

Article

In a Good Way: Braiding Indigenous and Western Knowledge Systems to Understand and Restore Freshwater Systems

Samantha Mehltrittter ^{1,*} , Andrea Bradford ¹, Sheri Longboat ² and Brittany Luby ³ ¹ School of Engineering, University of Guelph, Guelph, ON N1G 2W1, Canada; abradfor@uoguelph.ca² Faculty of Science, Wilfrid Laurier University, Waterloo, ON N2L 3C5, Canada; slongboat@wlu.ca³ College of Arts, University of Guelph, Guelph, ON N1G 2W1, Canada

* Correspondence: mehltrittter@uoguelph.ca

Abstract: Insights from Indigenous and Western ways of knowing can improve how we understand, manage, and restore complex freshwater social–ecological systems. While many frameworks exist, specific methods to guide researchers and practitioners in bringing Indigenous and Western knowledge systems together in a ‘good way’ are harder to find. A scoping review of academic and grey literature yielded 138 sources, from which data were extracted using two novel frameworks. The EAUX (Equity, Access, Usability, and eXchange) framework, with a water-themed acronym, summarizes important principles when braiding knowledge systems. These principles demonstrate the importance of recognizing Indigenous collaborators as equal partners, honouring data sovereignty, centring Indigenous benefits, and prioritizing relationships. The A-to-A (Axiology and Ontology, Epistemology and Methodology, Data Gathering, Analysis and Synthesis, and Application) framework organizes methods for braiding knowledge systems at different stages of a project. Methods are also presented using themes: open your mind to different values and worldviews; prioritize relationships with collaborators (human and other-than-human); recognize that different ways of regarding the natural world are valid; and remember that each Indigenous partner is unique. Appropriate principles and practices are context-dependent, so collaborators must listen carefully and with an open mind to identify braiding methods that are best for the project.

Keywords: Indigenous knowledge systems; freshwater social–ecological systems; braiding knowledge systems; ecosystem restoration



Citation: Mehltrittter, S.; Bradford, A.; Longboat, S.; Luby, B. In a Good Way: Braiding Indigenous and Western Knowledge Systems to Understand and Restore Freshwater Systems.

Water **2024**, *16*, 934. <https://doi.org/10.3390/w16070934>

Academic Editor: Yongjiu Cai

Received: 18 February 2024

Revised: 11 March 2024

Accepted: 14 March 2024

Published: 23 March 2024



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1. Introduction

“Rivers and their associated floodplains, groundwater, and wetlands are in crisis” [1] (p. 1). Human impacts on aquatic ecosystems are diverse and widespread. Freshwater systems are altered not only by pollution and water withdrawals but also by urban development, agricultural expansion, deforestation, shoreline infrastructure, water diversions, water control structures, irrigation, and drainage for alternative land use [1]. These changes diminish an aquatic system’s capacity to provide living things with habitat, food, and water, and they decrease the freshwater system’s ability to mitigate flooding, manage water quality, and regulate climate. Western society’s desire to control nature has disrupted the delicate balance of aquatic ecosystems, making them less resilient and placing us and others at greater risk in the face of climate change.

The United Nations’ declaration that 2020–2030 would be the decade of ecosystem restoration underscores the critical interdependence between people, the planet, and the ecosystems upon which we rely. Restoring freshwater systems holds the key to managing pressing challenges such as flooding, erosion, and water conservation, particularly in the face of escalating climate change. As we seek to restore complex social–ecological systems, however, McGregor [2] reminds us that “conventional Western systems have failed miserably in protecting our planet” (p. 17). Indigenous knowledge systems, in contrast, have

informed Indigenous Peoples' ways of life for millennia. With epistemologies that prioritize relationality with all beings and interconnectedness, Indigenous Peoples flourished while caring for Mother Earth. This is not to say that Western knowledge systems have nothing to contribute; they provide quantitative methods and monitoring technologies that can be used in a wide range of projects. Rather than relying on either Western or Indigenous knowledges alone, we can bring the strengths of both systems together for an enriched understanding of the social–ecological systems we seek to restore [3].

Bringing together knowledge systems is not a new concept. Indeed, Reid et al. [4] share frameworks created by Indigenous Nations from around the world that bring together Indigenous and Western knowledge systems. Each framework depicts how Indigenous knowledge systems (IKS) and Western knowledge systems (WKS) can come together either to co-create new knowledge (e.g., Two-Eyed Seeing) or so knowledge systems can exist in parallel with one another (e.g., Two-Row Wampum). Different terms are used to describe bringing knowledge systems together, such as *bridging*, *blending*, *weaving*, *connecting*, or *braiding*. Terms such as *integrating* are avoided because they connote knowledge assimilation [4], whereas terms such as *weaving* or *braiding* connote strands being brought together but maintaining their integrity. In a world dominated by Western society, it is important to recognize that Indigenous knowledges are complete without Western knowledge [5]. Terminology can also suggest that bringing “strands” together creates something stronger, like a braided rope, and something richer, like woven art. We use the term *braiding* because it also connotes care, like when braiding a loved one's hair or braiding sweetgrass.

But frameworks and terminology are only a starting point. We must learn *how* to braid IKS and WKS ‘in a good way’. Here, we analyze and synthesize projects in which knowledge systems have been braided for the deep insight they offer into what *braiding knowledge systems* means; in the process, we gained an appreciation for a wide range of possible practices. Reviews of this nature exist across the globe and across disciplines (see, e.g., [6–8]). Two such reviews synthesized knowledge system braiding projects within a freshwater context. Stefanelli et al. [9] and Alexander et al. [10] performed rigorous reviews to map projects attempting to braid IKS and WKS. They both, however, acknowledge limitations regarding the depth of methods, and Alexander et al. [10] expressly call for more in-depth analyses of braiding projects to demonstrate the variety and nuance of methods for bringing together IKS and WKS. The research presented here focuses on identifying specific and contextualized methods to answer the following question:

How are Indigenous and Western knowledge systems being brought together to better understand, manage, and restore freshwater social–ecological systems within parts of Turtle Island (colonially known as Canada and the United States) in a good way?

This phrase, ‘in a good way’, refers to an Anishinaabe philosophy of living that involves aligning one's actions with values and worldviews in which humans are in relation with all beings (animate and inanimate) [11]. When used in this paper, we extend this definition to mean aligning actions to the specific values and worldviews of the Indigenous Peoples engaging in the braiding process. Thus, we seek to provide principles, practices, and specific examples from a systematically identified body of records reporting on projects that sought to braid knowledge systems in alignment with the values and worldviews of Indigenous partners (i.e., ‘in a good way’). The phrase ‘in a good way’ also reinforces that every Indigenous community is unique; thus, every collaboration will differ. Ultimately, if non-Indigenous partners can take a step back and create spaces for equitable knowledge system braiding, then we can co-create an enriched understanding of these complex social–ecological freshwater systems, facilitating better management, restoration, and relationships with Water.

There are clear benefits in braiding IKS and WKS to find solutions to the ecological crises overtaking the planet. It requires trusting collaborations and respectful relationships between Indigenous and non-Indigenous Peoples. Unfortunately, there is a long history of mistreatment, objectification, and dehumanization of Indigenous Peoples by the West [12]. Now that the world is recognizing and taking responsibility for the colonial harms inflicted

on Indigenous Peoples, efforts are being made toward reconciliation. Healing broken relationships among Indigenous and non-Indigenous Peoples is paramount to enabling knowledge system braiding, and braiding IKS and WKS is vital to reconciliation. “As more and more people are realizing, the protection of Indigenous Peoples’ rights and the planet’s health go hand in hand” [13] (p. 5).

This paper contributes to the literature on bringing together IKS and WKS within the context of freshwater systems by assembling detailed methods from hundreds of projects (reported in both the academic and grey literature) across Turtle Island. While pursuing our own braiding project, we struggled to find clear guidance on *how* to enact frameworks and principles for braiding IKS and WKS. The objective of this paper is to provide users with specific and contextualized methods that can be applied in future braiding projects. We are not, however, attempting to distil down a select few methods that all projects must use. Instead, we present a range of specific methods, including contextual details where possible, to illustrate the numerous ways braiding IKS and WKS can occur throughout a project. We organize these methods into two novel frameworks. The first highlights foundational principles essential for braiding IKS and WKS in a good way, while the second organizes specific practices that achieve these principles at different stages of a project.

2. Materials and Methods

The authors of this paper come from both Indigenous and non-Indigenous ancestry. The lead author (SM) is a PhD candidate in water resources engineering at the University of Guelph who has been working with Niisaachewan Anishinaabe Nation and some of the co-authors to investigate *Manomin* (wild rice) decline on the Upper Winnipeg River. SM has distant European heritage and was raised and educated within the dominant Western society. Most of her higher education followed a positivist ontology. Since she began work with Niisaachewan on the Manomin Project, SM has started a journey of unlearning, opening her mind to different values, worldviews, and ways of knowing.

SM’s advisor and co-author, AB, is a water resources engineer and settler professor at an academic institution in what is currently known as Southern Ontario, Canada. Although AB comes from Western roots (ancestral and educational), she has always recognized the value of the natural world beyond its utility to humans. Thus, when she started working on the Manomin Project, some of Niisaachewan’s worldviews aligned closely with her own. She is still, however, learning how to support Indigenous self-determination and sovereignty and educate her students to do the same.

BL and SL are both Indigenous scholars at academic institutions in Southern Ontario. Indeed, BL’s paternal ancestors originate from Niisaachewan, and her relationship with her ancestral community brought the Manomin Project to fruition. She practices community-engaged research that reflects decolonizing methodologies and holds expertise in Treaty-making and environmental history. SL has Haudenosaunee Mohawk ancestry along with expertise in physical geography, water governance, management, and planning.

Providing a positionality statement aligns with many Indigenous cultures’ practice of self-locating [14]. We explicitly state our worldviews and expertise to show respect for Indigenous ontologies and so that readers know our lens and perspective. This statement also reflects the approach we have taken in this review. Although academic reviews are founded in WKS—where rigour is achieved through systematic, often linear, processes—many IKS do not align with this approach. Therefore, we have taken some aspects from the Western review process while also seeking to align our approach with Indigenous values. Our approach was not linear. We emphasized relationships and connections. Consensus and mutual understanding were prioritized. And we sought to be open to diverse records that braid IKS and WKS. Although replicability may be compromised at the scale of the individual record, we feel our approach is ideal for a review that aims to identify principles, practices, and examples and provide the discussion and context necessary to apply them.

2.1. Scoping Review

Unlike systematic reviews that seek to answer specific research questions from a specific body of literature, scoping reviews provide insights from a broader, possibly more varied body of literature on a more general topic [15]. Because of their broader and more flexible nature, scoping reviews allow for greater diversity in methodology and rely on descriptive overviews to characterize the relevant body of knowledge [15]. Furthermore, some reviews, such as systematic or critical reviews, tend to appraise the quality of the records while synthesizing findings [16]. Given the diverse representation of Indigenous Nations and the importance of relationships and context to Indigenous worldviews, we felt it was inappropriate for us to evaluate the quality of the records, which is congruent with scoping review methods [16]. Unlike scoping reviews, however, we go beyond mapping the body of knowledge. In our desire to investigate how to braid knowledge systems, we looked at all included records in depth and attempted to synthesize principles, practices, and examples of braiding IKS and WKS in a good way.

2.2. Search Strategy

SM designed a two-phase search strategy. The first phase focused on searching traditional academic databases. The second phase targeted grey literature. Four academic databases were searched, including Web of Science, Natural Science Collection, EBSCOhost, and Indigenous Studies Portal Research Tool. The latter, often called iPortal, is a database of documents by and for Indigenous Peoples initiated by the University of Saskatchewan in 2005 [17]. The database targets Canadian documents but includes documents from across Turtle Island.

We targeted the grey literature by using Google Scholar and Google Advanced Search. We modified the personalized search settings to ensure that our search histories and locations did not influence the results and took only the first 250 hits from each search.

