. Powley, 2003 and others). Subsequently, many First Nations are more cautious with sharing information in fear of past exploitations being repeated and losing further constitutional rights (Kadykalo et al., 2021). This lack of trust is apparent and is also recognized

by some western scientists as an important aspect of collaboration that needs to be addressed (Kadykalo et al., 2021; Eckert et al., 2020; Reo et al., 2017).

Epistemological differences

Another set of key difficulties cited by many Indigenous and western counterparts are epistemological differences between Indigenous worldviews, IK and WS (Kadykalo et al., 2021; Reid et al., 2021; Eckert et al., 2021; Watson, 2013). For many WS knowledge holders, there is an overall misunderstanding of what traditional knowledge or IK is, its construction and its role. Kadykalo et al. (2021) found that westerners generally perceive IK as "not really straightforward" and difficult to understand, translate and assess. Additionally, from a western perspective, some Indigenous cultural practices or decision-making processes are considered prolonged (Kadykalo et al., 2021; Whyte et al., 2015). Indigenous cultures and governance systems are diverse and each distinct in their own right. Cultural practices such as ceremonies, storytelling, songs and dances are important in many Indigenous communities for sharing and passing down traditions, knowledge or the formalization of memoranda, agreements and relationships (Whyte et al., 2015). Indigenous communities may follow very different decision-making processes to their western counterparts, which may be very specific, consensus-driven and multi-generational. For western counterparts to view these cultural practices and processes as prolonged and perhaps even unnecessary, is yet another example of the lack of respect given to Indigenous peoples.

In addition, there exists a perceived hierarchy of epistemology and knowledge where WS is perceived as superior to IK. In many cases, WS perceives IK as "other" and in binary opposition to WS (Battiste, 2005; Reid et al., 2021). Some Western scientists even consider IK as "not objective" or unreliable as it cannot be assessed under the same rigour or criteria as WS (Watson, 2013; Kadykalo et al., 2021). Following this logic, there is a prevailing perception that IK needs to be validated or verified by the criteria of WS to be useful (Kadykalo et al., 2021). The perceived superiority of WS in the eyes of western scientists and professionals can be considered a continuation of the Western colonialization of Indigenous peoples, knowledge and culture. Consequently, furthering the lack of trust and hesitation of Indigenous communities to engage with western counterparts. In addition, although there has been an increasing number of collaborations

between IK and WS, the fundamental designs and assumptions of land and water management in most studies are based on colonial capitalistic values and time scales (Eckert et al., 2020; Kadykalo et al., 2021) and do not reflect or adequately incorporate Indigenous worldviews (Reo et al., 2017). Furthermore, the evaluation of many 'integrated' knowledge studies has been largely concerned with the credibility of IK in the eyes of WS rather than on equal footing or otherwise (Bohensky and Maru, 2011; Kim et al., 2017). These examples hint at that, for the most part, 'integrated' knowledge studies have attempted to 'integrate' IK into WS frameworks. Due to the nature of IK and how closely it is connected to its holders, removing IK and placing it into WS frameworks creates a fundamental issue where IK loses some of its meaning and efficacy.

Power imbalances

The prevalence of interactions lacking respect between the west and Indigenous communities highlights the existence of power imbalances that have persisted through colonial activities. In practice, this translates into examples such as the aforementioned perceived hierarchy of knowledges as well as differences in decision-making power between non-Indigenous partners, governments and Indigenous Nations and knowledge holders. Western governments, stakeholders and proponents generally have more power as the predominantly recognized legal 'authority' on many facets of society.

Even with the affirmation of UNDRIP in Canada and around the world, suppression of IK in policy-making, socioeconomic structures and colonial practices are still common in today's political systems. Watson et al. (2021) found that the definitions of IK in many policies are derived from western worldviews rather than Indigenous worldviews. For example, current definitions of TEK and its parts are mostly defined by WS-driven languages that attempt to define IK's parameters, dimensions, qualities and possibilities with absolute exactness. However, most native sciences (i.e. IK), do not believe that all variables can be accounted for and that the world cannot be controlled. Therefore, by defining TEK with WS language and purpose (e.g. to control resources and nature), TEK can be considered an academic appropriation of IK (Kim et al., 2017). Furthermore, in both New Zealand and Canada, two countries considered to be at the forefront of the affirmation of Indigenous rights, there are no legislative requirements or standardized

