March 2026

A Practitioner's Guide for Pairing Indigenous and Western Knowledge Systems for the Management of Canada's Marine Fisheries

Alejandro Frid[1,2*], Kenneth Paul[3], Natalie C. Ban[1], Ken Cripps[4], Sarah Harper[5], Robyn E. Forrest[6], Carrie Holt[6], Daniel L. Curtis[6], Hannah Watkins[2], Robert Rangeley[7], Jaclyn Cleary[6], Melissa Evanson[8], Janet Lochead[6].

[1]*School of Environmental Studies, University of Victoria, Victoria, Canada*
[2]*School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC, Canada.*
[3]*Wolastoqey Nation at Neqotkuk, New Brunswick, Canada*
[4]*Kitasoo Xai'xais Stewardship Authority, Klemtu, BC, Canada*
[5]*Coastal First Nations-Great Bear Initiative, Vancouver, BC, Canada*
[6]*Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC, Canada.*
[7]*Oceana Canada, Halifax, NS, Canada*
[8]*Central Coast Indigenous Resource Alliance, Campbell River, BC, Canada*
[*]*Corresponding author: alejfrid@gmail.com*

Cover photo caption: The late Ernie Mason, from the fisheries program of the Kitasoo Xai'xais First Nation, is about to release a live Yelloweye Rockfish, caught for research purposes, using a descender device that will release the fish at depth. The Kitasoo Xai'xais fisheries program is a pioneer in research that pairs Indigenous and scientific knowledges, including recent collaborations with Fisheries and Oceans Canada (DFO). Ernie Mason was a Hereditary Chief and pillar of marine research until his untimely passing in 2022. Photo used with permission from the Mason Family. (Photo credit: Alejandro Frid.)

Recommended citation: Frid, A., Paul, K., Ban, N.C., Cripps, K., Harper, S., Forrest, R.E., Holt, C., Curtis, D.L., Watkins, H., Rangeley, R., Cleary, J., Evanson, M., Lochead, J., 2026. *A Practitioner's Guide for Pairing Indigenous and Western Knowledge Systems for the Management of Canada's Marine Fisheries*. Coastal First Nations--Great Bear Initiative, Vancouver, BC. https://coastalfirstnations.ca/wp-content/uploads/2026/03/Good-Practices-Pairing-Indigenous-and-Western-Knowledge-Systems.pdf

Table of Contents

Executive Summary

This Practitioner's Guide originated during a series of ongoing meetings which began in 2024 among executive leadership from Fisheries and Oceans Canada (DFO), Indigenous leaders, and most non-DFO authors of this guide. The discussions have focused on deficiencies in the inclusivity of Indigenous Peoples and their knowledges in Canadian fisheries management and potential avenues to address them. In the process, DFO requested written guidance on how the institution could better engage in ***pairing knowledges***: collaborations in which Indigenous and Western Knowledge Systems contribute their complementary strengths to improve management advice and decision-making. In response, we — a team of First Nations representatives, DFO scientists, academics, and a non-governmental organization representative — produced this guide with DFO as the intended audience while endeavouring to maintain relevance for broader readership.

Pairing knowledges is consistent with Canada's legal obligations to uphold and protect Indigenous rights. It can also improve our understanding of ecosystems and inform better management decisions.

The principles, concepts, and practices outlined here (see **Quick Guide**) are intended to support proactive, positive collaborations that pair knowledges to generate management advice and enable shared decision-making. The examples we provide demonstrate the feasibility of the approach and the potential for better outcomes for people, ecosystems, and fisheries.

Quick Guide

The guide begins by laying out a conceptual framework for pairing knowledges encapsulated by the following ***principles***:

1. Pairing knowledges is consistent with Canada's legal obligations to uphold and protect Indigenous rights.
2. Pairing knowledges, when agreed to by Indigenous Peoples, is valuable to everyone.
3. Pairing knowledges is not always desirable by Indigenous Peoples.
4. Pairing knowledges is not about filling knowledge gaps in an existing process that centres on Western Science or Western Frameworks for decision-making.
5. Indigenous Peoples are inseparable from their knowledge systems.
6. Indigenous Knowledge Systems (**IKS**) manage relationships, not "resources."
7. Co-governance agreements that actively support pairing knowledges and shared decision-making enhance success in collaborative fisheries management.

The guide then applies these principles by developing the following ***practices***:

- **Practice 0: Education and self-reflection.** This practice pertains to non-Indigenous people intending to engage in pairing knowledges, who must first do some personal work to better understand the historical and current impacts of colonialism, differences between

Indigenous and Western knowledge systems, and ongoing efforts to revitalize Indigenous sovereignty and knowledges.

- **Practice 1: IKS inclusivity.** Seek meaningful collaborations with Indigenous Peoples that align with federal policy including measures 37 and 40 of the *UNDA Action Plan*[1]).
- **Practice 2: Relationship building.** Develop trust and connection among potential collaborators. Meetings held in Indigenous communities that include shared time on the land and water are essential to this practice.
- **Practice 3: Support government personnel.** Practices 0 to 2 must be recognized and prioritized in the work plans of DFO personnel, with appropriate time commitments and funding. DFO managers and executive leadership can play a key role in implementing this practice by supporting workplans that align with measures 37 and 40 of the *UNDA Action Plan*, which specify DFO's obligations to collaborate with Indigenous Peoples.
- **Practice 4: Support Indigenous collaborators.** Implement measure 38 of the *UNDA Action Plan*, which requires DFO to "provide predictable and flexible funding" for Indigenous Peoples to engage in pairing knowledges and "advisory, co-management, and decision-making processes tied to aquatic resources and oceans management."
- **Practice 5: Honour place-based contexts.** Tailor collaborative processes to the place-based contexts and priorities of Indigenous collaborators.
- **Practice 6: Relationship continuity.** To the extent possible, government personnel should maintain continuity of relationships with Indigenous collaborators and develop relational transition plans in anticipation of staffing changes.
- **Practice 7: Data sovereignty.** Enable data sharing agreements that respect the sovereignty and confidentiality of IKS, which belong to Indigenous Peoples who may choose to share only specific elements of their knowledge.
- **Practice 8: Joint management decisions.** Meaningfully include Indigenous Peoples and their IKS in joint management decisions. Co-governance agreements are critical to ensuring the implementation of measures 37 and 40 of the *UNDA Action Plan*.

The guide then integrates these practices into five **generalized phases** for pairing knowledges and illustrates each phase with specific examples.

- **Phase 0: Education and self-reflection.** This phase begins prior to any bilateral discussions. It applies **practices 0 to 3** and is essential to legitimising the collaborative process.
- **Phase 1: Relationship building.** This phase applies **practices 0 to 5** and is primarily about forming relationships and building trust. It also includes initial discussions that examine the potential benefits, risks, and shared goals of a proposed collaboration.
- **Phase 2: Co-design.** This phase applies **practices 1 to 7**, requiring all parties to work together to co-design the project's goals, objectives, methods, data sharing agreements, and role in joint management decisions.

[1] The United Nations Declaration on the Rights of Indigenous Peoples Act Action Plan.

- **Phase 3: Co-produce.** This phase applies **practices 1 to 7**. It is when most elements co-designed during phase 2 are carried out. For collaborations with a research component, this is when data collection, analyses and communication of methodologies and results take place. For collaborations without a research component, this is when collaborators compile and agree on the existing knowledges that will support shared decision-making.
- **Phase 4: Implementation of joint management decisions.** This phase applies **practices 1 to 6 and 8**; it is pertinent only to collaborations that are inclusive of IKS in advice and decision-making. In the context of DFO, this phase requires inclusion of the co-produced management measures into Integrated Fisheries Management Plans.
- **Phase 5: Share lessons that would benefit future collaborations.** This phase applies **practices 0 to 6** and, if agreed by all parties, is about sharing lessons learned with a global community of practice.

We elaborate on these principles, practices and phases in sections 3, 4 and 5, respectively. This guide is intended to inform a national context but has two salient limitations. First, most examples are from the Pacific Region. Second, although several examples illustrate successful processes and the importance of co-governance agreements, we do not provide explicit guidance addressing: (1) procedural challenges and/or potential conflicts between knowledge systems; or (2) how to develop and apply general principles for co-governance and joint decision-making. Over time, we intend to revise the guide in collaboration with practitioners in management to better address these issues.

Section 1: Introduction

Positionality of the author team

Education scholar H. Richard Milner cautions that "dangers seen, unseen, and unforeseen can emerge for researchers when they do not pay careful attention to their own and others' racialized and cultural systems of coming to know, knowing, and experiencing the world" (Milner IV, 2007). His words are particularly relevant for collaborations that strive to pair knowledge systems, as we do. Accordingly, we offer the following positionality statement from the author team.

The concepts in this Practitioner's Guide reflect our combined experiences in working toward the pairing of Indigenous and Western Knowledge Systems in support of fisheries management. Ken Paul is a member of the Wolastoqey Nation at Neqotkuk and the other authors have settler/immigrant positionalities. Each of us has been collaborating with First Nations for years, decades in some cases. Some of us are embedded in academia (NCB, HW, AF), a non-governmental organization (RR), currently or formerly employed by a First Nation or aggregate of First Nations (KC, SH, AF, KP, ME), or employed by Fisheries and Oceans Canada (DFO) as scientists (RF, CH, DLC, JC, JL). Most of us are members of a collaboration that seeks to pair the knowledge of the Kitasoo Xai'xais First Nation with Western science in a fisheries context. Our shared objective is to find ways in which fisheries management can better support the cultural practices of Indigenous Peoples, commercial fisheries, and vibrant ecosystems.

Background

Collaborations between Indigenous and Western knowledge systems can contribute to Canada and other countries meeting their international obligations to protect Indigenous rights under the United Nations Declaration on the Rights of Indigenous Peoples (Ignace et al., 2023). They can also improve our understanding of ecosystems (Jessen et al., 2022), support better management decisions, and enable a more socially-just and ecologically resilient world (Strand et al., 2024). These outcomes are possible but not a given. They are achievable only if collaborations are conducted "in a good way", such that the goals and objectives for generating knowledge and making decisions are equitably inclusive of the priorities, values, and approaches of Indigenous Peoples, while finding common ground with the priorities, values and approaches of non-Indigenous collaborators (Campion et al., 2024; Mantyka-Pringle et al., 2025; Reid et al., 2024).

Consistent with these possibilities, in Canada there is growing interest for collaborative fisheries management: the joint management of fisheries (including marine spatial protections) by Indigenous and non-Indigenous governments (Swerdfager et al., 2025). As in other types of co-management (see "2.0 Key definitions"), collaborative fisheries management requires processes in which different knowledge systems — ways of understanding the world and making decisions — contribute their complementary strengths to generate new insights without

one knowledge system subsuming the other (Reid et al., 2021). These processes, which we refer to as *pairing knowledges* (Reid et al., 2021), require collaborators to value different worldviews and engage in pluralistic conversations that generate research goals, objectives, methods, and outcomes inherent to a shared vision (Strand et al., 2024). Key to these processes is the creation of an ethical space that nurtures individual relationships, builds trust, highlights common ground, and provides cross-cultural connections (Ermine, 2007; Nikolakis and Hotte, 2022). Pairing knowledges, however, is appropriate only when Indigenous Peoples choose to engage. (Ban et al., 2026).

Ultimately, the goal of pairing knowledges is shared decision-making that supports better management actions, policies, and laws for regulating relationships between humans and ecosystems (Reid et al., 2021; Strand et al., 2024). Attaining this goal can be challenging, partly because of philosophical differences between Western and Indigenous knowledge systems. Western Knowledge Systems (WKS) orient to the scientific approach, which strives for objectivity and employs empirical or analytical approaches that tend to not explicitly consider the cultures, governance, and values of the people who generate and use the ensuing knowledge. In contrast, Indigenous Knowledge Systems (IKS) are inseparable from the people and lifeways from which they originate (McGregor, 2021); they have an explicit ethic of respect and reciprocity towards all other beings (Kimmerer, 2002), which can lead to more precautionary and holistic approaches than those of Western fisheries management (Frid et al., 2023). Unlike WKS, IKS does not separate processes that generate knowledge from those that make management decisions (Ban et al., 2026).