Following a consultation with a librarian at the University of Guelph and discussions with her co-authors, SM prepared a base search string made up of four components: Indigenous knowledges, aquatic system, study applications or project outcomes, and geography. Twelve benchmark papers were also selected to verify that the search string returned the desired body of work. The list of benchmark papers (see S1 in Supplementary Materials) comprises papers found in similar reviews (e.g., [9,10]) and some hand-selected by the authors. The final base string included the following:

- **Indigenous knowledges:** Indigenous OR Aboriginal OR Inuit OR Metis OR First Nation OR Native American OR Indian OR First Peoples OR tribe OR tribal AND knowledge OR ways of knowing OR perspectives OR values OR science OR systems OR traditional ecological knowledge OR traditional knowledge OR cultural knowledge;
- **Aquatic system:** lake OR river OR stream OR wetland OR freshwater OR watershed OR basin OR catchment OR water resource OR aquatic OR inland water;
- **Study applications or project outcomes:** restoration OR management OR decision OR planning OR dam operation OR river regulation OR environmental flows OR ecological flows OR water allocation OR impact assessment OR environmental assessment OR risk assessment OR resilience OR adaptation;
- **Geography:** Canada OR United States OR North America OR Turtle Island.

Each database is unique, so the base search string was modified slightly to accommodate limitations (see S2 in Supplementary Materials). For example, Google limits queries to 32 words. Because the base search string is nearly 120 words, the searches were divided by geography to reduce the number of words needed in the “Indigenous knowledges” and “geography” components. The search strings used for each database are included in the Supplementary Materials.

Zotero (version 6.0.35) was used to manage records obtained from the eight databases ($n = 10,125$), including identifying and removing duplicates ($n = 2441$) [18]. Once the final set of records was ready for screening, they were exported from Zotero and uploaded to a free online review software, Rayyan [19]. Rayyan identified some duplicates that Zotero missed ($n = 99$) and was the main tool used for screening the records ($n = 7585$).

2.3. Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were developed over several discussions among the co-authors. This study was limited geographically to Turtle Island because of the authors' familiarity with Indigenous Nations in this region and to avoid pan-indigenization. Further, we only considered records published after UNDRIP was adopted by the UN General Assembly in 2007. We conducted the search in late June 2022. All records were published on or before 15 June 2022. Only records written in English were considered. Table 1 outlines the criteria used for screening.

Table 1. Inclusion and exclusion criteria for the scoping review.

	Inclusion	Exclusion
Spatial and temporal	• Turtle Island (continental North America, i.e., Canada and US). • Published 1 January 2007–15 June 2022.	• Mexico, Hawaii, US territories, and freely associated states (e.g., Puerto Rico, American Samoa). • Published prior to 2007.
Knowledge systems	• Attempts to bring IKS and WKS together. • Indigenous-led, Western-led, and equal partnerships.	• Insufficient presence of IKS. • Limited to consultation with Indigenous community. • Insufficient detail on the methods employed to bring IKS and WKS together. • No clear benefit to Indigenous Peoples.
Aquatic system	• Freshwater ecosystem. • Freshwater and anadromous species. • Land and natural resources management projects with clear connection to water.	• Marine/coastal ecosystem. • Limited to species physiology or species focus without connection to habitat/ecosystem. • Terrestrial ecosystems without clear connection to water.
Record type	• Primary, secondary, and grey literature. • Projects employing braiding methods, analyses of projects employing braiding methods and records suggesting braiding methods based on experience. • Literature reviews.	• Discusses only challenges/issues, not solutions (e.g., water issues in Indigenous communities). • Focus on engineered infrastructure (e.g., water treatment processes) without implications to ecosystem. • Education/curricular material or educational focus. • Legal analyses or reports on legislation enforcement. • General discussions about water governance (high-level) without clear analysis or application. • Records presenting braiding frameworks without concrete examples/case studies/methods.

2.4. Screening

Figure 1 outlines the screening process. Nearly 8000 record descriptions were screened. Then, the full papers were reviewed to assess whether they should be included. In the first stage of screening, a team of three junior reviewers (undergraduate research assistants in environmental science and engineering) and three senior reviewers (SM, BL, and AB) read only the titles and abstracts. The review team used Rayyan to label records “include” or “exclude”. They applied a third label, “maybe”, when they thought a quick look at the full paper was needed to confirm exclusion. “Maybe” was also used when the title and abstract did not load properly into Rayyan or, in the case of grey literature, there was no abstract.

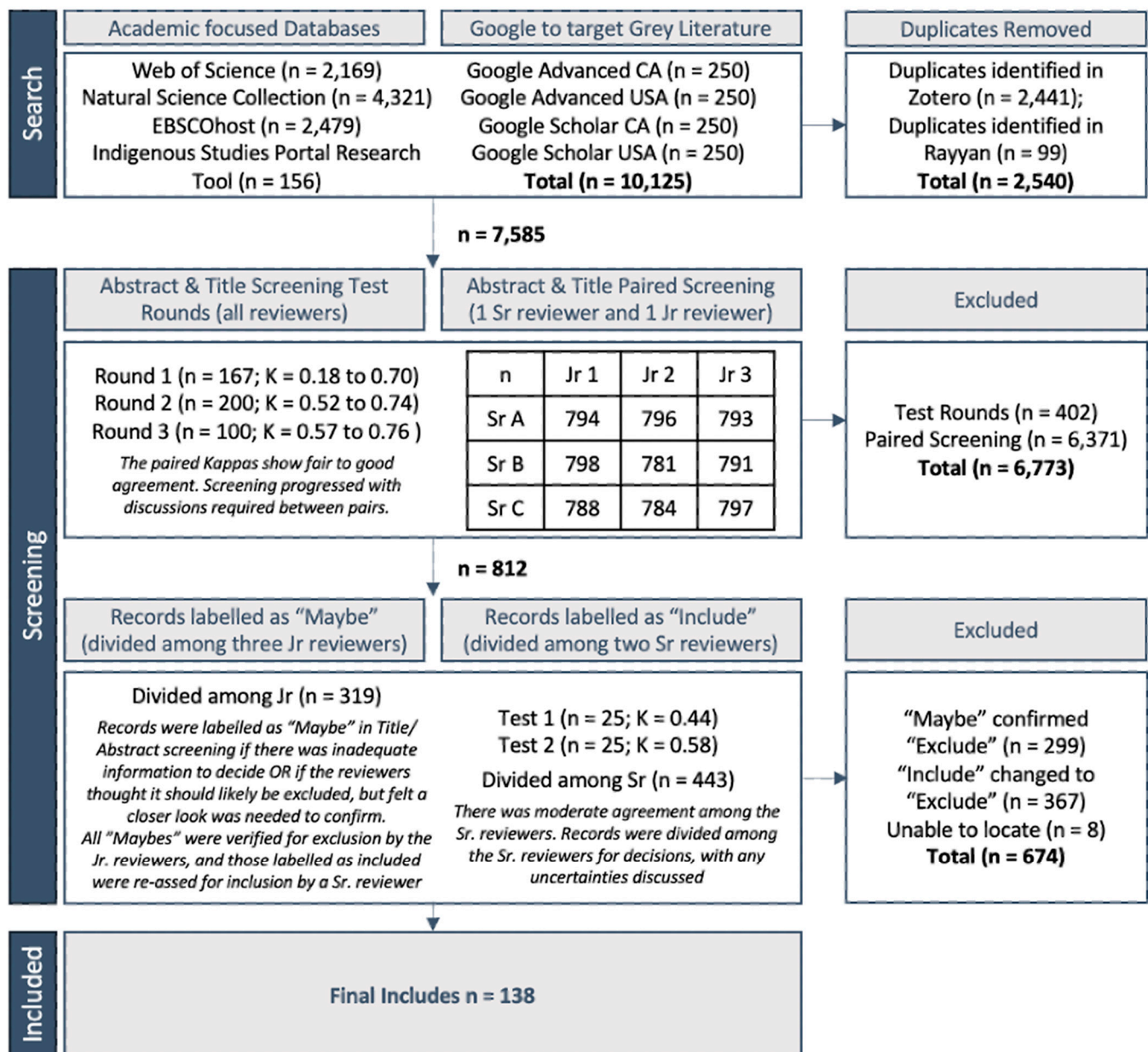


Figure 1. Scoping review process with accounting of included and excluded records and agreement statistics, where calculated.

The six reviewers completed three "test" rounds, during which they screened the same records independently. Inter-rater reliability was then calculated for individuals and the entire team. After each test round, the review team discussed discrepancies and refined their collective understanding of the inclusion–exclusion criteria. Following the test rounds, the mean weighted Cohen's kappa for the team was 0.65, which suggests substantial agreement [20]. The remaining ~7000 records were divided among all combinations of junior–senior reviewer pairings. The pairs were responsible for independently screening ~800 records and following up with a discussion to remedy conflicts. The reviewers were asked to err on the side of including records so they could be scrutinized more carefully in the next round. Consequently, all papers labelled "include" or "maybe" were fully screened in the next stage.

Two of the senior reviewers (SM and AB) screened the full papers of the “include” records, while junior reviewers screened the “maybe” records. Any “maybe” records that were changed to “include” after the junior reviewers screened the full paper were also reviewed by SM and AB. SM and AB completed three test rounds, during which they screened the same records. Inter-rater reliability was calculated. Then, the remaining records were divided among SM and AB for full paper screening; however, they continued to have discussions to promote consistency.

2.5. Novel Frameworks

Extracting specific and contextualized methods from 138 records required frameworks to organize ideas. The authorship team first broke down methods into principles and practices, where principles should be consistently applied throughout a project, and practices were methods that lent themselves to a particular stage of a project and respected the principles. This resulted in two distinct frameworks. The first summarized the principles of respectfully braiding IKS and WKS using an easy-to-remember water acronym: “EAUX”, the French word for waters. The plural form is used to reflect the multitude of ways water is in our lives and the many ways we value it. EAUX stands for the following:

- **Equity:** Valuing different knowledge systems by staying humble, remaining open to different ways of knowing, and challenging colonial hierarchies that celebrate Western teachings while questioning Indigenous ones;
- **Access:** Respecting data sovereignty of Indigenous collaborators, including cultural and intellectual property;
- **Usability:** Prioritizing project outcomes that benefit Indigenous collaborators and being responsive to community needs;
- **eXchange:** Maintaining ongoing communication between project partners with continuous and prior-informed consent and relationship building.

The second framework organized practices that lend themselves to a specific stage of a project. The framework was inspired by researchers who seek to report a study’s paradigm transparently (e.g., [21–24]). This practice is uncommon in Western natural sciences because the assumption is that there is only one truth that must be attained through objective, unbiased observation [24]. Based on this belief, researchers often assume that because there is no other worldview or way of knowing, there is no need to report this philosophy. In other academic fields, such as the social sciences, however, there is an understanding that researchers may have different beliefs about the nature of reality (ontology) and, consequently, the nature of knowledge (epistemology) [25]. Researchers need to be transparent about their ontological beliefs because they inform epistemology, methodology, methods, and data sources (i.e., the research paradigm). Brown and Dueñas’s [23] go one step further and argue that ontological beliefs are based on value systems (axiology); thus, axiology should be included in a research paradigm.

Like Brown and Dueñas’s [23] building blocks for paradigms, knowledge systems, more generally, are informed by axiologies, ontologies, and epistemologies, which, in turn, influence methodologies, methods, and sources of information. Knowledge systems also encompass the analysis and synthesis of knowledge and its application. Consequently, the authors created the axiology-to-application (A-to-A) framework to discuss how approaches to bringing together knowledge systems differ at each “stage” of a project.

We argue that knowledge systems can be braided at each stage. But the most important braiding stage is at the beginning, when the project partners’ values and worldviews (axiology and ontology) can be aligned or at least understood and respected. Our framework is cyclical rather than linear, illustrating that when knowledge systems are braided throughout a project, our axiologies and ontologies may also change. Figure 2 illustrates the five stages of the A-to-A framework.