procedures relating to co-governance arrangements nor the recognition of Indigenous law, jurisdiction or authority for Marine Protected Areas (Watson et al., 2021). Some researchers also found that IK has and can be ignored entirely by non-Indigenous partners due to such power imbalances. Inclusion of IK in western works does not always result in the respect of IK if colonial relationships (e.g. extractive usage of IK) are simply replicated (Boyd, 2006; Kadykalo et al., 2021). Some Indigenous people feel that non-Indigenous conservation partners maintain narrow views of IK and only recognize forms of mirror knowledge produced by WS (Reo et al., 2017). Consequently, due to many non-Indigenous counterpart's perceived hierarchy of knowledges, lack of education and understanding of Indigenous rights and cultures, power imbalances to the detriment of Indigenous communities around the world persist through interactions between IK and WS.

Giles et al. (2016) provides an example of how such power imbalances influence policy-making processes. On the east coast of Canada, *Unama'ki* or Cape Breton Island is home to the Eskasoni First Nation, the largest Indigenous community in Atlantic Canada and the largest Mi'kmaw community in North America (Reid et al., 2021). The *Unama'ki* Institute of Natural Resources (UINR) here frequently partners with external non-Indigenous partners on key environmental concerns to achieve their central goal of strengthening research and natural resource management while maintaining Mik'maq knowledges and worldviews (UINR, 2016; Giles et al., 2016; Reid et al., 2021). In Giles et al. (2016), researchers from Dalhousie University, UINR, commercial fishers and representatives from the Eskasoni First Nations examined Indigenous inclusion in policy level fisheries decision-making in Canada. The team identified challenges with reconciling IK and WS and respective values into government-level policy regarding the *Species at Risk Act*. The SARA specifically states that "the traditional knowledge of the aboriginal peoples of Canada should be considered in the assessment of which species may be at risk and in developing and implementing recovery measures". However, Giles et al. (2016) found minimal evidence of Mi'kmaq involvement in the policymaking process with non-Indigenous government respondents citing logistical (lack of legal or formal framework for 'integration'; concerns over data ownership), conceptual (no space for the inclusion of cultural or spiritual knowledge in processes; times scale differences) and communication-based (differing languages and interpretations; unresolved historical traumas and mistrust) barriers to legitimate and equitable inclusion of IK in policy-making processes.

Reid et al.'s (2021) examination of the case reinforces the need for a fundamental rethinking and restructuring of our dominant epistemology and how we manage land, water and resources that allow space for multiple ways of knowing. In the same discussion, Reid et al. (2021) emphasize the need for Indigenous involvement in government policymaking processes (through community advisory boards, scenario building activities) and understanding of the benefits that collaborative approaches (promoting enriched cross-cultural understandings, fostering mutual respect, trust and upholding constitutional and treaty rights) can offer. While significant strides in decolonizing WS and rightfully establishing Indigenous worldviews as a research method have been made over the last decade, the lasting impacts of colonialism on Indigenous knowledge systems and their power are rarely acknowledged let alone amended. As such, the power imbalance between the Indigenous and non-Indigenous world remains a major hindering factor to the formation of mutually respectful and beneficial relationships.

Differing objectives & limited resources and time

As noted earlier, non-Indigenous partners can struggle to understand and incorporate the concerns of Indigenous communities (Kadykalo et al., 2021; Reo et al., 2017). A common reason for this is that Indigenous communities and non-Indigenous partners may have differing objectives for the same project or initiative. These differences can be traced back to philosophical differences between Indigenous and Western worldviews. Boyd (2006) cites global dialogues on land management in relation to the Clean Development Mechanism as an example of how local knowledge has largely been ignored because local perspectives conflict with the narratives and objectives perpetuated by global institutions. Boyd argues that the narratives perpetuated by global institutions oversimplify the complexity of nature in local worldviews and that situations like the dialogues around CDM make genuine bridging of knowledge systems difficult if not impossible. Along with the lack of trust from Indigenous communities, the lack of motivation from global institutions to engage with Indigenous and local communities presents a key hinderance to respectful and meaningful collaborations.

Indigenous and local communities around the world are heavily affected by the impacts of climate change. The effects of climate change are also widely recognized in the non-Indigenous

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world, with scholars from all around the globe in consensus regarding the urgency at which climate action needs to occur. As such, it could be in the interest of both the Indigenous and non-Indigenous worlds to engage in respectful, meaningful and effective collaboration and bridging of knowledge systems.