In addition to navigating philosophical differences between knowledge systems, advancing from knowledge co-production to shared decision-making requires a leveling of the playing field that mitigates power imbalances (Ban et al., 2026; Silver et al., 2022). Collaborative fisheries management by itself does not specify and cannot guarantee shared authority for decision-making. In Canada, that authority rests by default with the Minister representing the federal government or, depending on the type of fishery, a provincial or territorial government. Consequently, collaborative fisheries management processes are more likely to succeed if they operate under co-governance agreements that specify how decision-making authority is shared between Indigenous and non-Indigenous governments (Swerdfager et al., 2025).

These are among the reasons why Ban et al. (2026) propose that the contributions of different knowledge systems occupy different positions along separate continuums of knowledge and decision spaces, and that examining these positions helps clarify the intent and outcomes of pairing knowledges. Ban et al. (2026) visualize the relationship between these two spaces as a woven basket in which the pairing of different knowledges strengthens toward the centre, where the weave is tighter (Figure 1). In this metaphor, pairing knowledges in one space does not necessarily lead to pairing knowledges in the other. Depending on the goals and perspectives of collaborators, different parts of the continuums of knowledge and decision

spaces can be appropriate to pursue (see examples in Figure 1 and Table 1). For collaborations to succeed, collaborators must agree early in the process on where they intend to work along these continuums (Ban et al. 2026).

Figure 1

Knowledge and decision spaces expressed as continuums in the form of a woven basket with tighter pairing (or weaving) of knowledges at the centre (reproduced with permission from Ban et al. (2026)). Acronyms are: Indigenous Knowledge Systems, IKS; Western science, WS. See Table 1 for examples of projects along these continuums which illustrate the numbered points. Artwork by nicole marie burton.

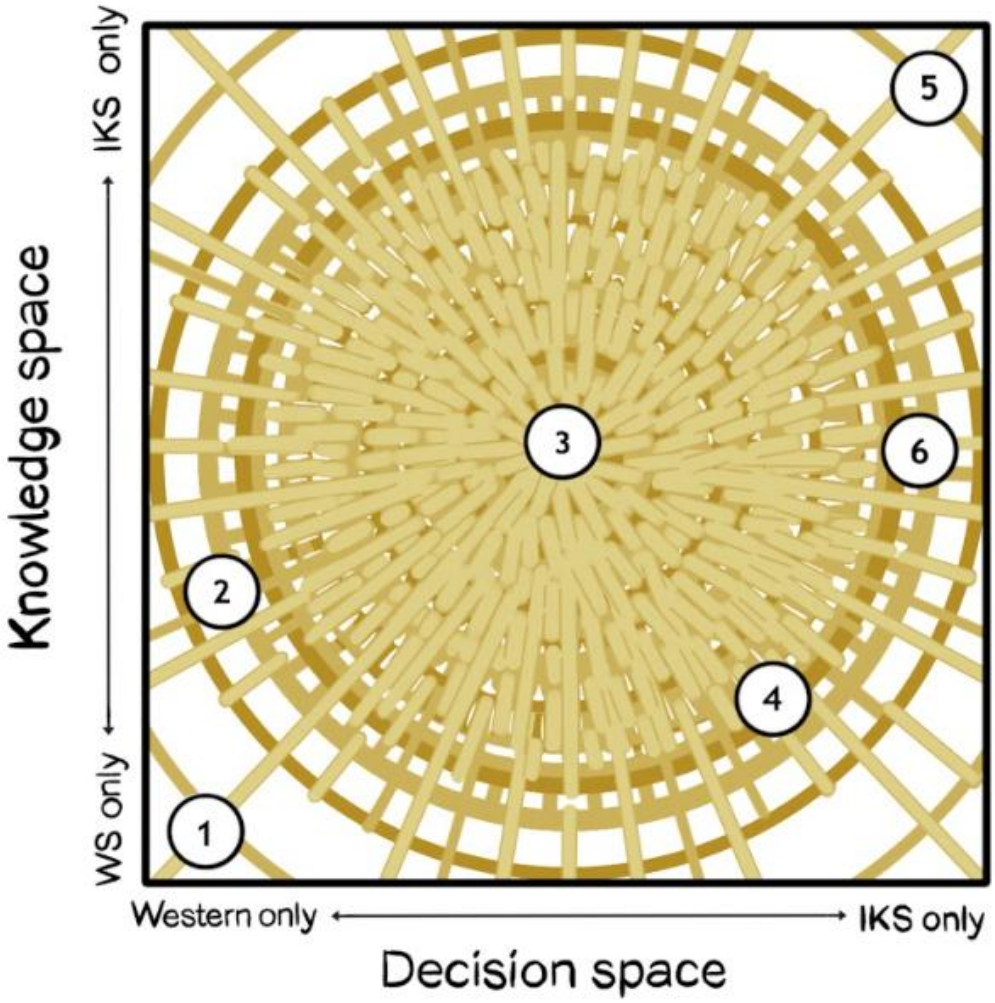
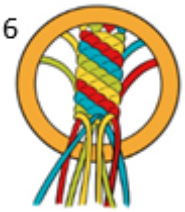


Table 1

Examples from different points on the continuums of knowledge and decision spaces (see Figure 1). The table is modified with permission from Ban et al. (2026). Artwork by nicole marie burton.

Position in Fig. 1	Description	Examples
1 	The status quo for fisheries management based on WKS.	Most management advice and Integrated Fisheries Management Plans, historically and currently used by DFO (Moffat et al., 2025).
2 	Incremental efforts to pair IKS and WKS primarily in the knowledge space and less consequently in the decision space.	The literature on the contributions of pairing knowledges to ecological understanding and its management implications is large and growing (reviewed in Jessen et al. 2022). Most case studies in this literature, however, rarely extend their reach to management decisions (Ban et al. 2026).
3 	Strong effort to pair IKS and WKS in both knowledge and decision spaces.	1. The rebuilding plan *Haida Gwaii ʻíináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan* (DFO et al., 2025). 2. The *Yáanuu · G̲iinuu Giant Red Sea Cucumber Management Plan* (DFO et al., 2026). 3. The design and ongoing implementation of the MPA Network for the Northern Shelf Bioregion (Beaty et al., 2024). (Section 5 describes these examples.)
4 	Management primarily by Indigenous Peoples may draw mainly on Western science to inform decisions, recognizing the many tools that Western science can provide.	The Wuikinuxv Nation used quantitative fisheries models to determine their sockeye salmon harvests that would respect the foraging needs of grizzly bears with who they share the Wanuxv river (Adams et al., 2021).
5 	Management decisions are made by Indigenous Peoples using their own Indigenous Knowledge Systems.	The Kitasoo Xai'xais Nation are using their traditional practices to restore herring, transplanting eggs on branches as guided by Kitasoo Xai'xais laws and stewardship principles.
6 	Indigenous decision-making may use both Indigenous Knowledge Systems and Western science, valuing the complementary strengths of both knowledge systems.	The Kitasoo Xai'xais Nation used both IKS and Western science to inform the design and implementation of the Gitdisdzu Lugyeks Marine Protected Area in their territory.

Between 2018 and 2023, Canada's federal government released or amended federal policies and legislation recognizing Canada's obligations to uphold Indigenous rights and perspectives, including commitments to considering Indigenous Peoples and their knowledges in fisheries management (Table 2). To date, however, the role of Indigenous Peoples in Canadian fisheries management remains very limited, signaling gaps between policy and practice and shortcomings in existing policies and legislation (Moffat et al., 2025). Further, the authority of the Minister of Fisheries to override any joint management recommendation remains a potential barrier to pairing knowledges in the decision space (Swerdfager et al., 2025).

This practitioner's guide aims to inform the way forward. Its primary goal is to synthesise principles and good practices which would help close implementation gaps for federal policies and legislation and make the management of marine fisheries in Canada inclusive of Indigenous Peoples and their knowledges. It is meant to inform processes that involve aspatial management tools (e.g., catch restrictions and reference points), spatial components of fisheries management (e.g., marine protected areas or other spatial fishery closures), or both. Within the framework proposed by Ban et al. (2026), the guide's primary goal is to inform processes for which the desired outcomes aim toward the centres of both the decision and knowledge spaces depicted in Figure 1.

The motivation for this guide stems from a series of ongoing meetings which began in the fall of 2024 and have included most of the non-DFO authors of this guide, the Chief Councillor of the Kitasoo Xai'xais Nation (Doug Neasloss), the Policy Director for Coastal First Nations-Great Bear Initiative (Trevor Russ), and DFO executive leadership, including Regional Directors and Assistant Deputy Ministers. During these meetings, DFO personnel have expressed a conscientious desire to learn and have requested written guidance on how to collaborate with Indigenous Peoples. The requests signalled a desire to work together "in a good way" (see "2.0 Key definitions"). The intended audience for this guide, therefore, centres on DFO personnel expecting to engage in pairing knowledges to support the management of Canada's marine fisheries. The desire to work collaboratively and need for guidance, however, extends beyond DFO. Accordingly, we endeavoured to make most components of this guide relevant to a broader audience, including Indigenous governments or organizations, academics, non-governmental organizations, and non-federal government personnel.

Table 2

Recently released or amended federal policies and legislation recognizing Canada's obligations to uphold Indigenous rights and perspectives, including commitments to make fisheries management inclusive of Indigenous Peoples and their knowledges.

Document, author, year and statute	Highlighted content and URL
Principles respecting the Government of Canada's relationship with Indigenous peoples. Minister of Justice Canada (2018)	Though not specific to fisheries, this document sets the overarching policy framework for how the federal government is to engage with Indigenous Peoples, stating that "The Government recognizes that Indigenous self-government and laws are critical to Canada's future, and that Indigenous perspectives and rights must be incorporated in all aspects of this relationship." https://www.justice.gc.ca/eng/csj-sjc/principles-principes.html
DFO Reconciliation Strategy. DFO (2019)	Intended actions specified by the strategy include: • "Involve Indigenous groups in the development and implementation of new policy, program, and operational initiatives in relation to fish and fish habitat conservation and protection." • "Increase Indigenous involvement in the prioritising, conduct, and communicating of science and survey activities." • "Enhance Indigenous involvement in fisheries management processes." https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40947208.pdf
Fisheries Act. Minister of Justice Canada (*R.S.C., 1985, c. F-14*, 2019, l. 2.5).	Under the 2019 amendment, Section 2.5 states that The Minister "**may** consider [emphasis added] the application of a precautionary principle and an ecosystem approach (2.5a) and Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister (2.5d)" in management decisions. https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/40947208.pdf
United Nations Declaration on the Rights of Indigenous Peoples Act (UNDA). Minister of Justice Canada (S.C. 2021, c. 14)	This legislation, though not specific to fisheries, acknowledges the "rights and legal traditions of First Nations, Inuit and the Métis and of their institutions and governance structures, their relationships to the land and Indigenous knowledge," thereby establishing the legal basis for fisheries-specific measures under its Action Plan. https://www.laws-lois.justice.gc.ca/eng/acts/u-2.2/page-1.html
The United Nations Declaration on the Rights of Indigenous Peoples Act Action Plan (UNDA Action Plan). Minister of Justice Canada (2023)	Measure 37, 38 and 40 of this Action Plan commits DFO to" • 37: "In a manner that is measurable, enhance collaborative tools agreements and transparent approaches to better deliver on the collaborative design, development, delivery and management of fisheries, as well as conservation and protection of fish habitat […and] to pursue fisheries-related collaborative governance opportunities through nation-to-nation, Inuit-Crown and government-to-government negotiations. • 38. Provide predictable and flexible funding that will ensure Indigenous partners have the capacity to provide fisheries, habitat, science, and oceans and marine-related services. Provide predictable and flexible funding to ensure Indigenous nations and organizations have the capacity to meaningfully participate in advisory, co-management, and decision-making processes tied to aquatic resources and oceans management. • 40: "Develop and employ mechanisms that respect and incorporate Indigenous Knowledge as a distinct knowledge system in the management of fisheries, fish habitat, conservation, marine safety and protection of the marine environment." https://www.justice.gc.ca/eng/declaration/ap-pa/ah/pdf/unda-action-plan-digital-eng.pdf

Section 2: Key Definitions

"The language used to describe and discuss knowledge systems [and related concepts] is continually evolving as researchers [and practitioners] strive to be more inclusive and equitable" (Strand et al., 2024). Acknowledging this, we offer the following working definitions.