Figure 2. The axiology-to-application (A-to-A) framework illustrates how IKS and WKS can be braided at all stages of a water project. Graphic created by Robyn Holysh.

2.6. Data Extraction

SM prepared a data-extraction form using Microsoft Excel and received feedback from AB, BL, and SL. Bibliographic and geographic information was included in the form, along with a list of possible freshwater social–ecological system topics (e.g., climate and environmental change, aquatic species, dams, extreme events, water quality) and project applications or outcomes (e.g., restoration, planning, wellness/health). But most of the form uses the EAUX and A-to-A frameworks to extract information about the principles for braiding knowledge systems and the practices employed to braid knowledge systems during different stages of a project. The form had a space at the end for notes or quotes that did not fit in other parts of the form.

SM and AB independently filled out the data extraction form for a record that demonstrated strong evidence for braiding IKS and WKS. Then, SM modified the form to improve clarity; she created an exemplar by combining SM and AB’s extraction forms (see S3 in Supplementary Materials). The exemplar was provided to SL and BL so that the remaining 137 records could be divided among the four individuals for data extraction. SM utilized R studio, an integrated development environment for the R programming language, and package of data management functions called the “tidyverse” to synthesize information from the data extraction forms of each record into a table [26,27]. For example, the “Equity” table synthesized the methods noted in each data extraction form that demonstrate the “Equity” principle (from the EAUX framework). Then, SM reviewed the tables for each of the EAUX principles and each of the stages of the A-to-A framework using a qualitative analysis software, NVivo 13 (2020, R1) [28]. SM highlighted relevant methods and identified themes.

3. Results

3.1. Included Records

The types of records included in the scoping review and the number of open access records for each record type are shown in Table 2. The vast majority of the 138 records were peer-reviewed journal articles ($n = 104$). Of the peer-reviewed articles, approximately 60% were open access. The reports, graduate theses or dissertations, and news articles were all open access.

Table 2. Types of records included in the scoping review and number of open access records for each record type.

Record Type	Number of Records	Number of Open Access Records
Peer-reviewed journal article	104	63
Reports	17	17
Graduate thesis or dissertation	13	13
Book or book chapter	3	0
News article	1	1

Figure 3 shows the authorship affiliations for each of the 138 records. Each ring represents a different category of authorship affiliation (from inner to outer ring: Indigenous organization, academic institution, settler government, and other). Approximately 85% of the records had authors affiliated with academic institutions, 41% of records had authors affiliated with Indigenous organizations (or the Indigenous organization was listed as an author directly), and 21% had authors affiliated with settler governments. Some records had other types of affiliations (e.g., consulting companies and nongovernmental organizations), but they represented only 14% of the records, so they were not differentiated. There were five records for which the affiliations were not clearly stated (grey on all four rings in Figure 3).

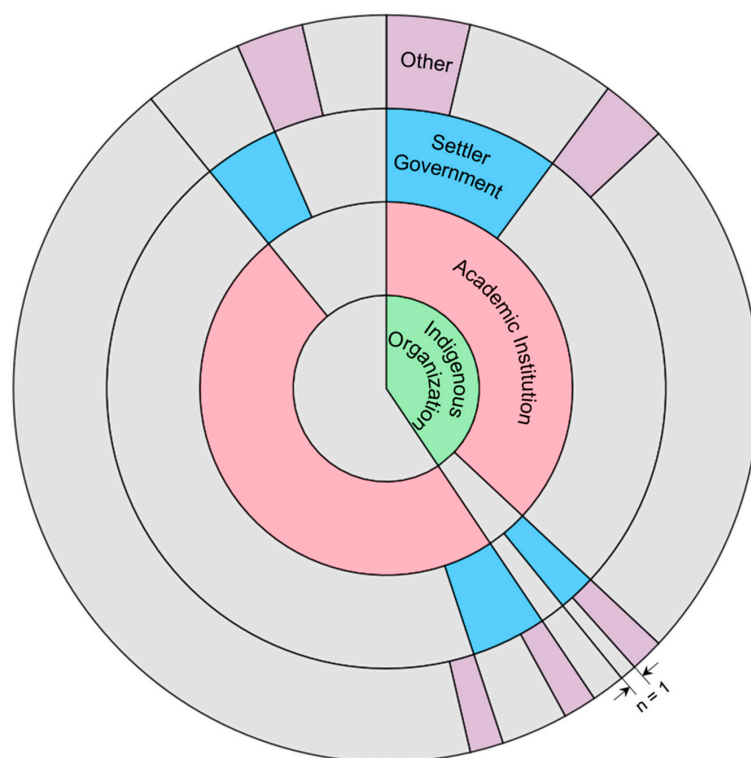


Figure 3. Author affiliations for 138 records included in the scoping review. Each ring represents a category of author affiliation. Inner to outer rings: Indigenous organization, academic institution, settler government, and other. Coloured portions of rings represent the presence of the affiliation; grey represents the absence of the affiliation. For example, $n = 1$ means there is one record with author affiliations from Indigenous organization(s) and settler government(s) but no academic institution(s) or other affiliation(s). Where all four rings are grey, the author affiliations were not reported.

Many records included different types of affiliations, reflecting the intercultural and intersectoral collaboration that occurred while documenting the projects. Of the 45% of records that reported at least two different types of affiliations, the most common combination was authorship from academic institutions and Indigenous organizations

($n = 51$; 82% of the records had more than one type of authorship affiliation). Five records included all four types of affiliations, demonstrating greater representation across sectors and cultures.

3.2. Spatial and Temporal Distribution of Records

Records from every year between 2007 and 2022 were included in the scoping review (Figure 4). The year with the most records was 2020; by contrast, 2009 and 2010 each had only a single record. Since 2016, there have been at least eight records per year about braiding IKS and WKS within a freshwater context. This increase may reflect the impact of the final report of the Truth and Reconciliation Commission in Canada, published in 2015 [29]. Figure 4 also shows the relative number of open access records in each year. In the last four years, more than 75% of the records were open access.

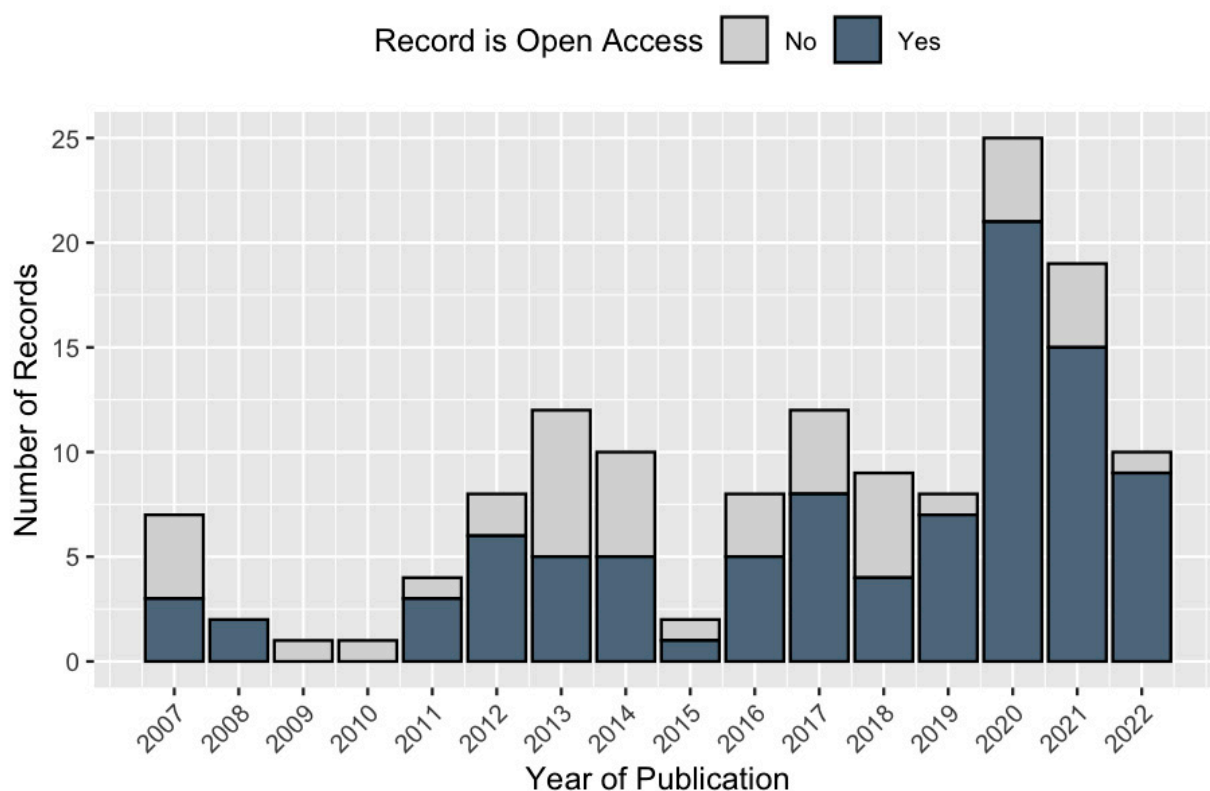


Figure 4. Temporal distribution of records included in the scoping review and whether the record is open access or not.

The geographic distribution of the records included in this scoping review is shown in Figure 5. Most of the records ($n = 101$) took place in what is currently known as Canada. Only 29 took place in what is currently known as the United States of America. The remaining eight records include cases from both countries. We found one record with a case in the northeastern United States but no records along the rest of the eastern seaboard or most of the central states. Figure 5 illustrates that the records seem to cluster around the large lakes and rivers of Turtle Island. For example, 35 case studies (from 22 records) clustered around the Great Lakes. Other common regions include the Pacific Northwest and Southern British Columbia, the Mackenzie River Basin, and the Saskatchewan River Delta. The greater number of Canadian records may reflect the authors' presence in Canada despite efforts to remove this geographic bias from the search strategy.

The scale of the projects varied (see Table 3). Some projects discussed braiding knowledge systems across watersheds ($n = 29$) or Indigenous territories ($n = 8$); however, the largest fraction focused on the local scale ($n = 60$). Although some projects were defined by water boundaries (i.e., watershed), others were defined by colonial boundaries such as the

nation ($n = 11$), state, province, or territory ($n = 3$). Only Stefanelli et al.'s [9] systematic realist review included cases from across Turtle Island.