Recommendations and good practices towards meaningful, effective, mutually respectful and beneficial collaborations

The key difficulties outlined above must be addressed to bridge IK and WS and achieve respectful, meaningful and effective collaboration. Future opportunities of collaboration should prioritize the establishment of long-lasting, mutually respectful and beneficial relationships in replacement of existing ad-hoc and reactionary 'consultation' processes between Indigenous communities and non-Indigenous partners (McGregor, 2008). Many researchers have identified the need to empower and strengthen Indigenous rights, voices, decision-making power and involvement in management and conservation projects (Bohensky and Maru, 2011; McGregor, 2008; Turnbull, 2009; Reid et al., 2021; Kadykalo et al., 2021; Reo et al., 2017). In particular, there have been calls for meaningful recognition, respect and protection by the law and governments, decolonization education and training for individuals who may work with Indigenous partners, and the adoption of a *Two-Eyed Seeing approach* (Reid et al., 2021; Kadykalo et al., 2021). A synthesis of recommendations and suggestions of good practices for holistic approaches to bridging and collaborations between IK and WS is presented here below.

Empowering & strengthening Indigenous rights, voices, decision-making power and community involvement

Indigenous communities are disadvantaged by colonial power imbalances that constrain their access to resources, employment, tradition and their rights. Through time these experiences created a lack of trust amongst Indigenous communities to engage with non-Indigenous partners in fear of being further disadvantaged. At the same time, due to colonial power structures, there is

commonly a lack of understanding and respect from non-Indigenous partners towards Indigenous communities and IK that may further hinder engagement. In addition, there is a general lack of legal requirements or standardized processes to involve Indigenous communities in management and conservation efforts that affect them. Against this background, collaborations between Indigenous and non-Indigenous partners can be quite tense. Researchers suggest that national laws and policies need to make space for Indigenous forms of cultural practice and knowledge (Bohensky and Maru, 2011). Many definitions of IK in western policies have lost parts of its meaning and cultural significance as they have been provided through non-Indigenous worldviews. Creating spaces where Indigenous forms of cultural practice and knowledge can exist on equal footing with non-Indigenous forms would aid in the protection of Indigenous culture and knowledge. This includes the need to negotiate on a Nation-to-Nation basis, instead of having a one-size-fits-all approach to collaborating or consulting Indigenous communities (Bohensky and Maru, 2011; McGregor, 2008). Furthermore, "a future for IK can only be ensured by ensuring the survival, resilience and flourishing of Indigenous peoples" (Turnbull, 2009). As such, it is imperative for governments around the world to uphold the affirmation of UNDRIP, acknowledge and address the destructive forces that impinge upon IK holders (Bohensky and Maru, 2011). In addition, aligning with the affirmation of UNDRIP, there needs to be an increase in governments' and states' confidence in the capacity of Indigenous peoples to "manage" or steward their own land and resources without federal oversight or another colonial force (Reid et al., 2021). It may help to establish a legally binding standardized set of actions required when collaborating with IK holders and communities (Kadykalo et al., 2021). These actions should be co-developed with IK holders and communities to prevent misunderstandings and misinterpretations of Indigenous concerns. The recognition and respect of Indigenous rights, affirming that Indigenous peoples, their cultures and rights are equal to all others, is a central theme in all of the recommendations presented herein. Consequently, it is crucial that legal recognition of Indigenous political authority, rights and binding agreements are provided and respected by governments and states around the world (Reo et al., 2017; McGregor, 2008). By respecting and creating space for Indigenous rights, cultures and knowledge, non-Indigenous partners can begin to repair or improve the relationship that has been damaged by previous interactions.

As Indigenous communities have suffered under colonial pressures for hundreds of years, the establishment of long-lasting, mutually respectful and beneficial relationships may occur over

time. In certain cases, Indigenous partners may refuse interaction and collaborations entirely. In these situations, and in general, when interacting with Indigenous communities, Indigenous decisions must be respected. Non-Indigenous partners (including those who work with Indigenous governments) are often unfamiliar with the values and perspectives of Indigenous peoples (e.g. culturally specific and long-standing traditions for stewarding the environment or cultural differences in understanding of human-nonhuman relationships). In addition, due to WS's prevailing attitude to validate IK through the criteria of WS, non-Indigenous decision-makers may misinterpret IK and be overly cautious in engaging with IK partners. Thus, revealing a need to train non-Indigenous scientists and decision-makers to practice open-mindedness, be educated in Indigenous cultures and worldviews and be trained in the decolonization of WS (Reo et al., 2017; Kadykalo et al., 2021; McGregor, 2008). Researchers have found that multi-party initiatives run better if all participants have a basic level of education and sensitivity about one another's cultural traditions, histories, values, priorities and aspirations (Reo et al., 2017). Any training or educational programs should be co-developed and co-delivered with Indigenous peoples and knowledge holders. These programs should be required for anyone who can be expected to come into contact with Indigenous peoples as part of their professional duties (McGregor, 2008).