Co-governance: negotiated arrangements between different governments (e.g., Indigenous, provincial, federal) for shared authority and decision-making in a specific context (e.g., management of a fishery). Examples of co-governance agreements include the *Fisheries Resources Reconciliation Agreement* (FRRA, 2021), *Rights Reconciliation Agreement on Fisheries between the Listuguj Mi'gmaq Government and the Government of Canada* (Anonymous, 2021), the Gwaii Haanas Gina 'Waadluxan KilGuhlGa Land-Sea-People Management Plan (CHN et al., 2018), and governance of the Marine Protected Area Network for British Columbia's Northern Shelf Bioregion (or Great Bear Sea) currently undergoing implementation (Beaty et al., 2024).

Co-management: "negotiated agreements designed to share varying levels of responsibility among Indigenous Peoples and State governments for the conservation and management of species that are integral to Indigenous food systems, identity, culture, and way of life" (Snook et al., 2022).

***Collaborative fisheries management*:** a subset of co-management in which Indigenous and non-Indigenous groups have joint management responsibility for the fisheries but non-Indigenous governments maintain authority over decisions. Examples include the *Collaborative fisheries management agreement between Abegweit First Nation and the Government of Canada* (Anonymous, 2023).

Ethical space: a metaphorical place in which collaborators come together to work on shared interests without pre-judging or diminishing each other's worldviews values, and knowledge systems (Ermine, 2007; Gonet, 2024; Nikolakis and Hotte, 2022).

Knowledge systems: the broader political, cultural, economic, and educational systems from which knowledge originates (McGregor, 2021).

Indigenous Knowledge Systems (IKS): ways of living in the world that intertwine governance, ceremony, ethics, values, empirical observations, harvesting practices, and other elements that support and enrich — spiritually, socially, and materially — the peoples who give rise to such knowledge. These systems are place-based, inseparable from the people, landscapes, and seascapes to whom they belong, which leads to their diversity across cultures while holding some key commonalities (McGregor, 2021) (Box 1). Indigenous languages are critical components of IKS, as they capture the specificity of place-based worldviews (e.g., Greening (La'goot), 2024; Kerinaiua (Mantiyupwi Mavis) et al., 2025).

Western Knowledge Systems (WKS): generally draw on the dominant Western or Eurocentric paradigm entwined with STEM (science, technology, engineering, mathematics) fields of Western sciences (WS), seeing the world as positivistic (i.e., there is a knowable truth) and hierarchical (Reid et al., 2021).

Pairing knowledges (or ***pairing knowledge systems***): collaborations in which different knowledge systems contribute their complementary strengths to generate new insights and mutual understanding without one knowledge system subsuming the other (Reid et al., 2021). To succeed, these collaborations require that two or more knowledge systems are equitably brought together in a shared ethical space that respects and maintains the integrity of each knowledge system (Ermine, 2007; Nikolakis and Hotte, 2022). Conceptually similar terms include *Two-Eyed Seeing* (Bartlett et al., 2012), *knowledge co-production* (Cooke et al., 2021), *weaving knowledges* (Tengö et al., 2017), and *bridging knowledges* (Mantyka-Pringle et al., 2017). We use *pairing knowledges* (or its variations) throughout this paper.

In a good way: in the context of collaborations between Indigenous and Western knowledge systems, this term refers to processes in which the goals, objectives, and methodologies "are identified as priorities by Indigenous people, reinforce Indigenous values, are informed by Indigenous frames of reference, and yield benefits to Indigenous individuals and groups" (Ball and Janyst, 2008). See also Reid et al. (2024).

Box 1: Some principles shared by Indigenous cultures across diverse geographies

The text below is quoted from Reid et al. (2022) and is consistent with the writing of Indigenous scholars from diverse geographies (e.g., Campion et al., 2024; Kimmerer, 2011; Strand et al., 2024).

Respect: All living beings deserve respect and need to be cared for. Take only what you need and heal any damages that occur to the lands and waters. Be patient and go slow; consider the long-term sustainability of your plans with careful forethought.

Balance and interconnectedness: All living beings are interconnected and changes to one species can cascade through the natural world, which affects intergenerational equity (i.e., actions by the current generation should not compromise well-being of future generations).

Intergenerational knowledge: We learn from the past and adapt our knowledge and decisions based on experience.

Reciprocity: The natural world provides us with everything that is necessary; we take care of the natural world first and it takes care of us.

Section 3: Key Principles for Pairing Knowledge Systems

The principles listed below provide guidance toward pairing knowledges. We recognize that the list reflects our personal experiences and is not comprehensive; it is a starting point to be augmented or revised in future versions of this guide.

1. **Pairing knowledges in a good way is consistent with Canada's legal obligations to uphold and protect Indigenous rights** (Ignace et al., 2023; Reid et al., 2024). The *United Nations Declaration on the Rights of Indigenous Peoples Act* (UNDA) and its *Action Plan* are among the legal documents that specify these obligations (Table 2).

2. **Pairing knowledges, when agreed to by Indigenous Peoples, is valuable to everyone**. Western approaches to knowledge generation and decision-making are limited in solving many of today's environmental problems (Kimmerer, 2011; Reed et al., 2024b), and the pairing of different knowledge systems can illuminate new understandings, methodologies, and solutions that might not be apparent otherwise (Bartlett et al., 2012), increasing socio-ecological resilience (Frid et al., 2023) and long-term economic benefits (Cisneros-Montemayor et al., 2022; Sumaila, 2021).
3. **Pairing knowledges is not always desirable by Indigenous Peoples.** Indigenous Peoples may choose, in some contexts, to use only their own knowledge systems to inform their own management decisions (Ban et al., 2026).
4. **Pairing knowledges is not about filling knowledge gaps in an existing WKS process**. Indigenous scholars characterize attempts to "incorporate" Indigenous knowledge into scientific research for the purposes of filling data gaps as extractive practices that dissociate Indigenous Peoples from their knowledge systems (Whyte, 2013). Collaborations in which IKS remain inherent to their fuller and more holistic contexts offer a better way forward (Reid et al., 2024; Strand et al., 2024).
5. **IKS and Indigenous Peoples are inseparable**. IKS are constantly evolving through the experiences of past, present, and future knowledge holders, and thus are inextricably linked to the peoples who give rise to such knowledge. In this context, knowledge is a verb: something that must be "lived" (Reed et al., 2024a; Whyte, 2013). As Anishinaabe scholar Deborah McGregor (2021) states, "[...] the only appropriate and effective way for IKS to be 'utilized' in environmental governance is to involve Indigenous peoples as nations, societies, and governments, with particular attention given to the holders/keepers and practitioners of IKS. It is simply neither appropriate nor constructive to try to 'extract' Indigenous knowledge from Indigenous peoples."
6. **IKS manage relationships, not "resources."** WKS practitioners typically think about managing "resources", which often equates with single species of commercial value, exacerbating a perceived demarcation between "nature" and humans. In contrast, IKS focus on managing human behaviours so that people stand in good and reciprocal relationships with all other beings, human or not (Gonet, 2024; Reed et al., 2024a).
7. **Co-governance agreements that actively support pairing knowledges and shared decision-making enhance success in collaborative fisheries management***.* In Canadian marine fisheries management, the ultimate decision-making authority rests with the Minister of Fisheries. However, co-governance agreements can specify shared authority between Canada and Indigenous Nations in the form of consensus recommendations (Swerdfager et al., 2025). Although the Minister may legally override consensus recommendations, doing so may be politically perilous. The *Fisheries Resources Reconciliation Agreement* (FRRA, 2021) between the governments of Canada and eight Pacific coastal First Nations is an example of a co-governance agreement that, among other objectives, is intended to support:

"…ecosystem-based management frameworks that aim to achieve the coexistence of healthy, fully functioning ecosystems and human communities using all available information

including Indigenous Knowledge, scientific information, best practices, and Indigenous laws and principles (including respect for the natural world, balance and intergenerational equity, intergenerational knowledge transfer, and reciprocity)."

The FRRA and similar agreements (Anonymous, 2021; Beaty et al., 2024; CHN et al., 2018) are proof of concept of the legal frameworks that could become more widespread to enable pairing knowledges and shared authority for decision-making (Swerdfager et al., 2025).

Section 4: Good Practices for Pairing Knowledges to Advance Collaborative Fisheries Management

This section introduces practices that we consider essential to pairing knowledges in a good way. Section 5 provides specificity for their implementation. We recognize that the list reflects our personal experiences and is not comprehensive; it is a starting point to be augmented or revised in future versions of this guide.

Practice 0: Education and self-reflection

This practice is about better understanding the historical and contemporary contexts in which Indigenous Peoples live. We numerate it as 0 (zero) to emphasize its fundamental role as the precursor to pairing knowledges (Strand et al., 2024).

Any non-Indigenous person intending to engage in pairing knowledges must first do some personal work to better understand the historical and current impacts of colonialism and ongoing efforts by Indigenous Peoples to revitalize their IKS (Wong et al., 2025, 2020). Resources for doing so include the findings, calls to action, and educational materials of the *Truth and Reconciliation Commission of Canada*, references cited in this document (e.g., Gonet, 2024; Newell, 1993; Reed et al., 2024a; Wong et al., 2025, 2020), and Indigenous-led documentaries on the lingering impacts of residential school (e.g., *Sugarcane* and *We Were Children*) and on pairing knowledges (e.g., *Signal Fire*).

Our advice for non-Indigenous practitioners includes the following:

1. Take time to understand how some federal legislation and policies have curtailed the ability of Indigenous Peoples to fish. Among them is the *Fisheries Act*, which was legislated in 1868. The purpose of the Act, as set out in section 2.1, is "to provide a framework for (a) the proper management and control of fisheries; and (b) the conservation and protection of fish and fish habitat, including by preventing pollution" (Minister of Justice, 2019). In practice, the *Fisheries Act* has historically supported the expansion of commercial fisheries while restricting and displacing Indigenous fishers. For example, it criminalized elements of IKS, such as weirs and stone traps at the mouth of salmon spawning rivers, which fish much more selectively and sustainably than the mixed-stock salmon fisheries managed under the *Fisheries Act* (Castañeda et al. 2020; Silver et al. 2022). Additionally, the 1969 Davis Plan and

the 1996 Mifflin Plan consolidated commercial licenses for Pacific salmon into a smaller fleet that favoured individuals or corporations with higher capital, terminating commercial participation by many Indigenous Peoples (Newell 1993; Silver & Stoll 2019).