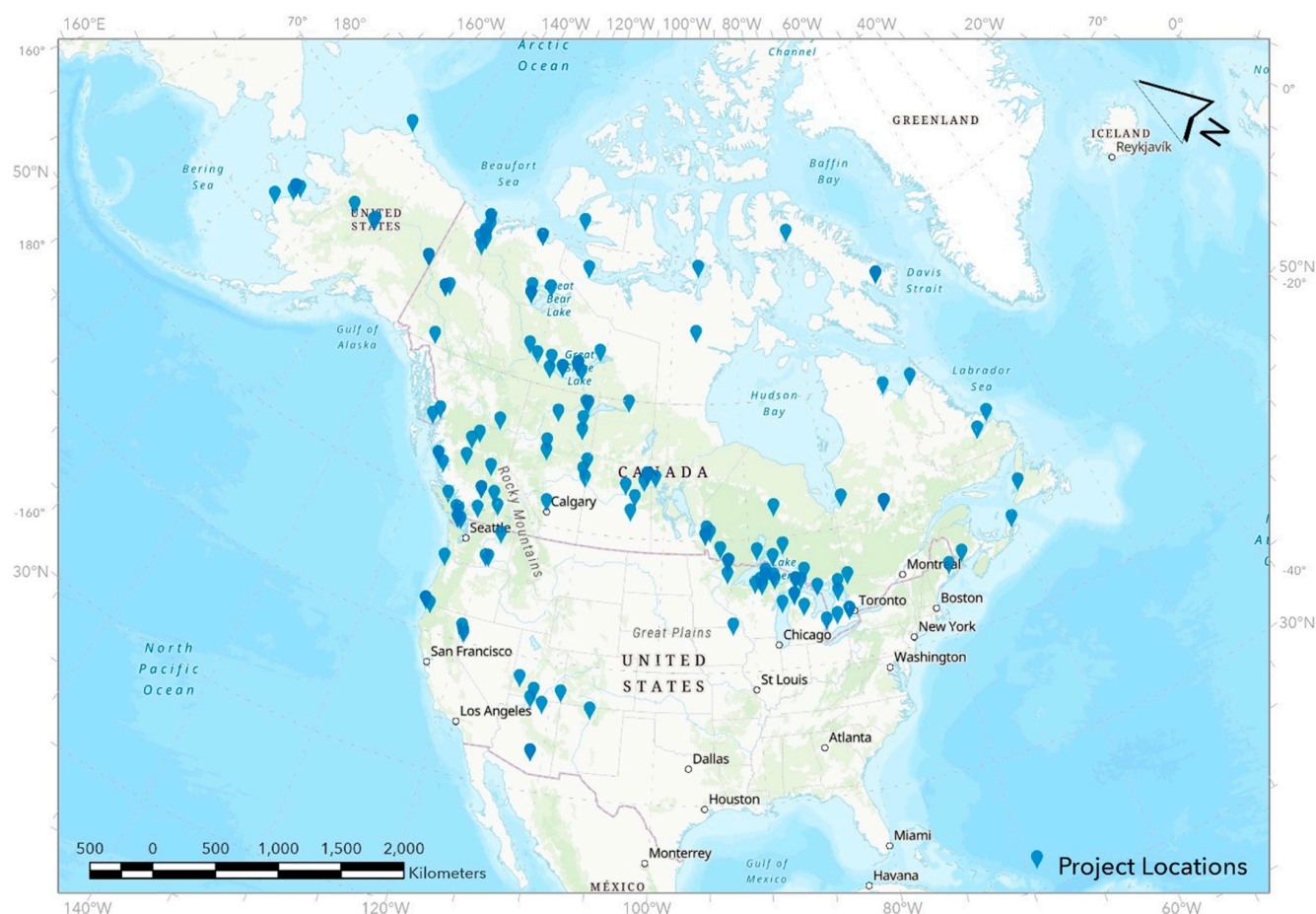


Figure 5. Map of approximate project locations. When distinct case studies were analyzed, each case was given a separate point. Some records, however, were general and discussed entire countries or included over 50 projects. In these instances, points were not included on the map. The map was created by Jane Mariotti in ArcGIS Pro 2.8 using the North American Lambert Conformal Conic Coordinate System.

Table 3. Approximate scale of records included in the scoping review, from smallest (top) to largest (bottom).

Approximate Description of Scale	Number of Records
Local	60
Regional	25
Watershed	29
Indigenous territory	8
State/province/territory (colonial boundary)	3
Country (colonial boundary)	11
Turtle Island	1

3.3. Freshwater Topics and Applications

The 138 records included in the scoping review were highly varied with respect to the nature (or purpose) of the records, the freshwater topics focused on, and the stated goal or purpose of braiding IKS and WKS (see Figure 6). The nature of the record reflects the style of writing and the purpose of the document reviewed. For example, most of the records described single projects that attempted to braid IKS and WKS (“Projects That

Braid” in Figure 6). These records typically included a “Methods” section. Other records, however, analyzed case studies that involved knowledge system braiding (“Analysis of Case Studies” in Figure 6) or were written more like essays reflecting on the authors’ experiences in projects involving knowledge system braiding (“Reflection on Braiding Project(s)” in Figure 6). A few of the records even used braiding practices in projects that analyzed braiding case studies. We refer to them as “Multi-level Braiding”. A few records were more general; rather than reporting on knowledge system braiding within a specific project, they offered the authors’ guidance on braiding knowledge systems (“Guidance Document” in Figure 6) or reviewed the literature (“Literature Review” in Figure 6). Finally, some of the records simply included both Indigenous and Western knowledges in the writing (“Documents That Braid” in Figure 6) or focused on documenting IKS exclusively (“Documenting IKS” in Figure 6). The “Documenting IKS” records may not seem to require much knowledge system braiding; however, given that the written documents reflected primarily WKS, some braiding is needed.

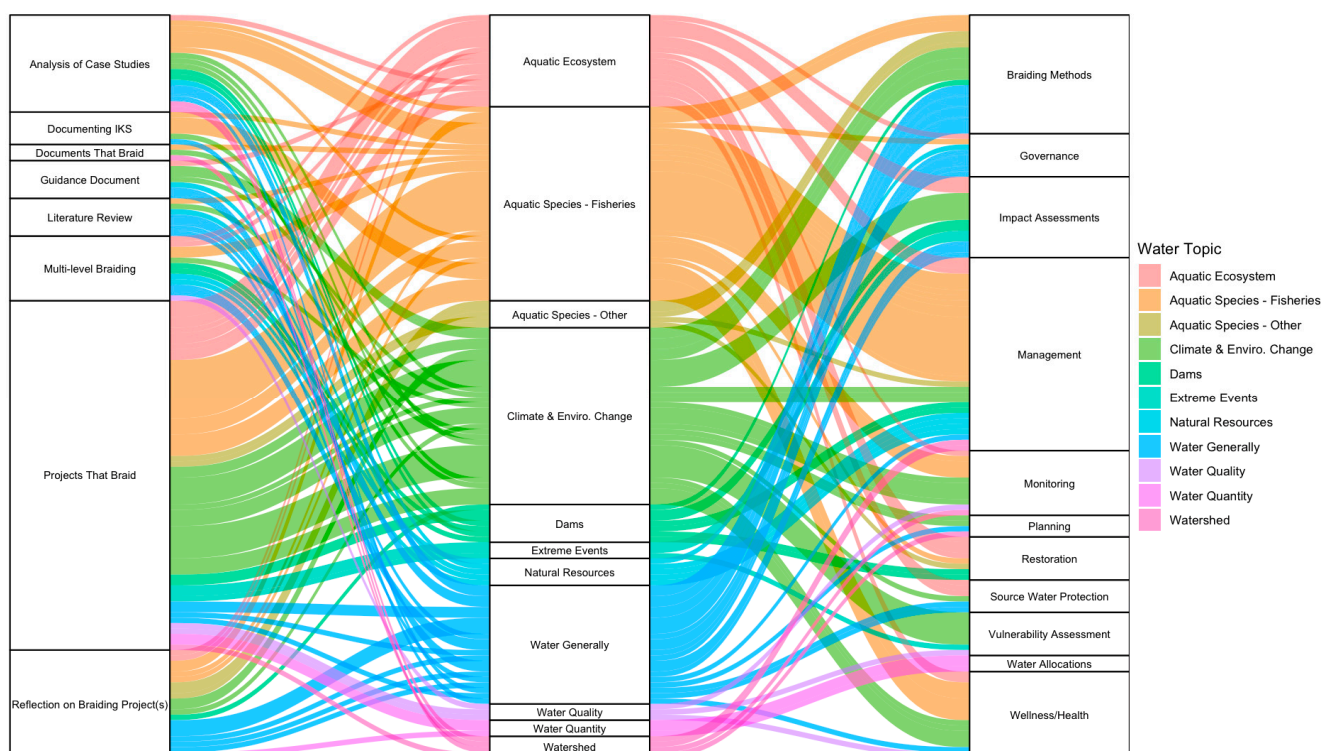


Figure 6. Relationships between the nature of the record, the primary water topic, and the primary water application.

The records covered several water topics. Most focused on particular fisheries (e.g., Pacific salmon, Arctic char, and Dolly Varden) or on climate and environmental change. Most of the fisheries’ records were written to inform fisheries management, and a few related to Indigenous wellness and health or monitoring. The climate and environmental change records, however, were more evenly distributed among the many applications. Some were written as methodological pieces (“Braiding Methods” in Figure 6); they focused on how to braid knowledge systems rather than on the freshwater topic itself. Many of these papers were about water or aquatic ecosystems generally, but some focused on climate change or an aquatic species (often a specific fishery). Others were about watersheds, dams, extreme events (e.g., floods, droughts, infrastructure failures), water within the context of natural resource management, and water quality and quantity. Applications, in addition to management and braiding methods, included large-scale governance discussions and focused discussions of how braiding was/can be used in the context of impact assessments,

restoration projects, water allocation decisions, and source-water protection. The variety of records in Figure 6 demonstrates the breadth of the scoping review’s coverage.

3.4. *How the EAUX Principles Are Enacted*

We looked for examples of the EAUX principles (Equity, Access, Usability, and eX-change) being enacted in the projects reviewed (see Table 4). We offer only a brief description to bring forth ideas; we recommend investigating the record directly for more detail regarding the context within which each practice was applied.

Some of the projects included their own principles for ethically engaging with Indigenous Peoples, a precursor to braiding knowledge systems. For example, Ellis and Perry [30] refer to the four Rs of Indigenous participatory community-engaged research from Kirkness and Barnhardt [31]. The four Rs are respect, relevance, reciprocity, and responsibility. Chief et al. [32] expand on Lomawaima’s four simple rules of tribal research, identifying six “components to gain trust and build partnerships with tribes” (p. 15). The components include being culturally sensitive, listening to community goals, following tribal protocols, which may require tribal oversight, engaging in ongoing communication, recognizing tribal ownership of data, and reporting back on project results [32]. Finally, Cochran et al. [33] present a “multi-pronged approach to broadening [I]ndigenous participation in climate-change research” (p. 11). The “prongs” relevant to all collaborative work with Indigenous communities include respecting multiple ways of knowing, working to help communities achieve their goals, and promoting equal partnerships. Each of these frameworks aligns with the EAUX principles and incorporates themes such as relationality, benefit to Indigenous Peoples, continuous communication, and respect for all knowledge systems.

3.5. *How Knowledge Systems Are Braided in the A-to-A Framework*

We observed many diverse practices for braiding knowledge systems in the records. Table 5 includes examples of how knowledge systems were braided at different stages of a water project using the A-to-A framework. As with Table 4, the practices presented in Table 5 should ideally be used after reviewing the records. The context of each example is important for understanding how it might be applied in other collaborative braiding projects.

Records that described braiding values and worldviews (axiology and ontology) emphasized listening, learning, and reflecting to better understand one another. This process is especially important for those with Western science backgrounds who are often taught that there is a single truth (positivism). This philosophy negates the existence of other knowledge systems, making it difficult for some to open their minds to alternative values, worldviews, and approaches to project execution. When a project is being conceptualized (epistemology and methodology), centring Indigenous ways of knowing is an important element of braiding. Centring often involves co-creating project objectives, utilizing Indigenous epistemologies to guide project methodologies, or ‘indigenizing’ Western frameworks and including culturally appropriate metrics. Regardless of how epistemologies and methodologies are braided, the process requires Indigenous partners to be brought in as partners before project planning starts. Knowledge sharing (data gathering) and inquiry (analysis and synthesis) were accomplished in many ways, including through informal interactions and cultural activities. Most often, interviews, participant observations, and sharing circles were involved. How knowledge was applied (application), however, differed greatly among projects. Some records recognized that engaging in the process of braiding knowledge systems may lead individuals to adapt their worldviews and values based on what they learned. This brings us back to the axiology and ontology stage of braiding knowledge systems in a freshwater project.

Table 4. Examples of how projects from the scoping review enacted the EAUX principles.