By respecting Indigenous rights and responsibilities to manage and steward their own lands and resources, meaningful participation and involvement of Indigenous communities and knowledge holders must take place at each step of the management or conservation project (Reid et al., 2020; Kadykalo et al., 2021; Reo et al., 2017; Popp et al., 2020). Meaningful engagements (or participation and involvement) can take the form of early involvement, where Indigenous people should have the opportunity to consent or be consulted 'early on' in processes that may affect their interests. 'Early' should mean being invited to participate when a project or initiative is being established. Early involvement allows Indigenous peoples to help determine the form and operations of the group and participate in advisory boards. In a sense, early involvement allows Indigenous peoples to contribute to the determination of how collaboration will unfold in these partnerships (Reo et al., 2017). An example of a product from early involvement could be a signed memorandum that details the objectives and expectations of a partnership. In addition, the involvement of participants from multiple generations (particularly youth and elders) is important in respecting the importance of intergenerational relationships, the continuation of traditions, cultural practices and the long-term monitoring and management post the initial project timeline

(Reo et al., 2017; Buscher et al., 2021). Indigenous Elders have deep insights and knowledge that can provide guidance through visioning processes and information poor situations. On the other hand, youth involvement can empower Indigenous youth in learning and reinforcing cultural practices and traditional values, develop their appreciation for science and conservation while building trust with non-Indigenous partners. These processes can train Indigenous youth as stewards or future stewards of their land, waters and resources (Reo et al., 2017).

Adopting a Two-Eyed Seeing approach

To address the complexity and existing problems, *Etuaptmumk* (Mi'kmaw) or "Two-Eyed Seeing" provides a framework to equitably embrace multiple perspectives within a system (Reid et al., 2021). *Etuaptmumk* is a conceptual framework that has been developed through the experiences and knowledge of generations of Mi'kmaq Knowledge Keepers. Mi'kmaw Elder and senior author Dr. Albert Marshall defines Two-Eyed Seeing as "learning to see from one eye with the strengths of IKs and ways of knowing, and from the other eye with the strengths of mainstream knowledges and ways of knowing, and to use both these eyes together, for the benefit of all" (Bartlett et al., 2012; Reid et al., 2021). The framework has been used to encourage the coexistence of and bridging of differing worldviews and knowledge systems in a variety of disciplines (Reid et al., 2021). Being an ethic of knowledge coexistence and complementarity in knowledge generation, knowledge systems are valued, used and protected on equal planes. As such, there exist no hierarchies of knowledge systems within the framework, where one is better than the other (Berkes, 2018). A Two-Eyed Seeing approach allows for the respect of multiple realities or worldviews and considers multiple knowledges as valid and equal. It upholds relationship accountability between knowledge holders by promoting respectful representation and reciprocity and carries out highly inclusive and situated research (Reid et al., 2021). Central to Two-Eyed Seeing is the notion that knowledge transforms the holder and that the holder bears the responsibility to act on that knowledge. In a sense, knowledge empowers one to uphold their responsibilities to future generations (Hatcher et al., 2009; Reid et al., 2021).

Two-Eyed Seeing approaches have defining features in application such that they are highly participatory, co-developed, co-run and co-evaluated by communities and knowledge

holders. Projects and studies taking a Two-Eyed Seeing approach will have meaningful and respectful engagement of Indigenous and non-Indigenous partners at all steps. Project objectives, vision, scope, planning, and execution should be co-developed, co-run and co-evaluated to ensure knowledge coexistence and complementarity. Co-evaluation processes are particularly important and distinct to Two-Eyed Seeing approaches. In a Two-Eyed Seeing approach, co-evaluation primarily measures knowledge systems against internal rather than external criteria or referents (experts evaluate their own expertise and output) (Reid et al., 2021; Bohensky and Maru, 2011). While inclusive and multi-knowledge system evaluation processes such as the Millennium ecosystem assessment have been gaining popularity, much of the evaluation of knowledge systems have been concerned with 'integrating' IK into WS frameworks. As such, co-evaluation processes require a more equal distribution of evaluative power across knowledge holders. Moller et al. (2004) argue that TEK has a crucial role in evaluating WS. By promoting collaborative teams that combine scientific and traditional monitoring methods, Indigenous wildlife users can evaluate scientific predictions on their own terms, increasing the likelihood that they will trust and interact with WS. As the Two-Eyed Seeing approach is inclusive and flexible, users are able to adapt the framework and accentuate different aspects to suit their needs. Presented below are summaries of case studies on projects and studies that each have a unique focus in their operationalization of the Two-Eyed Seeing approach.