2. Take time to learn the differences between IKS and WKS and why knowledge pairing is not about "integrating" data into Western scientific analyses (see Principles 4-6, Section 3). IKS have their own time-tested processes for validating knowledge, which should not be expected to fit into a WKS mold (Gonet, 2024; Reid et al., 2024; Whyte, 2013).
3. Learn where efforts have already been undertaken by Indigenous Peoples to include IKS in decision-making. Some of these efforts span decades (e.g., Denny and Fanning, 2016; Jones et al., 2010; McMillan and Prosper, 2016). Lack of awareness of this modern history may hinder progress, as Indigenous communities have limited capacity to re-educate potential collaborators who are new to the field.
4. In preparing to collaborate with Indigenous Peoples, knowledge of *The First Nations Principles of OCAP®* (Ownership, Control, Access, Possession) is essential. These principles assert that Indigenous Peoples have control over data collection processes, own their data, and control how it can be used (First Nations Information Governance Centre, 2025). OCAP® training is offered by the *First Nations Information Governance Centre* and can be taken as part of the training plan for DFO employees.
5. Understand that the ability of Indigenous Peoples to engage in pairing knowledges may depend on internal capacity and other priorities within the community. For instance, communities without home care, childcare, or elder care often rely on families to support their relatives. The implication is that knowledge-holders and practitioners of IKS may have family responsibilities that take precedence over attending gatherings or participating in collaborative work. Being receptive and flexible to longer timeframes for meetings and project deliverables will help Indigenous partners balance community priorities and help build trust for your collaboration.

Practice 1: IKS inclusivity

This practice is about seeking meaningful collaborations with Indigenous Peoples in alignment with federal policy. As detailed in Table 2, the 2019 *DFO Reconciliation Strategy* specifies actions for increasing the inclusivity of Indigenous Peoples and their knowledges in fisheries management. The *UNDA Action Plan* includes 10 action plan measures (APMs) that are specific to DFO. These include APM 37, which requires DFO to develop collaborative tools and transparent approaches to improve the "design, development, delivery and management of fisheries," and for DFO to pursue fisheries-related collaborative governance opportunities within Indigenous Peoples and their governments. Additionally, APM 40 requires DFO to "develop and employ mechanisms that respect and incorporate Indigenous Knowledge as a distinct knowledge system in the management of fisheries, fish habitat, conservation, marine safety and protection of the marine environment." (APM 38 also targets DFO and is discussed under Practice 4).

DFO's executive leadership (e.g., Assistant Deputy Ministers, Regional Directors) can play a key role in enhancing the inclusivity of IKS in fisheries management by supporting DFO managers, scientists, and other personnel in implementing APMs 37 and 40. The reason is that the *UNDA Action Plan* provides a policy framework for pairing knowledges and collaborative fisheries management yet lacks specificity for its implementation. DFO personnel with initiative to engage in activities that support UNDA APMs may encounter institutional obstacles that favour the status quo over pairing knowledges. Proactive support from DFO executive leaders to personnel seeking to engage in pairing knowledges may mitigate these risks.

Practice 2: Relationship building

This practice is about developing trust and connection among potential collaborators. Pairing knowledges is a people-based process. It involves meeting physically in the same space (at least for some portions of the work), listening to one another, sharing different perspectives, working together through challenges and disagreements, and staying committed to achieving shared goals. To do so, collaborators must see each other as individuals, not as components of institutions. Meetings that take place in Indigenous communities and include shared time on the land and water, rather than in DFO boardrooms or online, are essential components of this practice (Almack et al., 2023; Campion et al., 2024).

Practice 3: Support government personnel

Government personnel require validation of the time and resources they invest in becoming educated about Indigenous Peoples and IKS and in building trust-based relationships with Indigenous Peoples. Practices 0 to 2, therefore, must be recognized and prioritized components of work plans with appropriate time commitments and adequate funding. The implication is that relationship building and continuity are critical work components which require unstructured interaction and time on the land and water with Indigenous Peoples and consistent allocation of appropriate funding to support travel and gatherings. This work could contribute to other DFO priorities, such as Ecosystem Approaches to Fisheries Management and sustainability more generally (Frid et al., 2023). DFO managers and executive leadership can play a key role in implementing this practice, for example, by supporting workplans that, in alignment with UNDA APMs 37 and 40, specify engagement with Indigenous Peoples for pairing knowledges and collaborative fisheries management.

Practice 4: Support Indigenous collaborators

As detailed in Table 2, UNDA APM 38 requires DFO to "provide predictable and flexible funding" for Indigenous Peoples to engage in pairing knowledges and "advisory, co-management, and decision-making processes tied to aquatic resources and oceans management." This APM implicitly recognizes that pairing knowledges is most meaningful when Indigenous Peoples have the resources to fully engage and be acknowledged in all aspects of collaborative work, such as

participating in virtual and in-person meetings, developing data-sharing agreements, reviewing documents, co-developing objectives, priorities and timelines, managing their own data, co-producing outputs and being equitably awarded authorship of publications (Moffat et al., 2025; Strand et al., 2024). Consistent with APM 38, project planning should include budgeting to compensate Indigenous Peoples for their time spent in pairing knowledges.

Practice 5: Honour place-based contexts

This practice is about tailoring collaborative processes to the place-based contexts and priorities of Indigenous collaborators. Despite important commonalities across diverse cultures (Box 1), IKS are inseparable from the local people, landscapes, and seascapes to whom they belong (McGregor 2021). IKS, therefore, cannot be extrapolated from one culture to another nor be expected to align with decision-making processes that were not developed collaboratively (Strand et al., 2024; Swerdfager et al., 2025).

Practice 6: Relationship continuity

Continuity in personnel is essential to forming and maintaining the trust-based relationships required to pair knowledges (Swerdfager et al., 2025). For example, over the last decade-and-half the province of British Columbia has maintained the same primary staff engaged in the Marine Planning Partnership, a marine spatial planning collaboration with 18 First Nations, which has produced successful outcomes (Diggon et al., 2020). To the extent possible, government personnel should maintain continuity of relationships with Indigenous collaborators and develop relational transition plans in anticipation of staffing changes.

Practice 7: Data sovereignty

This practice is about enabling data sharing agreements that respect the sovereignty and confidentiality of IKS, which belong to Indigenous Peoples who may choose to share only specific elements of their knowledge systems (Reid et al., 2024; Strand et al., 2024). The IKS used in pairing knowledges requires explicit consent from its owners. Accordingly, training in OCAP® principles and understanding the necessity of data-sharing agreements that respect the sovereignty and confidentiality of IKS and related data are essential for pairing knowledges and collaborative fisheries management (Carroll et al., 2020; First Nations Information Governance Centre, 2025). As stated by the First Nations Information Governance Centre (2025), “Data in this context encompasses **data from First Nations**, including languages, cultures, knowledge, stories, songs, and ceremonies, **data about First Nations** such as demographics, housing, health, economies, labor, education, and **data on or about First Nations lands and resources**, which includes waters, medicines, and animals.” Data sharing agreements also apply to scientific data collected by Indigenous Peoples.

Practice 8: Joint management decisions

This practice is about meaningfully including Indigenous Peoples and their IKS in joint management decisions. Collaborative processes that include IKS only in research and knowledge generation but do not apply this knowledge to decision-making perpetuate a power imbalance in which WKS dominates management outcomes (Ban et al., 2026). The meaningful inclusion of Indigenous Peoples and their IKS in management decisions mitigates this power imbalance. In the context of DFO, this requires the implementation of UNDA APMs 37 and 40 (see Practice 1 and Table 2).

Co-governance agreements are critical to ensuring the implementation of the *UNDA Action Plan*. DFO executive leadership can play a key role by engaging with Indigenous leadership in negotiating co-governance agreements in as wide a range of contexts as possible (Swerdfager et al., 2025). While co-governance agreements are significant milestones, lack of specificity in their implementation may challenge engagement with stakeholders (e.g., commercial and recreational fishers). The reason is that not all stakeholders are fully aware that Indigenous Peoples are rightsholders and signatories in government-to-government agreements, which might lead to unrealistic expectations about stakeholder engagement. Federal personnel, therefore, can play a key role by educating stakeholders on DFO's commitments to shared decision-making, which are laid out in legislation and policy and implemented through co-governance agreements.

Importantly, the *UNDA Action Plan* commits DFO to inclusivity of Indigenous Peoples and their IKS in fisheries management, regardless of whether co-governance agreements have been developed.

Section 5: Applying the Good Practices

As stated earlier, processes for pairing knowledges will differ according to the place-based perspectives and priorities of different Indigenous collaborators. Different processes, however, also are likely to share important commonalities. Therefore, considering five generalized phases for pairing knowledges (Figure 2; Table 3) may help practitioners prepare for their roles in potential collaborations (Strand et al., 2024).

Phase 0: Education and self-reflection

Practices involved: 0, 1 and 3 (0: Education and self-reflection; 1: IKS inclusivity; 3: Support government personnel).

Description: This phase begins prior to any bilateral discussions involving Indigenous Peoples. It pertains primarily to non-Indigenous personnel who must undergo self-reflection and education to understand the power imbalances that have privileged non-Indigenous individuals and institutions (Strand et al., 2024; Wong et al., 2025, 2020). Without the proper time and

resources for slowing down and legitimising the collaborative process, dominant institutions and worldviews may reinforce power asymmetries (Campion et al., 2024; Mantyka-Pringle et al., 2025).

Accordingly, Phase 0 requires investment by DFO on the professional development of their personnel, ideally through training programs led by Indigenous Peoples, so that they learn to value IKS, understand the historical and contemporary policies that have affected them, thereby become better prepared to meaningfully collaborate with Indigenous Peoples (Moffat et al., 2025).

Examples:

1. During 2022-2024, DFO's Technical Expertise in Stock Assessment (TESA) program developed a seminar series in which Indigenous speakers presented on IKS and pairing knowledges to an audience of fisheries and ocean scientists and managers. Starting in 2025, this work continues under the national seminar series *Advancing Reconciliation through Science Speaker Series*.
2. Since 2023, some DFO personnel have joined the Co-management Community of Practice led by Indigenous scholar Jamie Snook, which includes online training, discussions, and presentations by Indigenous scholars and IKS practitioners and is now open to anyone interested in joining.
3. As part of British Columbia's commitment to implementing the Province of British Columbia's *Declaration on the Rights of Indigenous Peoples Act* and to improved understanding of Indigenous history, culture, and rights within the public service, provincial employees have received reconciliation training through mandatory and optional courses (e.g., Sany'as Cultural Safety training program).
4. OCAP® training is being rolled out across DFO staff. At the time of writing, more than 10% of DFO Science staff had completed the training, with a near-term commitment that all science executives, managers, researchers and project leaders should complete the training.

Figure 2: Generalized phases for pairing knowledges (modified from Strand et al., 2024). Solid arrows indicate the direction of flow between phases expected for most collaborations while allowing for cases that do not include Phase 4. Dashed arrows indicate situations in which work conducted at a later phase recognizes gaps (conceptual or otherwise) that are addressed by iterating back to an earlier phase. Names for numbered practices are: 0: Education and self-reflection; 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 7: Data sovereignty and 8: Joint management decisions.