Meaning	What It Might Look Like	Examples from the Review
Honour Indigenous sovereignty and self-determination.	Learning about Indigenous partners' history and cosmology	Harguth [34] highlights how both the Elwha Tribe and the National Parks Service (NPS) worked to better understand their counterpart's worldviews to collaborate effectively on restoring the Elwha River. This included the NPS staff undertaking "Treaty training".
	Seeking to disrupt power imbalances	- Fox et al. [35], a collaboration of settler researchers and multiple Indigenous Nations, participated in one another's community protocols and ceremonies to show respect to their partners and manage power imbalances. - Sutton [36] explains how time spent working on the farm and coordinating cultural events (not just acting as a researcher there to observe) helped manage power dynamics by engaging in reciprocity.
	Co-developing objectives, methods, and protocols	Brunet et al. [37]—who include members from academic universities and a member of Cold Lake First Nations—co-developed research objectives to investigate fish health and toxicology in the oil sands region of Alberta, CA.
	Acknowledging Indigenous sovereignty and rights	- Chief and Meadow [38] clearly articulate that tribes are sovereign nations that have the right to make decisions regarding their participation in projects and how their knowledge is used. - Indigenous sovereignty and self-determination are directly recognized in the records (e.g., [30,39–43]).
Equity	Respecting and valuing IKS	- Abu et al. [44] provide an empirical example of how IKS and WKS are brought together "on equal footing". When one system contradicts another, this prompts greater investigation rather than an assumption that one system is better than another. - Several records explain the importance of respecting and valuing IKS equally to WKS (e.g., [45–51]).
	Using the Indigenous partner's language	- Hovel et al. [52] include the abstract in the Gwich'in language. - Using place names, fish names, or other Indigenous terms is a respectful practice that centres Indigenous voices and shows respect for IKS (e.g., [40,53,54]).
	Compensating Indigenous research partners	- Honourariums are a means to thank participants for their time and knowledge [41,45,55]. - Goldhar et al. [56] provided gas or food vouchers to participating community members.
	Recognizing the intellectual contributions of Indigenous partners	- Ermine et al. [57] acknowledged Elders on the front page of a written publication rather than at the end. - Intellectual contribution was recognized in records through diverse bibliography (e.g., [37,58,59]) and authorship of Indigenous individuals (e.g., [60–65]) or Indigenous organizations (e.g., [45,66,67]).
Respect all worldviews.	Respecting (and engaging in, if invited) cultural activities	- In Wray et al. [68], one of the student researchers reflects that during their initial fieldwork, they were there to spend time with people and observe their cultural practices to better understand the community's concerns. - Hovel et al. [52] scheduled fieldwork, interviews, and training around cultural events and ceremonies.
	Valuing other-than-humans	- Kozich et al. [40] include walleye in the acknowledgements. - Luby et al. [69] offered tobacco to the Winnipeg River and Manomin (wild rice) when doing fieldwork.

Table 4. Cont.

Meaning		What It Might Look Like	Examples from the Review
Access	Support Indigenous data sovereignty.	Using formal instruments for data management	- Several records reference OCAP (the First Nations Information Governance Centre’s Ownership, Control, Access, and Possession) as a useful tool to support Indigenous data sovereignty (e.g., [70–74]), while others indicated adherence to academic research ethics boards (e.g., [47,75–77]) - Luby et al. [69] caution others from relying exclusively on colonial instruments, such as Canada’s Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (which informs many Canadian academic research ethics boards), as they tend to rely on Western worldviews.
		Co-developing a plan for managing data	Matson et al. [78] include their protocol for conducting responsible and accountable research in tribal–university partnerships in Supplementary Materials, which include details on data ownership, sharing, and dissemination.
		Respecting Indigenous partners’ decisions regarding what can/cannot be shared	- Luby et al. [69] note in their culturally sensitive field protocol that photos should not be taken of burial grounds and pictographs or during prayers and certain ceremonies. - Eisner et al. [79] explain that not all Indigenous knowledge shared should be included in the web GIS platform created; they elected to archive the knowledge for community use only.
Usability	Centre Indigenous benefit.	Indigenous-led and -initiated projects motivated by community interests, needs, and priorities.	- Fox et al.’s [80] analysis of three case studies illustrates the potential for knowledge braiding when Indigenous communities take the lead on large-scale dam removal projects. - Hopkins et al. [63] explain that one of the co-authors, McMurray Métis Elder Harvey Sykes, had advocated for a project to investigate declining freshwater mussels for over a decade. Once Alberta Environment and Parks (AEP) had sufficient funding, the McMurray Métis were the lead on the project with support from AEP and a consulting firm.
		Prioritizing Indigenous partner’s project goals	Parlee et al. [81] describe how each community involved in a network of community-based monitoring projects for the Mackenzie River Basin (one of the largest watersheds in the world) was encouraged to prepare their own program priorities and objectives rather than requiring the same outcomes from all programs for consistency.
		Being responsive to evolving objectives	Gill et al. [45] adapted the proposed community-based monitoring project to respond to community requests that intergenerational knowledge exchange and youth training be prioritized by pairing Elders and youth for land visits.
	Prepare project outputs that are accessible to facilitate use.	Considering available infrastructure, resources, and expertise within the community	- Eisner et al. [79] designed their web-based mapping tool (for sharing project results with the community) so it could be used under limited bandwidth and on older computers. They offered tutorials to help users navigate the website. - Gill et al. [45] left monitoring equipment in Gwich’in First Nation’s band office for individuals to sign out so that the community-based monitoring program could continue without academic partners. - Gérin-Lajoie et al. [82] sent three community members to a three-day interactive mapping workshop in Montreal so that the community-based environmental monitoring project could continue once academic partners left. - Armitage et al. [83] sought to communicate project outcomes in language understandable to all.
		Disseminating through more accessible platforms	- Reid et al. [41] describe a forthcoming book written collaboratively with their Indigenous partners. They feel a book will provide more space to include the context of the Indigenous knowledges being shared with a wider audience. - Open access publications increase accessibility (n = 94, e.g., [84–94]).

Table 4. Cont.

Meaning		What It Might Look Like	Examples from the Review
eXchange	Build relationships founded on respect and trust.	Engaging in non-project-related activities	- Marshall et al. [70] secured long-term funding for community engagement activities: “Researchers also just simply took the time to have a cup of tea, share a meal, and have a laugh with Elders, committee members, and others in the community” (p. 4). - One of the graduate student authors in Wray et al. [95] reflected that “sharing a meal together is one of the fastest ways to build a relationship and find common ground” (p. 14).
		Spend time with community, preferably on the land	- Kummer et al. [96] note that Government of Alberta staff built better relationships with Indigenous communities by spending more time on the land with Elders and knowledge holders, which supported Indigenous community-based monitoring programs. - Simms et al. [97] argue that building relationships by spending time with people “without worrying too much about what the objectives are, or without trying to work to something” is essential to collaborative governance (p. 14).
	Establish pathways for open, continuous communication.	Documenting agreements and protocols for how the project will unfold	- Reo et al. [98] share an interviewee quote that points to memorandums of understanding (MOU) being used to explicitly establish how Indigenous and Western knowledges will work together. - Harguth [34] explains that annual funding agreements (AFA) were the foundation of the collaboration between the Elwha Tribe and National Park Services in the Elwha River restoration project.
		Establishing “off-season” communication pathways	Reid et al. [41] describe an annual research symposium for approximately 80 collaborators (from research groups, First Nations, nongovernmental organizations, government agencies, and other relevant stakeholders) to discuss the larger research program and maintain relationships outside of the field season.
	Engage in reciprocity.	Fairly compensating the contributions of Indigenous Peoples	- Hovel et al. [52] gave honourariums (in accordance with daily compensation rates from the Renewable Resource Councils) to community-based researchers and knowledge keepers for their contributions to studies on muskrats and whitefish. - Matson et al. [78] emphasize the importance of compensating all project contributors, including conference participants, youth drummers, Elders, and others.
		Facilitating intergenerational knowledge exchange	- Sanderson et al. [65] sought to “achieve a transfer of knowledge between generations (Elders to youth), between cultures (Stellaquo and others), and across disciplines” (p. 141). - Gill et al. [45] facilitated intergenerational knowledge transfer by designing a community-based monitoring program based on Elder–youth pairs visiting and sharing knowledge about important places within the Lower Peel River watershed.
		Sharing knowledge (both IKS and WKS)	Gérin-Lajoie et al. [82] conducted science land camps to teach youth about natural and physical sciences from both Western and Indigenous knowledge systems.

Table 5. Examples from scoping review records of how to practice knowledge system braiding through all stages of a project using the A-to-A framework.

<i>What Braiding May Look Like</i>		<i>Examples from the Review</i>
<i>Axiology and ontology</i>	Listening to others and observing	Matson et al. [78] suggest we “listen carefully, because stories are a way for Indigenous collaborators to subtly but meaningfully inform researchers about cultural codes, expectations and priorities” (p. 113).
	Learning about Indigenous worldviews, values, and history	Hopkins et al. [63] prioritized learning about each other during their first meeting, which included Elders sharing the historical and cultural context of the project.
	Reflecting on one’s axiology and ontology	Shaw et al. [73] include a reflection by the lead author, part of which discusses how their focus shifted from restoring a resource to repairing relationships.
	Finding commonalities	Noble et al. [99] describe how a cultural and ecological keystone species (e.g., Pacific salmon or freshwater eels) can help align non-Indigenous and Indigenous worldviews and values.
	Respecting differences	Reo et al. [98] explain that being able to recognize Indigenous Peoples’ worldviews and cultural practices, such as ceremonies, as legitimate is perhaps more important than trying to artificially merge values and worldviews.
<i>Epistemology and methodology</i>	Co-creating objectives, methods, and protocols	Parlee et al. [81] describe a two-day facilitated participatory workshop where Indigenous partners from the Mackenzie River Basin came together to identify research priorities that would be common in a system of community-based monitoring projects.
	Framing project methodologies with Indigenous epistemologies	Reid et al.’s [41] research methodology followed the lifecycle and migratory path of salmon, a methodology they describe as an “insightful means of connecting with cultures and communities” (p. 723).
	Indigenizing Western frameworks	Collins et al. [100] discuss how Whitefish River First Nation consulted Ontario’s Source Water Protection framework but developed their own framework that prioritized traditional knowledge and community values.
	Choosing culturally relevant species and metrics	Failing et al. [101] include “cultural and spiritual quality” as an objective of the Lower Bridge River Restoration project, which was assessed using the “smell, sound, and movement of the river with reference to its spirit and voice” and “the interaction of people and water (e.g., ability to walk in/across the river)” (p. 426).

Table 5. Cont.

<i>What Braiding May Look Like</i>		<i>Examples from the Review</i>
<i>Data gathering</i>	Formal knowledge sharing	- Many records discuss using semi-structured interviews or workshops to learn from Indigenous knowledge keepers (e.g., [44,49,52,67,75,82,83,90,98,102–113]). - Prompts were sometimes used to stimulate knowledge sharing during semi-structured interviews. For example, Luttermann [110] used photos of the river, Marin et al. [114] used photos of lake trout and maps of Mistassini Lake, Mostofi Javid [115] provided graphical and statistical analyses, and Grimwood and Doubleday [116] asked participants to bring a photo that illustrates their personal relationship with the Thelon River.
	Knowledge sharing on the land	- Nightingale and Richmond's [117] community researcher organized activities during a week-long camp at Mountain Lake to "facilitate time and space for Elders and youth to be together and to share local Anishinaabe knowledge" (p. 3). - Other records mention knowledge sharing during camps, canoe trips, and other extended excursions on the land [61,81,118].
	Participating in cultural activities	Peterson Lewis [119] notes that "while a person was in the act of eeling, making an eel basket, or cleaning a lamprey, it often triggered thoughts and ideas about the species and the river system that they may not have thought of during a more formalised interview" (p. 6).
	Learning from other-than-humans	The Tribal Adaptation Menu Team [120] suggests learning "from beings and natural communities as they respond to changing conditions over time" by observing "survivors of pest or disease outbreaks, droughts, and windthrow events to learn how they tolerated change" (p. 23)
	Indigenous partners using Western methods/technology	Parlee et al. [81] documented 12 community-based monitoring programs in the Mackenzie River Basin, which included written observations of environmental change and Western data-monitoring equipment (e.g., flow/depth gauges, GPS).
	Indigenous partners collecting samples while harvesting/fishing on the land	Atlas et al. [121] describe a traditional fishing weir in Koeve River revived by Heiltsuk First Nation and then used to estimate sockeye salmon; Dale [67] and Dale and Natcher [122] similarly discuss the re-establishment of traditional fishing weirs and the contribution to fisheries management.