Power neutrality in research processes – Slave River Delta

In the first case study, set in the Slave River Delta in the Northwest Territories of Canada, a collaborative team of Indigenous community members, academics and other groups came together to develop community-based monitoring activities throughout the region to address the local communities' growing concerns over fish health (Mantyka-Pringle et al., 2017; Reid et al., 2021). Mantyka-Pringle et al. (2017) used participatory modelling (Bayesian belief networks) to bring together interview transcripts, field data, existing models and expert judgement to provide a power neutral approach to answering a set of co-developed research questions and produce a co-authored report. In the study, ecosystem health indicators were developed along two distinct but complementary lines (Reid et al., 2021). On the WS side, health indicators included turbidity and

fish external anomalies. In parallel to these metrics, IK holders developed physical appearance of water and fish aesthetics as health indicators based on IK. By combining visual, narrative and textual tools, key knowledge holders assessed the causal links between indicators and guiding questions. Key knowledge holders included an equal number of Elders, harvesters, fishers, government staff and scientists. The balance and equality of power between groups, their respective knowledges operationalized the Two-Eyed Seeing approach and allowed different knowledge systems to coexist on equal planes (Reid et al., 2021)

Consilience between different knowledge systems – Saskatchewan River Delta

In a second case study, Abu et al. (2019), came together with local Indigenous communities and academics to address concerns over the impacts of upstream anthropogenic activity on system hydrology, and fish and wildlife populations. One of the main goals of the study was to find ways for Indigenous communities and academic researchers to work together as equals, where both knowledge systems are equally valued and unified to improve the collective understanding of the ecosystem. The team used a multiple evidence base approach guided by Two-Eyed Seeing that brought together 3 evidence bases to examine the state of their social-ecological system. In the first evidence base, IK, interviews with Elders and harvesters (fishers, hunters and trappers) were transcribed and analyzed. The preliminary results from IK were presented to the community for review and approval. In the second evidence base, archival records of key historical events and past system changes from the Provincial Archives of Saskatchewan and information on local resource policies were used. The third evidence base was scientific instrumental observations (e.g. water gauges, fish landing data, etc.). The 3 evidence bases showed a high degree of agreement (or consilience) across knowledge systems for almost all indicators of ecosystem health. The high level of congruence between knowledge systems provides strong reasons for all knowledge holders to be confident in the validity and reliability of other knowledge systems.

Indigenous Guardianship Program – Gitanyow Lax'yip

For the third case study, Popp et al. (2020; Popp et al., 2019), the *Gitanyow* Moose monitoring Indigenous Guardianship Program (IGP) presents an example of how the weaving or bridging of IK and WS through a Two-Eyed Seeing approach can benefit long-term monitoring and management and communities when there is legal protection for Indigenous rights. In northwestern British Columbia, Canada, the *Gitanyow Lax'yip* (traditional territory) spans over 6,000km2 and is intertwined within two major watersheds that support a high diversity of fish and wildlife (Popp et al., 2020). Through the *Gitanyow Lax'yip* Land Use Plan (GLLUP, won after 3 court cases against the British Columbia Minister of Forests) contains legal protection of their rights to steward their own land and resources, local ecosystem networks and ungulate winter range for moose determined by hereditary chiefs. Under this backdrop and growing community concerns over moose populations, the *Gitanyow* Moose monitoring IGP was initiated. Moose hunting is an essential part of *Gitanyow* culture and livelihood, "providing food and spiritual and physical health benefits while contributing to the maintenance of intergenerational relationships and knowledge exchange amongst *Gitanyow* peoples" (Popp et al., 2019). As such, the IGP provided needed monitoring of moose populations in their territory to inform stewardship and management decisions. The *Gitanyow* moose monitoring IGP (and IGPs in general) focused heavily on community-led environmental monitoring activities. Guardians steward the land, carrying out daily activities or promoting community-centered participation in monitoring and enforcement of Indigenous laws, taking leadership in information gathering, designing management plans and fostering intergenerational knowledge transfer and cultural revitalization (Popp et al., 2020). In addition, in a similar spirit to Two-Eyed Seeing approaches, IGPs embrace multiple knowledge systems and the inclusion of both IK and WS to promote holistic solutions to monitoring wildlife and the environment. In the *Gitanyow* case, the IGP approach included community monitoring which benefited moose monitoring as typical WS-based monitoring strategies (aerial surveys, land user surveys, fecal pellet surveys) were difficult, resource-intensive and often left uncertainty and gaps in population information. In their moose monitoring IGP, each season began with pre-season meetings with *Gitanyow* wildlife biologists, Guardians, and hereditary chiefs to review information and updates on moose population. Decisions are then made with the agreement and consent of the hereditary chiefs and harvest strategies are then shared with the community for