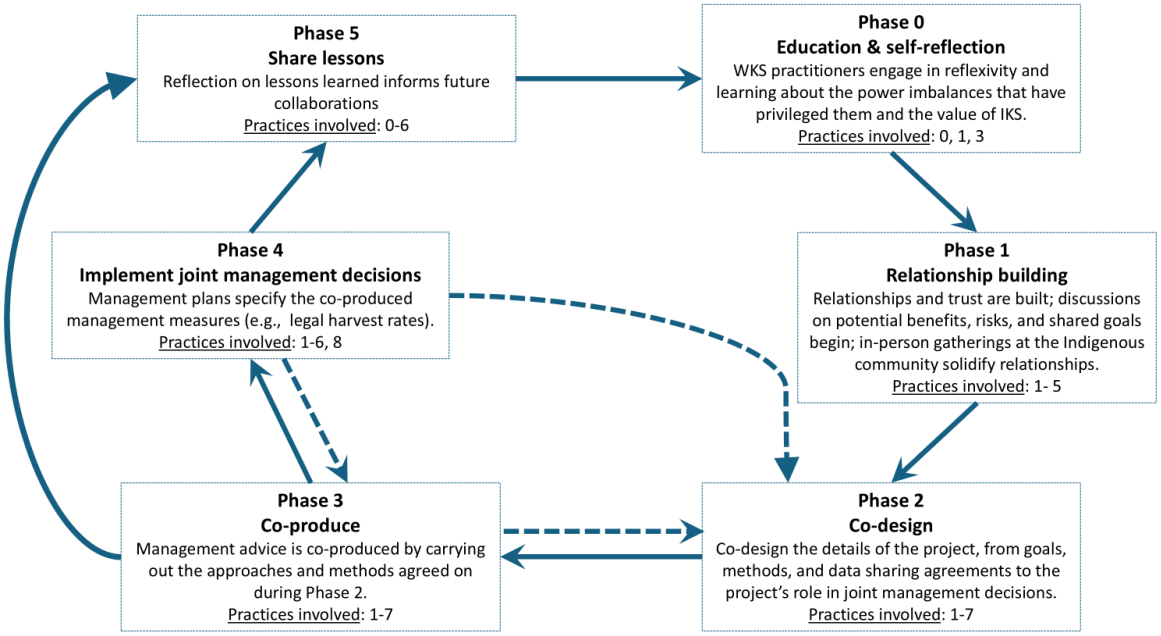


Table 3

List of the generalized phases for pairing knowledges, the practices involved, and examples for each phase. See text for Section 5 for a fuller description of these examples.

Phase		Practices involved	Example
Number	***Name***		
0	Education and self-reflection	0 to 1 and 3. 0: Education and self-reflection; 1: IKS inclusivity; 3: Support government personnel.	Engagement in the Co-management Community of Practice.
1	Relationship building	0 to 5. 0: Education and self-reflection; 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts	Collaborative process described by Almack et al. (2023)
2	Co-design	1 to 7. 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 7: Data sovereignty	Co-design process for the *Yáanuu · Ḡiinuu Giant Red Sea Cucumber Management* Plan (DFO et al. 2026)
3	Co-produce	1 to 7. 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity	The document *Haida Gwaii ’íináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan* (DFO et al. 2025) illustrates the culmination of Phase 3 for a collaboration, in which IKS occupies both knowledge and decision spaces (see Figure 1).
4	Implementation of joint management decision	1 to 6 and 8. 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 8: Joint management decisions	The Pacific Herring IFMP (DFO 2025b) implements management measures stemming from the rebuilding plan for Pacific herring in Haida Gwaii (see example for Phase 2) (DFO et al. 2025)
5	Share lessons	0 to 6. 0: Education and self-reflection; 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6 Relationship continuity	Process for Pairing Knowledges described by Mantyka-Pringle et al. (2025).

Phase 1: Relationship building

Practices involved: 0 to 5. (0: Education and self-reflection; 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts).

Description: This phase is primarily about forming relationships and building trust. It is also when initial discussions examine the potential benefits, risks, and shared goals of a proposed collaboration for pairing knowledges.

To initiate this phase, WKS practitioners and potential Indigenous collaborators initiate contact. If an Indigenous community is part of an aggregate organization (e.g., Central Coast Indigenous Resource Alliance; Unama'ki Institute of Natural Resources), then contact is best initiated through the staff of that organization. Otherwise, contact may be initiated via personnel from the Stewardship or Resource Management offices of the Indigenous community. Whether DFO personnel are expected to initiate the contact may depend on the specificity of their workplans and support from their supervisors. Positive responses are typically followed by in-person meetings that cement the desire to collaborate. Ideally, this phase culminates with collaborators gathering in-person at the Indigenous community, where personal contact and invited participation in cultural practices may solidify relationships, provide non-Indigenous practitioners with an experiential understanding of IKS and the community, establish an ethical space (Ermine 2007), and build the foundation for subsequent phases.

While approaches on how to conduct gatherings at Indigenous communities will vary, Harvey Robinson, a Hereditary Chief of the Kitasoo Xai'xais, offers the following recommendations:

1. Technical staff from the Indigenous community should brief leadership and knowledge holders ahead of time using documents and presentations co-developed with collaborators.
2. A meal is customary to get to know one another as human beings. Be sure to spread your team out so that there are DFO representatives at every table.
3. A trip on the land or water really helps cement relationships and allows Indigenous knowledge holders to share information and subtleties of their knowledge.

Examples:

1. Almack et al. (2023) describe a collaborative process between the Saugeen Ojibway Nation and the Ontario Ministry of Natural Resources and Forestry (MNRF) which transformed the relationship between the partners from a history of conflict to a collaborative way forward for pairing knowledges. MNRF personnel were invited to Saugeen Ojibway Nation territory, where they engaged in ceremony and other cultural practices and learned first-hand about Saugeen Ojibway Nation concerns to be addressed by pairing knowledges.
2. In the spring of 2023, the Kitasoo Xai'xais First Nation, scientists from DFO's Pacific Region, and partners from Oceana Canada and academia began Phase 1 for an ongoing

collaboration that aims to pair knowledges to improve understanding and management of Pacific herring. During Phase 1, all parties met in person outside Kitasoo Xai'xais territory to discuss the potential collaboration. Following this meeting, a scoping document and a project charter were drafted which, in combination, specified agreement on the background and intent of the work, a general framework and set of principles for how partners would collaborate, and broad concepts and issues to be examined. Phase 1 culminated in the fall of 2023 with an in-person gathering in Klemtu (the home community of the Kitasoo Xai'xais), which solidified relationships through personal contact, shared meals, time in the field with IKS knowledge holders, and first-hand exposure to Kitasoo Xai'xais traditional stories and other cultural aspects. The Klemtu gathering included a workshop with technical staff, fishers, and Hereditary Chiefs that identified Kitasoo Xai'xais priorities for the collaboration. The project was later named *Git qm̓sistá (people of the moon tipped over): learning together to revitalize herring* and is ongoing, with follow-up gatherings in Klemtu during herring season in March 2025 and March 2026.

3. The Salmon Benchmarks Subcommittee for the Central Coast Management Council — which operates in British Columbia under the Fisheries Resources Reconciliation Agreement (FRRA, 2021) and is comprised of DFO and the Heiltsuk, Nuxalk, Wuikinuxv, and Kitasoo Xai'xais First Nations — gathered during October 2025 at the Kunsoot land-based healing centre near Bella Bella, the home community of the Heiltsuk Nation. This gathering took place during an early stage of the subcommittee's work and, as described in the meeting report, served to "(1) Deepen relationships, respect, and trust within the group, through discussion in meetings and informal interactions over shared meals and evenings in the main lodge and around the fire; (2) Listen to and learn from Knowledge Holders who have witnessed significant changes in the watershed over time and hold knowledge of the past as shared with them through oral histories within their families; (3) Visit the Kunsoot fish trap and walk through the watershed (experiential learning), which contributed to embodied understanding of the ecosystem and cultural context for salmon; (4) Learn about available empirical data to support FRRA benchmarks; (5) Explore tensions among value systems in facilitated discussion; (6) Identify ways forward that draw on both Indigenous stewardship values and priorities and western scientific tools."

Phase 2: Co-design

Practices involved: 1 to 7. (1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 7: Data sovereignty).

Description: In this phase all parties work together to co-design the details of the project, including goals, specific objectives, methods, data sharing agreements, and the project's role in joint management decisions. Depending on the goals of the collaboration, this phase may present an opportunity to design management measures that aim to optimize long-term

economic benefits and socio-ecological resilience through a lens that considers both Indigenous and Western knowledge systems (Cisneros-Montemayor et al., 2022; Frid et al., 2023; Sumaila, 2021).

Collaborators are likely to require multiple meetings and process documents to agree on the best approaches for pairing knowledges, including potential roles for Indigenous methodologies (Kovach, 2021) and Western scientific methods (qualitative, quantitative, semi-quantitative, and/or mixed methods). Agreeing on approaches may require an iterative process. Ideally, initial discussions would:

1. identify knowledge gaps and management levers to be addressed;
2. establish a shared understanding of the system for which human relationships are being managed, for example, through conceptual mapping (Trochim, 1989); and
3. identify disagreements about current management approaches and whether they stem from (a) divergent perspectives about the system — such as the appropriateness of the current spatial scale of management for a focal species, which might require additional research, or (b) from divergent values — such as disagreements over "precautionary" levels of harvest, which may require a greater effort toward identifying shared values.

The need for multiple meetings is underscored by the requirement of collaborators representing Indigenous communities to consult with their stewardship offices and leadership to assess or confirm support at major decision points (e.g., use of qualitative methods that might require community involvement). These steps may lengthen timeframes but cannot be overlooked. Joint development of meeting agendas, sharing of the facilitator role, and roundtables that include all voices can support inclusivity in meetings.

Collaborators might also want to discuss the potential contributions of IKS elements (e.g., interviews with knowledge-holders, traditional laws and stories) already gathered and archived by Indigenous Nations. Contributions from archived materials, led and controlled by Indigenous collaborators, may be critically important (e.g., Ban et al., 2019; DFO et al., 2025). They reduce the burden on veterans of previous interviews and provide an archive of the knowledge of those who have passed away.

Indigenous Nations may already have established protocols for the sovereignty of their data and for collaborative agreements, to which WKS practitioners are accountable. In lieu of those protocols, The *First Nations Principles of OCAP®* (First Nations Information Governance Centre, 2025) and related principles outlined by Carroll et al.'s (2020) may guide the development of data sharing-agreements to be signed by all parties.

As elaborated in the Introduction, collaborations that pair knowledges may occupy different points in the continuums of knowledge and decision spaces illustrated in Figure 1 (Ban et al.,

2026). At the extremes of these continuums, either WKS or IKS dominate. At other points along the continuums, both systems contribute to knowledge generation *and* decision-making (potentially equally, but not necessarily). An objective of Phase 2 should be to collaboratively resolve where the parties wish to work along these continuums (Figure 1, Table 1).

Examples:

1. The rebuilding plan *Haida Gwaii ’íináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan* (DFO et al. 2025), co-produced by DFO, the Haida Nation, and Parks Canada, was formally initiated in 2017 through establishment of a technical working group (Box 2). The plan was co-designed to pair Haida knowledge, principles, and language with rigorous scientific methods and — given a pre-existing co-governance agreement (CHN et al., 2018) — was linked to shared decision-making from the outset. IKS already gathered and archived by the Haida Nation in the Haida Marine Traditional Knowledge Study played critical roles in the design and development of the plan (DFO et al., 2025).
2. The *Yáanuu · Ḡiinuu Giant Red Sea Cucumber Management Plan* (DFO et al., 2026), also co-produced by DFO, the Haida Nation, and Parks Canada, originated after the Haida Nation expressed to DFO “concerns regarding a potential future commercial sea cucumber fishery on Haida Gwaii.” Following that communication, in 2015 a working group comprised of personnel from the Haida Nation and the federal government was created to address Haida concerns about sea cucumber management. In 2019, the working group made recommendations for establishing a monitoring program, identifying priority research questions and ecosystem-based management approaches for a potential commercial fishery, and scoping further collaborative work between the Haida Nation and Canada. In 2021, the Council of the Haida Nation, Canada and British Columbia signed the GayḠahlda “Changing Tide” Framework for Reconciliation (FR), and a new working group called the GayḠahlda Ḡiinuu Working Group (GḠWG) was formed. It was comprised of members of the Council of the Haida Nation, DFO and Parks Canada and included many of the same personnel as the previous working group. The GḠWG worked together to cooperatively achieve the “good faith measures” related to sea cucumbers identified in the FR, which included initiating work to cooperatively develop a sea cucumber management plan for Haida Gwaii. The 2019 recommendations, together with updated GḠWG recommendations, guided the co-design of the Management Plan, which shared key elements with the Haida Gwaii herring rebuilding plan (DFO et al., 2025), e.g., the pairing of Haida knowledge, principles, and language with rigorous scientific methods, explicit links to shared decision-making as established through co-governance agreements, and use of IKS already gathered and archived by the Haida Nation (DFO et al., 2026).
3. Project *Git ɑm̓sistá* (also example 2 of Practice 1) — included here with the caveat that it still proceeding towards subsequent phases — required three in-person meetings (some lasting two days) and multiple online meetings held over the course of a year to determine the specific objectives and primary methodologies. Meetings and decisions were documented,

which contributed to transparency and accountability and sustained a shared focus for the collaboration. Among the points of agreement reached during this phase was recognition that DFO collaborators (mostly scientists) lacked authority to enable shared decision-making and that their contributions would be restricted to knowledge co-production (Figure 1: along the middle of the Y-axis and far left of the X-axis) while the Kitasoo Xai'xais Nation and Coastal First Nations-Great Bear Initiative would lead engagement with DFO executive leadership to advocate for the inclusivity of IKS (including knowledge co-produced by the project) in shared decision-making (Figure 1: closer to the figure's centre).