Table 5. Cont.

	What Braiding May Look Like	Examples from the Review
Analysis and synthesis	Facilitating workshops/sharing circles	Sanderson et al. [65] detail how two rounds of workshops were used, one to share knowledge on impacts and potential solutions and the second to discuss results and collaborate to identify strategies and future needs. Similarly, Walsh et al. [123] utilized multiple workshops to iterate through knowledge gathering and analysis.
	Participating in cultural activities	Spinney and Pennesi [113] describe how through “[i]mmersion in community life and events (e.g., volunteering weekly at local schools, attending . . . celebrations, taking part in fundraising activities), Spinney was able to contextualise more accurately the information presented by project participants during interviews and discussions” (p. 363)
	Sharing knowledge	Mapping can be used to synthesize and share knowledge. For example, Hayman et al. [124] utilized Google Earth’s multimedia capacity to include Tlingit and Tagish oral histories. Similarly, Eisner et al. [79] used web-based GIS to share knowledge from the project, including photos, videos, and music.
	Synthesizing knowledge systems using Western tools	- Abu et al. [44] utilized Venn diagrams to illustrate congruencies and inconsistencies among knowledge systems and where one system filled a gap of another. Baldwin et al. [46] similarly looked for synergies between knowledge systems and sought explanations/rationales for discrepancies. - Patrick and Baijous [51] demonstrate how Western planning frameworks can be used to provide structure to the plan while ensuring the content of the plan reflects Indigenous values and worldviews.
	Interpreting WKS using an Indigenous lens	Shultz et al.’s [125] resist–accept–direct framework was modified to reflect Indigenous practices, as Western meanings of resisting, accepting, and directing may differ from other worldviews. For example, ‘accept’ might mean accepting other gifts and giving time for Ogaa (walleye) to heal.
	Collaborating to review/interpret results	Lowitt et al.’s [126] intercultural team collaborated to identify key themes for analyzing interviews. Similarly, Plummer et al. [127] collaborated to evaluate indicators on a co-developed scale, identify indicator thresholds, and determine appropriate weights for a water vulnerability assessment (also see Middleton et al. [128], Marshall et al. [70], Satterfield et al. [129], Stenekes et al. [130], Straka et al. [118], and Strangway et al. [131]).

Table 5. Cont.

What Braiding May Look Like		Examples from the Review
Application	Decision-making and planning	• Communities can make their own decisions by interpreting both IKS and WKS [100,125,132,133]. • Harguth [34] discusses the consensus-based decision-making process between tribal members and the state and federal governments in the Elwha River dam removal and restoration project.
	Ceremony	• The First Salmon Ceremony applies knowledge by imposing a brief moratorium on fishing to allow the first fish to spawn [35,62,134] • Reo et al. [98] explain that ceremonies may be used to consult with ancestors before making decisions.
	Informing values and worldviews	• Caine [135] explains how the “story of the Water Heart. . . alter[ed] people’s personal thinking about eco-systems and organizational practices around resources and management” (p. 344).
	Knowledge sharing	• Fox and Hatcher [62] describe the Indigenous community’s view that knowledge is living and that, by passing it to others through stories, ceremonies, songs, and practices, it is being applied. Similarly, Reo et al. [98] note that knowledge can be enacted through prayer, songs, and other cultural protocols.
	Different ways to apply braided knowledge systems	• The Assembly of First Nations [136] explains that an application can be repairing relationships between the community and the land. • Davidson-Hunt and O’Flaherty [137] describe how research activities prompted knowledge (re)creation, revitalization, and the expansion of Iskatwizaagegan knowledge.

4. Discussion

As illustrated in Section 3, braiding IKS and WKS for freshwater projects comprises numerous practices. There are methods for enacting the EAUx principles (Table 4), which create the foundations for ethical braiding and practices that can be used to braid knowledge systems at different stages of a project (Table 5). Each of the methods listed in Tables 4 and 5 can be employed in a way that braids (or supports braiding) in a good way. However, if taken out of context, these methods can be misused, reinforcing colonial power structures and impeding efforts toward reconciliation. Consequently, we provide a deeper discussion of some of the important concepts and themes from the scoping review records to foster braiding with care.

4.1. “A Transformation of My Mindset” (Inspired by Shaw et al. [73])

Having the right mindset before any engagement starts is essential if a project hopes to braid knowledge systems in a good way. The concept of ethical space, described by Ermine [57], a Cree ethicist and researcher, suggests that the unspoken thoughts and feelings between two entities influence their engagement. When there are two entities with disparate worldviews (in this case, Indigenous and Western), there is an unseen, unspoken space between them that influences their engagement [120]. Ermine [57] explains that

“[a]t the superficial level of encounter, the two entities may indeed acknowledge each other but there is a clear lack of substance or depth to the encounter. What remains hidden and enfolded are the deeper level thoughts, interests and assumptions that will inevitably influence and animate the kind of relationship the two can have.” (p. 195)

When this unseen space is rendered visible so that each knowledge system can be valued and respected by the other, then braiding can occur. This means Western thinkers need to abandon their belief in Western universality [138], and all team members need to be open to and humble when it comes to different ways of knowing.

Shaw et al. [73] include the lead author’s reflections on how her mindset regarding braiding knowledge systems changed during her doctoral research with the Keweenaw Bay Indian Community (KBIC). A settler scholar, Emily Shaw, describes how her research experience reframed her view of science and her role as a researcher. This self-reflective process, which includes learning and unlearning, is an important, if not essential, experience for settler researchers engaging with Indigenous Peoples. In our A-to-A framework, we describe the need to braid knowledge systems at the axiology and ontology stage of a project, even before the project’s goals and methodologies are conceptualized. Attempting to braid Indigenous and Western values and worldviews is perhaps the beginning of the transformative experience that Shaw et al. [73] describe.

Before learning about IKS, it is important for people brought up in Western society to understand the assumptions inherent in WKS. Often considered a positivist ontology, WKS assumes that there is a single objective truth that can be revealed through reductionist processes [139]. This belief system poses a unique challenge for Western thinkers seeking to collaborate with Indigenous Peoples. Stefanelli et al. [9] explain that “positivist ideas... appear fundamentally incommensurable with the existence of multiple ways of knowing and the relationality of Indigenous knowledge” (p. 330). Believing in a single objective truth means there is no space for alternative worldviews, and any suggestion of a different way of knowing is immediately deemed invalid or of less value. If Western collaborators cannot move past this ideology, then braiding knowledge systems will never occur in a way that considers both knowledge systems as equal. Therefore, Western team members must spend time unlearning so they can open their minds to alternative ways of seeing the world and the role of humans within it. Fortunately, there are abundant resources to engage in unlearning (e.g., Wilson [139] and Tuhiwai Smith [12] were commonly cited in the records we reviewed).

Drawing on resources outside of formal publications is also valuable. For example, attending seminars by Indigenous speakers may be another route to learning about different worldviews [73]. Team members in Febria et al.'s [140] community-based pluralistic research program were given a manual, created by the project team, to learn and unlearn concepts of equity, diversity, inclusion, Indigeneity, reconciliation with Indigenous Peoples, and decolonization. Teams can also organize formal training to ensure team members are engaged with the (un)learning process [34,48]. Regardless of how it is carried out, Shaw et al. [73] remind us that it is not the Indigenous community's responsibility to teach Western collaborators what can be learned by "doing your homework" (p. 9).

It is not enough to learn about Indigenous Peoples generally because each nation is unique. Be sure to learn about local land claim and governance structures and familiarize yourself with the community's priorities and interests [52]. Many Indigenous communities have their own websites or are part of larger collectives of nations with information available online. Familiarizing yourself with projects the community has already been involved in will help you develop an understanding of the community's accomplishments and priorities. Other water practitioners (academics, consultants, government agencies) who have worked with the community or in the territory may also be good resources. Sometimes, their publications include useful resources. For example, Hovel et al. [52] provide a list of websites for those working with people in the Gwich'in Settlement Area.

In addition to learning about the community's history, governance structure, and past projects or collaborations, new collaborators must familiarize themselves with cultural norms. Without this knowledge, settler partners may be inadvertently disrespectful. For example, in Reo et al. [98], a Treaty organization employee expresses frustration because a settler government agency insulted the First Nation by dismissing their spiritual and ceremonial connection to rocks: "The whole lack of NWO [referencing an agency in northwest Ontario, Canada] not even doing homework on how they approach subjects from that type of Indigenous perspective, that's where the anger came out" (p. 63). The Tribal Adaptation Menu Team [120] suggests reaching out to a tribal historic preservation officer, if the nation has someone in this role, to learn more about a specific community. It is tremendously disrespectful to the community and their worldviews to arrive ill-prepared. In contrast, spending time learning independently before meeting community members may set the tone for a respectful and equitable relationship.

Once Western partners have engaged in some unlearning and preparation, developing a deeper appreciation for another's worldview comes from spending time with people. No amount of reading can support the unlearning individuals from colonial upbringings need to understand different values and worldviews. Donkersloot et al. [60] note that it is lived experience that drives someone's understanding of the world and how knowledge is formed. This lived experience may involve engaging in cultural activities on the land. For example, Fox et al. [35] explain that participating in cultural activities created opportunities for dialogue about cultural practices, teachings, and the community's perspectives on river restoration. Shaw et al. [73] explain that listening to KBIC staff and fishermen helped the lead author appreciate the significance of *Ogaa* (walleye) to the community. Regardless of how the time together is spent, listening with an intent to understand rather than respond is perhaps the most important practice.

Learning about different worldviews and value systems is not enough. Western thinkers must also engage in reflexive practices to identify their own biases, assumptions, and privileges. Buell et al. [49] comment, "It was essential for those trained in WS [Western science] to come into the partnership [with Saugeen Ojibwe Nation] with self-awareness of where their knowledge base came from, what it is rooted in and how that is fundamentally different from Indigenous epistemologies" (p. 11). Kuzivanova [54] states that when someone can critically reflect on how their frame of reference influences their thoughts, feelings, and actions, they can adapt this frame of reference to be more inclusive and open to other worldviews. When they realize the assumptions inherent in Western knowledge systems may have been limiting their openness to different ways of knowing [39], they

may be able to open their minds to different axiologies and ontologies. This openness to different worldviews is important for non-Indigenous individuals to embody if project teams are going to braid disparate axiologies and ontologies.

Beyond being open to different knowledge systems, non-Indigenous People need to recognize that these knowledge systems are equally valid to Western knowledge systems. There is no way to prove that a particular worldview or value system is right or wrong—it is just different. Getting a team of people with different worldviews to practice knowledge system braiding may require reflexive practices in addition to individual reflection. Being reflexive is the ability of an individual to reflect on how their feelings, reactions, motives, biases and assumptions influence their interactions with others [141]. Hopkins et al. [63] attribute some of the Clam Team's success to reflexivity. They explain that by “moving beyond attending to colonial legacies of knowledge production described above and recognizing that each Clam Team member has unique knowledge and skill to contribute to the project”, they were able to learn together [63] (p. 328). Being humble and recognizing that everyone on the team has something to offer enables knowledge co-production. One of the graduate students in Wray et al.'s [95] reflection on collaborative research with Indigenous communities stated that “humility is key” (p. 11).

When everyone arrives with an open and humble mindset, then team members can learn from one another and engage in braiding knowledge systems. They can consider how different worldviews and value systems can both hold space in a project independently and seek commonalities among them. Harguth [34] explains that National Park Services and the Elwha Tribe focused their attention on their mutual desire to restore the Elwha River, even if they initially had different beliefs about the best way to approach the problem. Similarly, Mantyka-Pringle et al. [111] emphasized the team's shared value of ecosystem health, which drove their knowledge-braiding project. When worldviews do not align, however, they can still act in parallel; being able to recognize Indigenous Peoples' worldviews and cultural practices, such as ceremonies, as legitimate is perhaps more important than trying to artificially merge values and worldviews [98]. When we understand someone else's perspective, even if we do not adopt that perspective, we can still respect that it is valid.