feedback. Guardians also worked closely with BC Conservation Officer Service and provide the harvest strategy for each year to help with enforcing the harvest strategy. Popp et al. (2020) found that Indigenous community feedback and knowledge can better inform decisions regarding monitoring methods to target knowledge gaps or uncertainties. Better informed decisions can then provide more efficient uses of resources and improve consistency in monitoring. Both of which can be crucial in many cases where funding and resources may be limited. Due to the success of the program over the last few years, the *Gitanyow* IGP has been successfully expanded from 2 part-time seasonal Guardians to 3 full-time Guardians who carry out daily monitoring and patrols. As Guardians are trained in a wide variety of wildlife, fisheries, hydrology, veterinarian and ecological monitoring techniques, there is significant potential for capacity building through the IGP program. Through the success of the *Gitanyow* moose monitoring IGP, ecological benefits (increases in moose sightings per field day by Guardians and moose population by ~50%) and social-economic benefits (community engagement, intergenerational involvement and knowledge transfer, Indigenous-Non-Indigenous collaborations) provide a stellar example of how weaving or bridging IK and WS can not only strengthen and contribute to more effective management strategies, community stewardship as well as ecological and cultural integrity (Popp et al., 2020).

Conclusion

As the global community continues to search for deeper understandings and solutions to achieve better management of land and water systems, the Two-Eyed Seeing approach presents a fitting framework to carry this work forward. By operationalizing the balance, equity and collaborative nature of the Two-Eyed Seeing approach, the cases above illustrate that there is a way forward to achieve effective, mutually respectful and beneficial collaborations between IK, WS and their respective knowledge holders in the context of conservation science. These examples show that IK, WS and their respective knowledge holders can work in complementarity and provide positive building blocks towards future opportunities. However, to achieve a future where effective, mutually respectful and beneficial collaborations are common, the systemic imbalances and inequalities that gave rise to the difficulties faced must be addressed. As lasting impacts of colonialism and the colonial roots of many WS disciplines continue to contribute to power

imbalances and the lack of trust and respect between Indigenous communities and the western world, Indigenous rights, voices, involvement and decision-making power must continue to be empowered along with meaningful affirmation and application of UNDRIP around the world. Decolonization of WS, education and cultural sensitivity training would also be needed to reach a setting with no perceived hierarchies of epistemology, where knowledge systems and diverse cultures are celebrated and held equal. Through the creation and formalization of spaces where Indigenous worldviews and WS can exist on equal planes, it is the author's hope that the findings and recommendations presented in this work would encourage and contribute to effective, mutually respectful and meaningful collaborations between IK and WS in the future.

Supplementary reading list: Decolonizing Conservation & Two-Eyed Seeing

As the findings in this work presents a call to reflect on restructuring the dominant epistemological in our discipline to create space for open-mindedness, different cultures, ways of knowing and ways of life, I invite the reader to reflect on this notion and explore some of the readings below on decolonizing conservation science and the Two-Eyed Seeing framework.

- **Decolonizing conservation – Sara Cannon**

  Cannon, Sara E. (2019). Decolonizing Conservation: A Reading List. Zenodo. https://doi.org/10.5281/zenodo.4429220

- **Two-Eyed Seeing Essential Reads – Andrea Reid, Jesse Popp, Deborah McGregor, Jacquie Miller and Albert Marshall**

  Reid, A. J., Popp J.N., McGregor, D., Miller, J., Marshall, A. (2020). 20 Essential Reads to Enable Two-Eyed Seeing in Aquatic Research and Management. IAGLR Lakes Letter. Retrieved from: http://iaglr.org/docs/LL7__2eyedSeeing_essentialReads.pdf

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