4. The *Rebuilding plan: West Coast of Vancouver Island Chinook Salmon, Oncorhynchus tshawytscha, Suuhaa | SX̱OḰI | sat'sam* (DFO, 2025a) was "collaboratively developed through a Joint Steering Committee made up of DFO and West Coast of Vancouver Island (WCVI) First Nation representatives, with extensive engagement with First Nations, and commercial and recreational harvesters." An article by *Uu-a-thluk* (the fisheries program of the Nuu-chah-nulth Tribal Council) summarizes Phase 2 of this work: "From 2020-2022, Nuu-chah-nulth and Pacheedaht First Nations took part in several activities related to the rebuilding plan, including risk assessment workshops that were co-facilitated by West Coast Aquatic (WCA) and DFO, with technical support from Redd Fish Restoration Society. The workshops were designed in a holistic manner that made space for different ways of knowing, identifying biological bottlenecks and creating strategies for recovery and rebuilding (Charlie, 2025).

Box 2: Chronology of events leading to the rebuilding plan for Pacific herring in Haida Gwaii (DFO et al., 2025).

2012: Increasing concerns from the Haida Nation about the critical state of herring in their territory led to an initial workshop with DFO to discuss the need for a rebuilding plan.

2015: The Haida Nation wins an injunction to block the commercial herring roe fishery from opening that year, which strained relationships. The judge emphasizes the need for cooperation between governments.

2016: The report *Sustaining Canada's Major Fish Stocks* determines that a rebuilding plan is needed for the Haida Gwaii major herring stock.

2017: DFO, via a letter from the Regional Director General of the Pacific Region, formally invites the Haida Nation to form a government-to-government working group to co-develop a rebuilding plan. The Haida Nation accepts.

2018: The Gwaii Haanas *Gina 'Waadluxan KilGulhGa Land-Sea-People Management Plan* (CHN et al. 2018) is signed, committing the Haida Nation and the Government of Canada to collaboratively develop a rebuilding plan for Haida Gwaii herring by 2020. Also committed in this plan is the development of an ecosystem-based management framework to guide all fisheries in Gwaii Haanas by 2020.

2022: Haida Gwaii herring are listed in the Fish Stocks provisions of the Fisheries Act, triggering a 2 to 3 year requirement for developing a rebuilding plan. Funding to do so was allocated in departmental work plans.

2025: Publication of *Haida Gwaii 'íináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan* (DFO et al., 2025)

Phase 3: Co-produce

Practices involved: 1 to 7. (1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 7: Data sovereignty).

Description: This phase is when most elements co-designed during Phase 2 are carried out. For collaborations with a research component, this is when data collection, analyses and communication of methodologies and results take place. For collaborations without a research component, this is when collaborators compile and agree on the existing knowledges (i.e., archived or published materials from IKS and WS) that will support shared decision-making. If the collaboration intends to proceed to Phase 4 (implementation of joint management decisions), then Phase 3 is also likely to include stakeholder engagement processes (e.g., Beaty et al., 2024). If conceptual gaps or other shortcomings are identified during this phase, then it may be necessary to iterate back to Phase 2. Outcomes of the knowledge co-production process containing sensitive information (e.g., commercial fisheries data exempted from DFO's "rule of five" (see Tomasic, 2023); some aspects of IKS are likely to be communicated only internally

(e.g., briefing notes from technical staff from either DFO or an Indigenous community to their respective leaderships). Other outcomes of knowledge co-production are likely to be communicated in publicly available documents (e.g., reports, academic papers, rebuilding plans).

For collaborations with a research component, it is critical that people from Indigenous communities participate in or lead data collection, as many aspects of analyses as possible, and in the interpretation and communication of results, with external collaborators supporting skill development. In doing so, Indigenous collaborators can directly ensure the legitimacy with which the collaboration represents their knowledge and perspectives.

Although the specific process for doing so will vary across communities, engagement with knowledge holders who choose to share their IKS often is done in group gatherings led by the community (e.g., knowledge elicitation and sharing workshops facilitated by staff from the Indigenous community or, if appropriate, an external Indigenous facilitator). These gatherings may prompt recollections and enhance collective knowledge. Live graphic recording by an artist can visually capture and communicate the essence of these discussions in a medium that is relatable to a broad audience (e.g., visual summaries of the discussion from a herring workshop for project *Git qmsistá*).

Examples:

1) The document *Haida Gwaii ’íináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan* (example #4 in Phase 2) (DFO et al., 2025) illustrates the culmination of Phase 3 for a collaboration, in which IKS occupies both knowledge and decision spaces (see Figure 1). Among other elements, the herring rebuilding plan discusses or presents: 1: the pairing of knowledge systems; 2: characteristics of a rebuilt herring system based on ecological, cultural, social, economic, management, and governance objectives; 3: different spatial scales of management; 4: rebuilding targets grounded in Haida knowledge, i.e., an upper stock reference and target reference point derived from a historical baseline consistent with the biomass required to "Rebuild and conserve herring populations and protect their habitat to support related species and key ecosystem features and processes;" 5: management strategy evaluation (a quantitative modeling framework (e.g., Punt et al., 2016)) assessing the potential for different management options to meet rebuilding targets under alternative scenarios; 6: management measures for rebuilding; and 7: specificity on how “The governance partners will work together to implement the Haida Gwaii ’íináang | iinang Herring Rebuilding Plan using a collaborative governance and management approach.”
2) The document *Yáanuu · Giinuu Giant Red Sea Cucumber Management Plan* (example 2 in Phase 2) (DFO et al., 2026) illustrates the culmination of Phase 3 for another collaboration, in which IKS occupies both knowledge and decision spaces. Among other elements, the management plan discusses or presents: 1: “guiding principles and knowledge systems that

underpin the management approach, including Haida ethics and values, policy drivers and context, and traditional and scientific knowledge;" 2: ecological, cultural, social, economic, governance, and management objectives; 3: "current understanding of the Yáanuu · G̱iinuu ecosystem, detailing ecological, cultural, social, and economic aspects, and management considerations;" 4: "monitoring and management strategies, including population assessment, management measures, population and ecosystem monitoring, fishery monitoring, and enforcement;" and 5: "identifies research and data gaps and proposes collaborative governance, management, and stewardship strategies."

3) The document *Rebuilding plan: West Coast of Vancouver Island Chinook Salmon, Oncorhynchus tshawytscha, Suuhaa | SƮOḰI | sat'sam* (example 3 in Phase 2) (DFO, 2025a) illustrates the culmination of Phase 3 for a collaboration in which IKS is acknowledged and described but has a more limited role in determining rebuilding targets and management decisions. The document specifies that rebuilding targets are "Based on advice from DFO Science and WCVI First Nations‡," yet also notes that "Current frameworks lack specific descriptions for integrating IK and Western science in decision−making, especially in co−developing species rebuilding targets and reference points across broad spatial scales involving many populations and First Nations." The rebuilding plan also acknowledges that questions such as "What is a healthy Chinook ecosystem according to the Tla−o−qui−aht, Ahousaht, and Mowachaht/Muchalaht First Nation knowledge holders?" and "how Nuu−chah−nulth Knowledge can be effectively paired with Western science to inform the WCVI Chinook Rebuilding Plan" are not explicitly addressed by the current rebuilding plan. However, the document also states that "The rebuilding plan will be reviewed 1 year after completion to incorporate key knowledge on objectives and management measures from two research programs finishing in March 2026 […including] a Masters thesis project currently being completed on Nuu−chah−nulth Rebuilding Objectives."

4) From 2015 to 2024, seventeen First Nations, the Government of Canada (represented primarily by DFO), and the Province of British Columbia paired IKS and Western science (e.g., Reid et al. 2022) to collaboratively design a marine protected area (MPA) Network for the Northern Shelf Bioregion (Beaty et al., 2024). As detailed by Beaty *et al.* (2024), "All

‡ Nuu-chah-nulth contributions to the rebuilding plan for WCVI chinook (DFO, 2025a) were informed by a separate document, co-produced by *Uu-a-thluk*, and the Salmon Watersheds Lab at Simon Fraser University, examining risks to salmon in Nuu-chah-nulth territories (Sainsbury et al., 2024). Elements of Phase 2 for this work include the following (Sainsbury et al., 2024): "During the Spring of 2021, Eric Angel (Uu-a-thluk, Nuu-chah-nulth Tribal Council) and Nigel Sainsbury (Salmon Watersheds Lab, Simon Fraser University) found common ground in seeking to better understand the causes of declining salmon populations in the Nuu-chah-nulth *ha-ha-houlthee* [territories]. This need was emphasized by unique river and stream salmon population declines being apparently ignored by the Federal government. Several principles for the research were agreed from the outset: that Nuu-chah-nulth voices, values, and worldview would be given centre stage; that the research would strive for the highest ethical standards, including in terms of research protocols, Indigenous Data Sovereignty, and being non-extractive; that all research participants contributing their knowledge through interviews and focus groups would be offered the opportunity to co-author the outputs; and that the research would only commence with the permission of the Council of *Ha'wiih* [Hereditary Chiefs]."

phases of the planning process, including governance, development, engagement, design, and analysis, were guided by the following principles: collaborative governance, multiple ways of knowing, participatory engagement, and adaptation to new information." The phase culminated with a Network Action Plan that specifies how the MPA network is being implemented (Beaty et al., 2024).

Phase 4: Implementation of joint management decisions

Caveat: We reiterate that co-governance agreements can specify shared authority between Canada and Indigenous Nations in the form of consensus recommendations. However, the authority granted to the Minister of Fisheries — who may legally override consensus recommendations stemming from co-governance processes — remains a potential impediment to the implementation of joint management decisions under the *Fisheries Act* (Swerdfager et al., 2025).

Practices involved: 1 to 6 and 8. (1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity; 8: Joint management decisions).

Description: This phase involves the implementation of joint management decisions. Therefore, it applies only to collaborations that are inclusive of IKS in both knowledge *and* decision spaces (towards the centre of Figure 1). In the context of DFO, this phase requires inclusion of the co-produced management measures into Integrated Fisheries Management Plans (IFMPs). Phase 4, therefore is likely to be under the purview of DFO fisheries managers and executive leadership, and Indigenous leadership supported by their technical staff. If implementation barriers are encountered during this phase, then it may be necessary to iterate back to Phases 2 and/or 3.