4.2. “Long-Term Personal Relationships and Trust” (Inspired by Reo et al. [98])

Building relationships within project teams and with community members was discussed in many of the scoping review records. Buell et al. [49] explain that the “strong relationships built between the community experts and the scientific experts created a level of trust that facilitated easier transfer and translation of knowledge between the many Indigenous, and non-Indigenous participants” (p. 6). Building relationships that support such knowledge co-production, however, can take a considerable amount of time. Febria et al. [140] noted that they spent most of the first year of their research project focusing on relationship building. Wray et al. [95] noted that students were often encouraged not to rush research activities and to instead spend time building meaningful relationships with community partners. Taking time to learn about a community before engagement communicates respect for the Indigenous partners. So, too, does spending time with them.

The records describe many different formal and informal activities. Reid et al. [41] describe spending time at fish camps, helping bring fish home for Elders, and joining community feasts. Fox et al. [35] travelled to all the partner's home communities to participate in cultural events and spend time on the rivers. Through these experiences, they spent time with their partners in formal and informal settings, getting to know one another and building trusting relationships. Fox et al. [35] explain that even when individuals do not share the same spiritual connections to the land (or water, in this case), it is important to engage in the Indigenous community's cultural protocols, especially on their land. This “goes a long way towards recalibrating unequal power relations,” an important element of building respectful and trusting relationships [35] (p. 532). Shaw et al.'s [73] lead author similarly participated in community events but also volunteered at the community's Debweyendan Indigenous Gardens, which established the foundational relationships for

their doctoral research. Gérin-Lajoie et al. [82] explain that “researchers spent as much time in the community as possible. . . and had an open, friendly, and respectful attitude toward community members” (p. 391).

Another important element of forming relationships is listening. A practitioner interviewed for Marshall et al.’s [70] work to develop an effective source-water protection plan stated that the most important lesson they had learned was to listen. Similarly, Matson et al. [78] list actively listening to Indigenous perspectives as one of their ten tenets for responsible research. When we emphasize listening to others, we are demonstrating our respect for their knowledge system. Further, when non-Indigenous People prioritize listening over speaking, they are also beginning to dismantle the colonial bias of Western superiority [142]. According to Shaw et al. [73], “Critical to caring for our relationships and facilitating equitable knowledge exchange is careful listening.” (p. 10).

The structure of project teams also influences the potential for relationship building and what those relationships look like. For example, the Clam Team described Métis project partners taking leadership roles to manage power imbalances inherent in colonial-Indigenous partnerships [63]. Clam Team members, however, collaborated in all aspects of the project, creating opportunities to build relationships and develop a shared sense of responsibility for the project.

But it is not always possible to have entire teams engaged in all stages of a project. In such instances, choosing a leader from each knowledge system may help to balance power and responsibilities throughout the project [117]. It is important to recognize, however, that communities may not always have the capacity to lead all aspects of a project. Nightingale and Richmond [117] explain that because of “time and capacity constraints on the community researcher, a collaborative determination was made that the lead author would undertake preliminary analysis of the data” (p. 4).

When project teams come together to share knowledge, it is important to use meeting formats that manage potential power imbalances. For example, sharing circles, an approach based on ceremony, ensure that everyone has a turn to share their thoughts and ideas without judgment from others [143]. Establishing that everyone will have a chance to speak and be listened to promotes equal treatment of knowledge systems and respect for different ideas and perspectives. Some researchers noted that removing agendas from meetings or using open forums to create a space for anyone to share their ideas improved relationships and knowledge sharing (e.g., [66,71,140]). Febria et al. [140] suggest using circular tables and facilitators for meetings and eliminating hierarchical roles such as leaders to foster feelings of equality and respect.

Employing community liaisons can improve relationships between non-Indigenous and Indigenous project partners. In projects where community members were employed, they helped organize community events, arranged interviews, and liaised with the rest of the team. Gérin-Lajoie et al. [82] noted an improvement in the engagement of youth when they hired a local coordinator. Febria et al. [140] explain that individuals in connector roles can help research objectives, build trust between project partners, and provide important insight into community perceptions and needs. Knopp [47] trained community members in Western science methods and data management to support project longevity. When there are individuals on the team who come from both IKS and WKS, their insights are particularly valuable [78]. Walking in two worlds provides a unique perspective that may propel knowledge braiding.

Connector roles and individuals from both knowledge systems can facilitate relationship building across cultures; however, diversity within teams may exist in other ways. For example, Donkersloot et al. [60] explain that the working group for the State of Alaska’s Salmon and People knowledge synthesis project was selected to ensure that multiple disciplines, sectors, cultures, and generations were represented. Within Indigenous communities, knowledge may be dispersed among different families, each holding distinct responsibilities and unique knowledge [98]. Thus, the participation of individuals of different ages, genders, and community roles may improve knowledge co-production.

And it is essential that Indigenous partners are given the opportunity to lead the selection of community members for the team. The validation process of different knowledge systems may differ; thus, expertise can be evaluated only by those within the community. It is highly inappropriate and disrespectful for project partners from outside of the community to attempt to validate or verify the expertise of an Indigenous knowledge keeper.

When teams are created and relationships have been built upon trust and mutual respect, braiding knowledge systems is more likely to be successful [144]. For example, Straka et al. [118] noted that collaborative surveying, which included overnight stays in trapping cabins, fostered relationships and “provided opportunities to share, exchange, and discuss knowledge about muskrat” (p. 221). Similarly, Luttermann [110] describes community partners participating in vegetation surveys along the Churchill River riparian zone, during which co-learning occurred. Initial relationships were formed when Luttermann canoed most of the river with three Innu families.

And efforts to build relationships must continue once the project starts [73]. Relationship building is an ongoing process. This process involved all project team members in Buell et al. [49]. This not only ensured the equitable presence of knowledge systems within their risk assessment, but it also nourished relationships among project partners. When fieldwork is seasonal, Reid et al. [41] note that hosting an annual conference held for project partners can help with maintaining relationships. Regardless of how relationships are built, they take time and effort from all project partners and must be prioritized for successful knowledge braiding.

4.3. “The River Is Us” (Inspired by Fox et al. [35])

Many Indigenous cultures hold strong connections to the land (and waters) upon which they live. Their knowledge is often highly contextual and place-based. Further, Indigenous Peoples often greatly value their relationships with other-than-humans and feel responsible for contributing to their care, just as Mother Earth cares for us. Consequently, ethically braiding knowledge systems requires non-Indigenous People to recognize, respect, and honour their Indigenous partner’s relationships with the land and all of creation throughout a project.

In the early stages of project work, when partners are learning about different world-views and value systems, spending time on the land allows non-Indigenous partners to develop their own connections to the land in addition to facilitating relationship building and trust among project partners. In Shaw et al. [73], a team member reflects that “without place-based relationships for myself, I could not transfer others’ teachings as my own learning. This motivated me to build relationships with the lands. . . and community members” (p. 10). Similarly, Sutton [36] explains that “[i]t is the body’s physical presence that interacts with places, communities, and key collaborators to learn what community partners find significant and how research and local knowledge can work together” (p. 75). Being physically present on the land and with the community is an important first step to braiding.

Being on the land while knowledge gathering is sometimes necessary for WKS (i.e., fieldwork), but in IKS, it is almost always needed to avoid extracting knowledge from its context. Day et al. [143] ask, “[H]ow can a teacher teach it in school from a textbook? You have to be out there living it” (p. 13). This philosophy is reflected in many records that chose to conduct semi-structured interviews on the land. For example, Dubé et al. [61] participated in a Healing Journey by which project partners paddled down the Yukon River, “visiting every village, listening to stories of people’s lives along the banks of the Yukon and hearing the wisdom of the Elders” (p. 441). Similarly, the Clam Team visited known clam beds to learn from Elders [63], and project partners on the Manomin Project travelled to ancestral *Manomin* stands to listen to Elders tell stories of harvesting rice as children [69]. Matson et al. [78] contrast WKS fieldwork with land-based learning from IKS: “Researchers and students on our project learned to step off frenetic fieldwork schedules and took the time to paddle the full stretch of a Manomin river with a life-long ricer as

he shared his stories” (p. 113). This change of pace allows greater time for reflection and appreciation of the lands project partners are learning upon. It also helps project partners contextualize the knowledge shared [108,145].

In addition to helping non-Indigenous partners develop their own connections to the land, being physically present on the land enables informal knowledge gathering. These informal interactions create opportunities for project partners to problem solve, begin hypothesizing and co-creating new knowledge, and build relationships [35]. The land-based knowledge-gathering experiences varied among records but often included interviews and meetings on the land (e.g., [61,81,96,118]) and participating in cultural activities (e.g., [113,119,146]). A few records even describe non-Indigenous project partners spending extended periods in the community, engaging in many aspects of the community’s livelihoods (e.g., [36]). When they are not present on the land, non-Indigenous partners may miss invaluable knowledge-sharing opportunities prompted by co-experiences.

Sensitivity to Indigenous Peoples’ strong ties to the land was apparent in records that detailed how project teams chose the location of project activities. For example, some teams asked interviewees to choose the location of the interview in the hope that it would promote feelings of safety when knowledge was shared. Interviews were held in a variety of locations, including Elders’ homes or backyards, the riverside, smokehouses, canoes, and around a fire [60,109,119]. Feelings of comfort on the land, along with the memories being on the land elicits, may align Western knowledge-sharing mechanisms such as interviews with Indigenous epistemologies.

Indigenous Peoples’ connection to the land brought up interesting discussions about whether mapping is culturally appropriate. For example, Houde [147] discusses how their first introduction to traditional ecological knowledge was through a mapping database in which Indigenous knowledges were reduced to polygons on a map. Not only was this knowledge being used as a bargaining chip, but it existed outside of the community’s control [147]. Eisner et al. [79] likewise describe the inappropriateness of modern cartography for representing Indigenous knowledges; they note that the stationarity of maps is at odds with the Indigenous worldviews that boundaries are fluid. Hayman et al. [124] explain that “[c]olonial mapping embeds assumptions and biases about projections, scale, nation-state borders, and the naming and categorising of places/features into its geographical representations” (p. 86). Even when an Indigenous community leads a mapping exercise, non-Indigenous project partners should consider how maps may encourage the misuse of Indigenous knowledges.

There are, however, examples of modern mapping approaches that better reflect Indigenous knowledge systems. Web-based multimedia mapping can reflect that Indigenous knowledge is more than a point on a map and that it is living and forever changing [45,62,74]. Video journaling can also be used to map in a more culturally appropriate way [148]. Hayman et al. [124] describe their use of deep mapping through which they produce an aquacentric (as opposed to the typical terracentric) counter-map to braid multiple water knowledge, including using audio recordings of Tlingit and Tagish place names (toponyms) in their language [124]. This practice preserves the community’s unique dialect and is consistent with the oral traditions of many Indigenous Nations [124]. Several other records recognized the value of using toponyms in the partner community’s language (e.g., [36,53,81,135,143]). It facilitates knowledge sharing and shows respect to the Indigenous community who named these places and relations long before settlers arrived.