Examples:

1. The most recent Pacific Herring IFMP (DFO, 2025b) implements management measures stemming from the rebuilding plan for Pacific herring in Haida Gwaii, which was created under a co-governance agreement (see examples in Phases 2 to 3) (DFO et al., 2025), e.g., "The Haida Gwaii major stock assessment area will be closed to commercial fishing in 2025."
2. The *Yáanuu · G̲iinuu Giant Red Sea Cucumber Management Plan* (see examples in Phases 2 to 3) (DFO et al., 2026) is very recent and therefore not yet integrated into an IFMP at the time of writing. The Management Plan, however, achieved one of the "good faith measures" in the GayGahlda "Changing Tide" Framework for Reconciliation. All decisions related to the development of the plan and ultimately the fishery will be routed through collaborative governance bodies for consensus recommendations (the Haida Gwaii Aquatic Management Council and the Archipelago Management Board for Gwaii Haanas). As stated in its preface, the plan "is a significant step towards the sustainable management of sea cucumber populations in Haida Gwaii. It embodies a commitment to cooperation, partnership, and

reconciliation. The plan is a testament to the power of collaboration and the shared vision for the future of Haida Gwaii's marine resources, including the sustainable development of a commercial Giant Red Sea Cucumber fishery on Haida Gwaii."

3. The most recent IFMP for Pacific salmon for southern British Columbia (DFO, 2025c) acknowledges the rebuilding plan for WCVI chinook (see examples in Phases 2 to 3) (DFO, 2025a) and states that its "targets and management measures will be implemented through collaborative efforts undertaken by the Department, First Nations and British Columbia." An article by *Uu-a-thluk* also highlights that a steering committee comprised of representatives from Uu-a-thluk, Ha'oom Fisheries Society, Pacheedaht First Nation, Maa-nulth Treaty Nations and DFO will support the implementation of the plan (Charlie, 2025). However, the plan was developed in the absence of co-governance agreements and does not reflect consensus recommendations by First Nations and DFO.
4. Co-governance agreements for the MPA network for the Northern Shelf Bioregion (see example for Phase 3) were signed by all partners in June of 2024 and network implementation is ongoing (Beaty et al., 2024). As Beaty et al. (2024) state, "These legally binding governance agreements together with the conservation plan are a groundbreaking contribution toward reconciliation across Indigenous and Crown governments in Canada as they establish collaborative decision-making structures that recognize each First Nations' inherent right to self-government and self-determination."
5. The Central Coast Collaborative Crab Management Process (DFO, 2025d) shifted over time across different points along the continuums of knowledge and decision spaces (Figure 1) before culminating in a co-governance agreement and consensus recommendations for shared decision-making. In the early 2000s, four First Nations of British Columbia's Central Coast became concerned about their declining access to Dungeness crab and asked DFO to close commercial and recreational fisheries at specific locations, but DFO continued to apply only WKS in both knowledge and decision spaces (bottom left corner of Figure 1). In the early to mid 2010s, the First Nations continued to experience declining access to crab and engaged their own processes for pairing knowledges to generate evidence supporting their requests to DFO for fisheries closures (Ban et al., 2017; Frid et al., 2016), yet WKS continued to drive the decision space. It was not until 2017 that DFO agreed to pairing knowledges and shared decision-making, co-establishing a collaborative process in which the knowledge and decision spaces are near the centre of Figure 1. The Pacific region crab IFMP describes the collaborative process and states that "Based on the joint recommendation and associated data/documentation, DFO implemented 11 new commercial closures and 15 year-round recreational closures on April 1, 2021, and two seasonal recreational crab closures on June 1, 2021" (DFO, 2025d).

Phase 5: Share lessons that would benefit future collaborations

Practices involved: 0 to 6. (0: Education and self-reflection; 1: IKS inclusivity; 2: Relationship building; 3: Support government personnel; 4: Support Indigenous collaborators; 5: Honour place-based contexts; 6: Relationship continuity).

Description: Pairing knowledge systems is difficult because it requires moving beyond the institutionally and historically entrenched dominance of WKS. It requires pluralistic conversations in culturally sensitive contexts that strive towards equity for Indigenous Peoples and inclusivity of IKS. Many processes that engage pairing knowledges, therefore, are likely to encounter challenges, missteps, and discomfort, and these issues apply beyond Canada (Strand et al., 2024). Ideally, collaborations in other countries or regions would benefit from lessons learned by others pursuing similar tasks. If agreed by all parties, public communications with wide reach (including but not limited to academic papers) would contribute to a global community of practice.

Examples: The global literature that synthesizes lessons learned from specific processes for pairing knowledges is rapidly expanding. Entry points into it include Alexander *et al*. (2021, 2019), Kourantidou et al. (2020), Reid et al. (2021), Campion et al. (2024); Strand et al. (2024), and Mantyka-Pringle et al. (2025).

Section 6: Limitations

There are two salient limitations to this guide. The first is that its content largely reflects the experience of most of the author team, which centres on the Pacific Region of Canada. While we believe that the guide already informs a national context, we intend to conduct future revisions to strengthen its applicability to other regions.

The second limitation pertains to our examples for Phases 3 and 4, which are meant to inform processes for pairing knowledges that situate IKS in both knowledge and decision spaces. Although these examples summarize specific processes that have succeeded and highlight the roles of co-governance agreements, they do not provide explicit guidance addressing two separate but interlinked issues:

1. how to address procedural challenges and/or potential conflicts between knowledge systems; and
2. how to develop and apply general principles for co-governance and joint decision-making.

Again, over time we intend to revise the guide to better address these issues. In the interim, we offer the following comments.

Regarding the first issue, work by the Species at Risk Committee (SARC) of the Northwest Territories illustrates one potential approach to addressing procedural challenges and potential

conflicts. As detailed by Singer et al. (2023), the SARC developed two sets of complementary assessment criteria with independent components reflecting Indigenous knowledge and scientific knowledge, and a process that "permits a more equitable consideration of all sources of best available knowledge and more effectively reflects biocultural linkages." Singer et al. (2023), however, caution that the approach "represents a modification of a structure derived from western science and therefore, may not yet fully accomplish the balanced and respectful inclusion of both knowledge systems." While the broader literature on decision support frameworks is potentially helpful (e.g., Schwartz et al., 2018), similar caveats apply to it. For these reasons, Indigenous approaches to resolving procedural challenges and potential conflicts might offer the most fruitful way forward (e.g., Almack et al., 2023; Campion et al., 2024).

Regarding the second issue, the development and application of general principles for co-governance and joint decision-making is challenged by the lack of transparent and publicly available documentation for how these processes have unfolded. Processes for including IKS in decisions may follow a complex path and can sometimes take a long time. However, a recent study by Wilson et al. (2026) — based on interviews with Crown (primarily DFO) and Indigenous participants in eight co-governance case studies from Pacific Canada — has identified specific recommendations for fostering consensus in co-governance and shared decision making (Box 3). Their recommendations are pragmatic; they reflect the experience of Indigenous and DFO personnel who directly engage in challenges inherent to the decision space and complement the guidance we provide in this Practitioner's Guide.

Box 3

Recommendations made by Wilson et al. (2026) *for fostering consensus in collaborative fisheries management involving Indigenous Peoples and DFO or other crown personnel.* (Table reproduced with permission from Wilson et al. (2026)). These recommendations derive from interviews with "key informants from both the [First] Nation and Crown sides" of eight co-governance case studies from Pacific Canada. Although the work was conducted to inform the implementation of the Fisheries Resources Reconciliation Agreement (FRRA, 2021), its recommendations likely apply in a broad range of co-governance contexts. For quotes in the second part of the table, "FN" and "GOV" identify, respectively, First Nations and Crown Government interviewees.

General guidance	
What does not work?	**What does?**
Strategic disputes, individual and relationship burnout	Structures enabling frequent, effective collaboration and understanding
Technical collaboration without strategic collaboration (or, vice versa)	Prioritization and joint visions, definitions, and communications
Reduced and/or risk averse staff, unclear direction	Strong leadership, training and support, and established processes for escalation

Unilateral and limited stakeholder engagement	Meaningful engagement by all governance partners
Hard limits on capacity, legislative and jurisdictional flexibility	Open and frequent communication and collaboration for strong relationships
Examples of specific recommendations made by interviewees	
Develop a mutual understanding of what collaborative governance means. This includes how it is supposed to work, specific goals and objectives of the agreement; agree on the problem that the agreement is addressing; what consensus means. Check in regularly to ensure mutual understanding of what you are working towards; identify points of connection and disagreement.	
Develop a process diagram of how / where decisions are made, what criteria are used to guide/make decisions, how things move up the chain and/or back down; include what the end-goal is (i.e., decision-making or recommendations).	
Develop a guidance document that includes making legislative and regulatory requirements clear; identify relevant policies.	
Hold regular, in-person meetings, even when there are not issues arising or active fisheries happening.	
Develop regular briefing-up through collaborative (i.e., co-written, agreed to by both parties) briefing notes/memos with common messaging; build support from senior levels.	
Put people in place who work for all parties; "you've got to have somebody who can work and build relationships with both sides" (FN 5); these are neutral people, who get done what needs to get done, and have a structure to report to; this can be set up as a secretariat that has trusted membership from the parties to keep things on track; builds up the infrastructure to make it functional.	
Develop a thorough on-boarding process for new staff, including context, history, rationale, meaning of collaborative governance, expectations, when/how to escalate issues, cultural safety, Indigenous Knowledge Systems, etc.	
Given that there will never be enough capacity, *be strategic about what to focus on.* It helps to have a small core group of people (2 to 3) who have a good handle on the political and legal landscape; find ways to be more efficient/less bureaucratic reporting.	
Document successes; "The more we can point to success, the more we can replicate" (GOV 9).	
For DFO: "You can't just say no" (GOV 2): Develop a process for going beyond saying "no". Be transparent about what the key issues are so creative ways of moving forward can be found. Show up in good faith.	
For DFO: "The more we can support culture change within the federal bureaucracy, the better" (GOV 9); develop foundational tools to educate DFO people at all levels about the commitments in the agreement. Support culture-change within the federal bureaucracy; this could include learning exchanges, lunch and learn with First Nations.	

Section 7: Concluding Remarks

The concepts and practices that we present here are intended to support proactive and positive collaborations in which the complementarity of IKS and WKS determine management advice *and* lead to shared decision-making. The examples we provide for Phases 3 and 4 demonstrate the plausibility of this approach.

Two of these examples, however, also illustrate past challenges that serve as learning opportunities. First, the Central Coast Collaborative Crab Management Process, though ultimately resulting in a positive outcome, was a response to potential conflict and lacked Phases 2 and 3. Going forward, this example illustrates the type of situation that proactive collaboration can pre-empt. Second, the rebuilding plan for WCVI chinook illustrates a case in which the role of WKS is much stronger than that of IKS in both knowledge and decision spaces, which points to the importance of co-governance agreements that support a stronger role for IKS. Lessons learned from these can inform a better way forward.

In closing, we highlight that collaborations between Indigenous Peoples and DFO have progressed substantially in recent years. This is a good sign. It is our hope that this guide will support further progress in that direction.

Acknowledgements

We thank Trevor Swerdfager and Kyle L. Wilson for helpful reviews of earlier drafts, and Jennifer Whyte for editorial support.

Section 8: References

Adams, M.S., Connors, B., Levi, T., Shaw, D., Walkus, J., Rogers, S., Darimont, C. (2021). Local Values and Data Empower Culturally Guided Ecosystem-Based Fisheries Management of the Wuikinuxv Bear–Salmon–Human System. *Marine and Coastal Fisheries*, 13, 362–378. https://doi.org/10.1002/mcf2.10171

Alexander, S.M., Provencher, J.F., Henri, D.A., Nanayakkara, L., Taylor, J.J., Berberi, A., Lloren, J.I., Johnson, J.T., Ballard, M., Cooke, S.J. (2021). Bridging Indigenous and Western sciences in freshwater research, monitoring, and management in Canada. *Ecological Solutions and Evidence* 2, e12085. https://doi.org/10.1002/2688-8319.12085

Alexander, S.M., Provencher, J.F., Henri, D.A., Taylor, J.J., Lloren, J.I., Nanayakkara, L., Johnson, J.T., Cooke, S.J. (2019). Bridging Indigenous and science-based knowledge in coastal and marine research, monitoring, and management in Canada. *Environmental Evidence*, 8 (36). https://doi.org/10.1186/s13750-019-0181-3

Almack, K., Dunlop, E.S., Lauzon, R., Nadjiwon, S., Duncan, A.T. (2023). Building trust through the Two-Eyed Seeing approach to joint fisheries research. *Journal of Great Lakes Research*. https://doi.org/10.1016/j.jglr.2022.11.005

Anonymous (2023). Collaborative fisheries management agreement between Abegweit First Nation and the Government of Canada [WWW Document]. URL https://www.dfo-mpo.gc.ca/about-notre-sujet/publications/fisheries-peches/agreement-accord/abegweit-eng.html (accessed 11.23.25).