Many Indigenous Nations are also deeply connected to other-than-humans. Frequently, their philosophies are based on having reciprocal relationships with spirited beings such as plants and animals and water and rocks, who are viewed as having agency. Non-Indigenous partners need to be open to this important element of a Nation’s worldview, as it can greatly influence project epistemologies, methods, and desired applications of knowledge. For example, Fox et al. [35] conveyed an ethic of caring for the River and listening to their patient’s needs during three river restoration projects:

“For Anishnaabe. . . rivers are living ancestors that require some help from people to heal damages and illnesses caused by people. By providing care for these ancestors, in part through ceremony, people themselves (or communities) are undergoing their own healing processes by restoring their relationships with rivers. This creates a depth of commitment to restoration that goes well beyond the ecological rationales that generally motivate other river projects. (p. 528)”

Fox et al. [35] conclude that river restoration is as much about repairing human–river relationships as it is about restoring ecosystem processes and functions. Luby et al. [69] similarly emphasize the Anishinaabeg’s relationship with an other-than-human: *Manomin* (wild rice). They argue that when researchers work with Anishinaabeg, who view *Manomin* as kin, the ethics and protocols of working with plants should be considered. The team collaborated with Elders to develop a culturally appropriate field protocol for their project, which included actions such as giving tobacco. Shaw et al.’s [73] lead author recounts forming relationships with other-than-humans by spending time with plants and animals and showing respect to these relations by learning their names.

4.4. “There Is No Magic Recipe” (Inspired by Gérin-Lajoie et al. [82])

Gérin-Lajoie et al. [82] share that there is “no magic recipe to building trust and reciprocity” (p. 391). Nor is there a magic recipe for braiding knowledge systems. Instead, non-Indigenous partners need to elevate the specific voices of the Indigenous community they are collaborating with and recognize and support their rights as sovereign nations to take the lead on freshwater projects. Latulippe and Klenk [149] call this “making room and moving over” (p. 9).

There are certain methodologies that facilitate this concept of making room and moving over. For example, community-based participatory research (CBPR) prioritizes community participation in the research design process instead of academics from outside the community controlling all aspects of the project. This approach is especially prudent when working with Indigenous Peoples who associate research with Western academics extracting Indigenous knowledge and using it for their benefit rather than for the benefit of the community [12]. With CBPR, the objective is to share power and control of the research project with the community, emphasize relationship building and trust, and recognize community ownership of the project [116]. Balancing power dynamics and inviting community members into project conceptualization and design elevates Indigenous voices and needs, rather than non-Indigenous researchers presuming what a project should be. Additionally, it is important to recognize that even though CBPR is a research methodology, it can be used in any collaborative freshwater project.

Methodologies such as CBPR that require joint control and ownership of the project require the early involvement of Indigenous communities [73] if the project is not initiated by the community (which is preferred). This was a common theme in the scoping review, specifically while discussing how knowledge braiding occurs at the epistemology and methodology stages in the A-to-A framework. For example, in environmental assessments, BCEAO [48] indicates that engagement should start as early as possible [41]. This is true more broadly. In any community-based project, it is important to involve community members in project planning [120]. Dale [67] describes being able to discuss and co-create research objectives and goals with the community contact because of early engagement. Similarly, several projects co-developed project objectives with communities to ensure that the project was responsive to the communities’ needs (e.g., [101,128,130,150]). Although early involvement is important, Lukawiecki et al. [77] remind us that just because community members are engaged early in the project does not mean engagement ends once the project objectives are established.

When partnerships among Indigenous and non-Indigenous partners are shared, decision making throughout the project is necessary. This means that non-Indigenous project partners must be flexible and responsive to the Indigenous community’s needs and goals as they arise and as they change [77]. This might be flexible with the direction interviews

take [75] or adapt schedules/timelines for unplanned activities on the land [45]. Perhaps formal, intentionally flexible knowledge-sharing activities, such as semi-structured interviews, are inherently braiding practices because they originate from WKS but create space for more IKS-aligned activities, such as storytelling [114]. Sutton [36] explains that to really understand what the community wants and respond to those needs, it is important “not to assume an order or protocol” (p. 45). For example, Sutton [36] adapted when the quantitative fisheries survey did not align with the community’s needs or values. They changed course and used qualitative interviews, including co-creating the interview protocol with community partners.

Other records describe co-creating protocols or materials for various data-gathering activities (whether primarily IKS or WKS). For example, as described by Sutton [36], interview protocols were co-created, but interview questions were also sometimes co-developed (e.g., [37,44,46,150]). As previously mentioned, Indigenous partners should identify knowledge keepers for interviews, as the community alone can evaluate their expertise. Bowles et al. [151] explain that the interviewees for their study were not identified randomly but were “well-respected authorities on matters of fishing within the community” (p. 1130). When Western science data collection occurred within a community’s territory, the sampling sites were identified by community members [37,118,152]. Luby et al. [69] explain that Elders from the Niisaachewan Anishinaabe Nation identified ancestral *Manomin* stands where researchers were permitted to learn from *Manomin* using co-created field protocols, including Western data-collection methods.

In addition to projects using community-based participatory research approaches, the scoping review also revealed several Indigenous-led projects that demonstrate braiding knowledge system practices. For example, Collins et al. [100] describe how Whitefish River First Nation led their community source-water protection plan by modifying the Ontario framework to better reflect cultural values and the importance of Indigenous knowledges. In Fox et al. [80], three Indigenous-led dam removal projects are analyzed. Each case demonstrates how tribal leadership brought a much-needed spark to initiate dam removals and frequently raised the necessary funds as well. Their relational values and feelings of responsibility to care for Rivers made them “viscerally committed to dam removal” [80] (p. 46). The tribes also utilized WKS, leading or initiating engineering feasibility studies and ecological monitoring, demonstrating their capacity to braid knowledge systems without non-Indigenous Peoples. These large dam removal projects did, however, require collaboration, so tribes fostered positive relationships, forming diverse teams with a common goal: restoring human–river relationships.

Although fostering and promoting Indigenous-led projects, which underline the self-determination and sovereignty of Indigenous Nations, is preferred, it is not always possible. Reinforcing the idea that “there is no recipe”, each Indigenous community has different needs and different circumstances that non-Indigenous partners need to be responsive to. Even in projects led by non-Indigenous team members, there are many ways that knowledge system braiding projects can unfold. For example, involving community members in WKS data gathering (e.g., [153]) can generate unique insights given the inherent knowledge system braiding that can occur. Similarly, knowledge systems are braided when the gathering of WKS uses culturally meaningful metrics identified (or co-developed) by community members [111,154,155].

The scoping review also revealed examples where project teams collaborated to “indigenize” WKS frameworks or structures (e.g., source-water protection plans, environmental assessments), so they aligned with the values of the community [70,89,112,156–158]. Wesche and Armitage [159] used qualitative scenarios (a WKS framework) to understand the vulnerability of an Indigenous community to climate change but ensured the scenarios were communicated through story and visual representations to reflect Indigenous ways of knowing. In other cases, IKS frameworks, methodologies, or methods were used with or alongside WKS. For example, Reid et al. [4] review three case studies that apply Two-Eyed Seeing, Elder Albert Marshall’s framework for bringing knowledge systems

together. Similarly, Parrill et al. [160] explain that by seeking to honour “the past, present and future; the interconnectedness of all things; and the spiritual, physical, emotional and mental aspects of human beings”, their research on small-scale fisheries aligned with the Indigenous community’s holistic worldviews (p. 23).

In examples where Indigenous knowledges are shared, whether in parallel with Western knowledge or for its interpretation through a Western lens, it is paramount that non-Indigenous project partners respect community ways of knowing, methods, and protocols. This project approach is perhaps the most susceptible to knowledge extraction but can be accomplished in a way that is respectful and useful to the community. For example, Patrick [161] explains that while collaborating with six Indigenous communities to develop source-water protection plans, the community protocols were respected. For example, committee meetings might be opened and closed with a prayer by an Elder, or gifts of tobacco may be given to knowledge keepers [68,161]. Similarly, during a meeting to inform the science advisory report for Qasigyat Lake Arctic char (by Canada’s Department of Fisheries and Oceans), an opening prayer was given by an Inuit of Pangnirtung [162]. We are not suggesting that a prayer alone is “enough” for knowledge systems braiding, but it does demonstrate the non-Indigenous partners’ respect for the community’s worldviews and ways of knowing. Non-Indigenous partners must recognize ceremony as a valid method to share and apply co-created knowledge.

Regardless of the methodology and methods used to share knowledge, many of the projects we analyzed ultimately sought to co-produce knowledge. This meant coming together as a project team with individuals from both knowledge systems to consider the knowledge gathered and how it informs our understanding of complex social–ecological freshwater systems. For example, Lea et al. [153] describe how the community’s knowledge that Dolly Varden spawn, rear, and overwinter near persistent holes in the ice pointed WKS experts to the role of thermal refuges and, consequently, groundwater flows for Dolly Varden fisheries. It is not always easy to truly co-interpret or co-create knowledge, but several records describe sharing circles, team discussions, and facilitated workshops to create the space for IKS and WKS experts to come together to form new insights [49,64,65,116,146,155].

When project teams cannot come together to co-create knowledge, for example, because of global pandemics, it is important that non-Indigenous partners seek to elevate Indigenous voices. The Status of Tribes and Climate Change Working Group’s (STAC-CWG) [163] report includes 34 narrative submissions from Tribal members as well as numerous Indigenous authors. Similarly, Patrick et al. [71] describe a drafted development plan with community artwork, Elder stories, youth input, and photography. When co-creating knowledge is not possible, Indigenous partners must be given the opportunity to review all project outputs. For example, Cooke et al. [164] had a local steering committee to verify that results aligned with IKS, and Wilson [165] sought validation of her results from participating communities. The projects analyzed often included community review and feedback on project deliverables, demonstrating respect for IKS [4,41,102,166–168].

5. Conclusions

Each Indigenous Nation is unique; each Nation holds its own values, worldviews, and ways of knowing. Different cultural protocols and varying capacities to collaborate or lead freshwater projects among Indigenous Nations means collaborators must listen carefully and with an open mind to Indigenous partners. Relationship building, unlearning, and collaborating with Indigenous Peoples takes time and requires all partners to be patient, flexible, and humble. Unlike WKS, which tend toward linear processes, IKS are living entities that are constantly growing and evolving, suggesting more cyclical and nonlinear pathways to knowledge creation. Ultimately, if non-Indigenous partners can take a step back and create spaces for the equitable braiding of IKS and WKS, then together, we can co-create an enriched understanding of these complex social–ecological freshwater systems, facilitating better management, restoration, and relationships with Water.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/w16070934/s1>. S1: Benchmark Papers; S2: Search Strings by Database Title; S3: Sample Data Extraction Form.

Author Contributions: Conceptualization, S.M., A.B., S.L. and B.L.; methodology, S.M. and A.B.; validation, S.M. and A.B.; formal analysis, S.M. and A.B.; investigation, S.M. and A.B.; resources, S.M. and A.B.; data curation, S.M., A.B., S.L. and B.L.; writing—original draft preparation, S.M.; writing—review and editing, S.M., A.B. and S.L.; visualization, S.M.; supervision, A.B.; project administration, S.M.; funding acquisition, S.M., A.B., S.L. and B.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the National Sciences and Engineering Research Council (NSERC) of Canada through the Canada Graduate Scholarship—Doctoral program (CGSD3-548052–2020); George Weston Ltd. and Loblaw Companies Limited’s Seeding Food Innovation Grant (SFI19-0374); and the University of Guelph’s Guelph Institute for Environmental Research. The authorship team also contributed a technical report for the Global Commission on the Economics of Water [169], which was based on the research presented in this paper. Funding from the Netherlands Government was provided for peer-review of the technical report. The peer-review comments also helped to improve portions of this manuscript.

Data Availability Statement: The original contributions presented in the study are included in the article/Supplementary Material; further inquiries can be directed to the corresponding author.

Acknowledgments: We would like to recognize Jane Mariotti, Tony Huynh, and Laura Legzdins for helping the authorship team assemble and screen over 10,000 records from the scoping review search, along with their participation in discussions about screening criteria. We would like to thank the Indigenous scholars who peer-reviewed the technical report for the Global Commission on the Economics of Water (which was based on the research presented in this paper). These reviewers did not review this manuscript, but due to the timing of publications, their feedback on the technical report was used to improve this paper.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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