Anonymous (2021). Rights Reconciliation Agreement on Fisheries between the Listuguj Mi'gmaq Government and the Government of Canada [WWW Document]. URL https://www.dfo-mpo.gc.ca/about-notre-sujet/publications/fisheries-peches/agreement-accord/listuguj-migmaq-listuguj-eng.html (accessed 11.23.25).

Ball, J., Janyst, P. (2008). Enacting Research Ethics in Partnerships with Indigenous Communities in Canada: "Do it in a Good Way." *Journal of Empirical Research on Human Research Ethics* 3, 33–51. https://doi.org/10.1525/jer.2008.3.2.33

Ban, N.C., Eckert, L., McGreer, M., Frid, A. (2017). Indigenous knowledge as data for modern fishery management: a case study of Dungeness crab in Pacific Canada. *Ecosystem Health and Sustainability* 3, 1379887. https://doi.org/10.1080/20964129.2017.1379887

Ban, N.C., Watkins, H., Forrest, R.E., Frid, A., Holt, C.A., Hall, S., Service, C.N., Ramirez, L., Curtis, D., Wilson, K., Ignace, L., Reid, A., Moffat, K., Neasloss, M., Burton, N. (2026). Weaving Indigenous and Western knowledge systems across a continuum of knowledge and decision-making spaces. *Current Opinion in Environmental Sustainability.* In press.

Ban, N.C., Wilson, E., Neasloss, D. (2019). Strong historical and ongoing indigenous marine governance in the northeast Pacific Ocean: a case study of the Kitasoo/Xai'xais First Nation. *Ecology and Society* 24(10). https://doi.org/10.5751/ES-11091-240410

Bartlett, C., Marshall, M., Marshall, A. (2012). Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences,* 2, 331–340. https://doi.org/10.1007/s13412-012-0086-8

Beaty, F., Brown, K.H.T., Braun, J., Diggon, S., Hartley, E., Heidt, A., Maddin, H., Maloney, A., Martone, R., McDougall, C., Reid, M., Robb, C., Rubidge, E., Short, C., Worsley, K. (2024).

From design to implementation: Lessons from planning the first marine protected area network in Canada. *Marine Policy,* 170, 106360. https://doi.org/10.1016/j.marpol.2024.106360

Campion, O.B., West, S., Degnian, K., Djarrbal, M., Ignjic, E., Ramandjarri, C., Malibirr, G.W., Guwankil, M., Djigirr, P., Biridjala, F., O'Ryan, S., Austin, B.J. (2024). Balpara: A Practical Approach to Working With Ontological Difference in Indigenous Land & Sea Management. *Society & Natural Resources,* 37, 695–715. https://doi.org/10.1080/08941920.2023.2199690

Carroll, S.R., Garba, I., Figueroa-Rodríguez, O.L., Holbrook, J., Lovett, R., Materechera, S., Parsons, M., Raseroka, K., Rodriguez-Lonebear, D., Rowe, R., Sara, R., Walker, J.D., Anderson, J., Hudson, M. (2020). The CARE Principles for Indigenous Data Governance. *Data Science Journal*. https://doi.org/10.5334/dsj-2020-043

Charlie, M. (2025). WCVI Chinook Rebuilding Plan enters implementation phase [WWW Document]. URL https://uuathluk.ca/wcvi-chinook-rebuilding-plan-enters-implementation-phase/ (accessed 11.27.25).

CHN, PCA, DFO (2018). Gwaii Haanas Gina 'Waadluxan KilGuhlGa Land-Sea-People Management Plan [WWW Document]. URL https://parks.canada.ca/pn-np/bc/gwaiihaanas/info/consultations/gestion-management-2018 (accessed 11.23.25).

Cisneros-Montemayor, A.M., Croft, F., Issifu, I., Swartz, W., Voyer, M. (2022). A primer on the "blue economy:" Promise, pitfalls, and pathways. *One Earth* 5, 982–986. https://doi.org/10.1016/j.oneear.2022.08.011

Cooke, S.J., Nguyen, V.M., Chapman, J.M., Reid, A.J., Landsman, S.J., Young, N., Hinch, S.G., Schott, S., Mandrak, N.E., Semeniuk, C.A.D. (2021). Knowledge co-production: A pathway to effective fisheries management, conservation, and governance. *Fisheries,* 46, 89–97. https://doi.org/10.1002/fsh.10512

Denny, S.K., Fanning, L.M. (2016). A Mi'kmaw perspective on advancing salmon governance in Nova Scotia, Canada: Setting the stage for collaborative co-existence. *The International Indigenous Policy,* Journal 7.

DFO (2025a). Rebuilding plan: West Coast of Vancouver Island Chinook Salmon, Oncorhynchus tshawytscha, Suuhaa | SṮOḰI | sat'sam [WWW Document]. URL https://publications.gc.ca/collections/collection_2025/mpo-dfo/Fs144-87-2025-eng.pdf (accessed 2.3.26).

DFO (2025b). November 7, 2024 – November 6, 2025, Pacific Herring. Pacific Region Integrated Fisheries Management Plan [WWW Document].

DFO (2025c). Integrated Fisheries Management Plan for Salmon of Southern British Columbia: July 1, 2025 – June 30, 2026 [WWW Document]. URL (accessed 11.28.25).

DFO (2025d). Pacific Region Integrated Fisheries Management Plan, Crab By Trap, April 1, 2025 – March 31, 2026. https://www.publications.gc.ca/collections/collection_2025/mpo-dfo/Fs143-3-23-2445-eng.pdf

DFO, CHN, PC (2026). Yáanuu · G̲iinuu Giant Red Sea Cucumber Management Plan [WWW Document]. URL https://chnmarineplanning.ca/news/draft-haida-gwaii-yaanuu-giinuu-giant-red-sea-cucumber-management-plan (accessed 11.25.25).

DFO, CHN, PC (2025). Haida Gwaii 'íináang | iinang Pacific Herring: An Ecosystem Overview and Ecosystem-based Rebuilding Plan [WWW Document]. URL

https://publications.gc.ca/collections/collection_2025/mpo-dfo/Fs144-80-2025-eng.pdf (accessed 2.3.26).

Diggon, S., Bones, J., Short, C.J., Smith, J.L., Dickinson, M., Wozniak, K., Topelko, K., Pawluk, K.A. (2020). The Marine Plan Partnership for the North Pacific Coast – MaPP: A collaborative and co-led marine planning process in British Columbia. *Marine Policy,* 142, 104065. https://doi.org/10.1016/j.marpol.2020.104065

Ermine, W. (2007). The ethical space of engagement. Indigenous LJ 6, 193.

First Nations Information Governance Centre, 2025. The First Nations Principles of OCAP® [WWW Document]. URL https://fnigc.ca/ocap-training/ (accessed 9.19.25).

Frid, A., McGreer, M., Stevenson, A. (2016). Rapid recovery of Dungeness crab within spatial fishery closures declared under indigenous law in British Columbia. *Global Ecology and Conservation,* 6, 48–57. https://doi.org/10.1016/j.gecco.2016.01.002

Frid, A., Wilson, K.L., Walkus, J., Forrest, R.E., Reid, M. (2023). Re-imagining the precautionary approach to make collaborative fisheries management inclusive of Indigenous Knowledge Systems. *Fish and Fisheries,* 24, 940–958. https://doi.org/10.1111/faf.12778

FRRA (2021). Fisheries Resources Reconciliation Agreement [WWW Document]. URL https://www.pac.dfo-mpo.gc.ca/reconciliation/docs/frra-arrh-eng.html (accessed 2.21.26).

Gonet, J. (2024). Worldview violence and Non-Human People in (conservation) science. *Ecology and Society,* 29. https://doi.org/10.5751/ES-15501-290411

Greening (La'goot), S. (2024). Gugwilx'ya'ansk and goats: Indigenous perspectives on governance, stewardship and relationality in mountain goat (mati) hunting in Gitga'at territory. People and Nature n/a. https://doi.org/10.1002/pan3.10688

Ignace, L., Burton, L., Mynott, S., Meehan, M., Olson, E., Steel, J., Ojeda, J., Harper, S., Ramirez, L., Baker, D., Sleigh, L., Frenkel, C., Rhodes, C., Ban, N.C. (2023). Researchers' responsibility to uphold Indigenous rights. *Science,* 381, 129–131. https://doi.org/10.1126/science.adh4470

Jessen, T.D., Ban, N.C., Claxton, N.X., Darimont, C.T. (2022). Contributions of Indigenous Knowledge to ecological and evolutionary understanding. *Frontiers in Ecology and the Environment,* 20, 93–101.

Jones, R., Rigg, C., Lee, L.(2010). Haida marine planning: First nations as a partner in marine conservation. *Ecology and Society,* 15. https://doi.org/10.5751/ES-03225-150112

Kerinaiua (Mantiyupwi Mavis, J., Brekelmans, A., Spencer, M., Ayre, M., Jones, M., Young, A.R., Kerinaiua (Mantiyupwi Fiona, J., Kurrupuwu (Jikilaruwu Ancilla, W., Kantilla (Malawu Callista, M., Alimankinni (Mantiyupwi Jacinta, J., Orsto (Mantiyupwi Francis, L., Puruntatameri (Malawu Francilla, T., Puantulura (Jikilaruwu James Darren, W., Nicholson, E. (2025). Composing, decomposing, and recomposing engagement in Indigenous-led research for land and sea management, Tiwi Islands, Australia. *AlterNative: An International Journal of Indigenous Peoples,* 21, 274–284. https://doi.org/10.1177/11771801251334917

Kimmerer, R. (2011). Restoration and reciprocity: the contributions of traditional ecological knowledge, in: Human Dimensions of Ecological Restoration: Integrating Science, Nature, and Culture. Springer, pp. 257–276.

Kimmerer, R.W.(2002). Weaving Traditional Ecological Knowledge into Biological Education: A Call to Action. *BioScience* 52, 432–438.

Kourantidou, M., Hoover, C., Bailey, M. (2020). Conceptualizing indicators as boundary objects in integrating Inuit knowledge and western science for marine resource management. *Arctic Science,* 6, 279–306. https://doi.org/10.1139/as-2019-0013

Kovach, M. (2021). Indigenous methodologies: Characteristics, conversations, and contexts. University of Toronto press.

Mantyka-Pringle, C., Beaumont, J., Clarke, C., Ayoub, N., Kortsalo, P., Saal, S., Fraser, K., Staples, K., Hwëch'in, T. (2025). Walking in two worlds: insights from implementing a Tr'ondëk Hwëch'in approach to bridging knowledge systems in conservation and land use planning. *Ecology and Society,* 30. https://doi.org/10.5751/ES-15753-300222

Mantyka-Pringle, C.S., Jardine, T.D., Bradford, L., Bharadwaj, L., Kythreotis, A.P., Fresque-Baxter, J., Kelly, E., Somers, G., Doig, L.E., Jones, P.D., Lindenschmidt, K.-E. (2017). Bridging science and traditional knowledge to assess cumulative impacts of stressors on ecosystem health. *Environment International,* 102, 125–137. https://doi.org/10.1016/j.envint.2017.02.008

McGregor, D. (2021). Indigenous Knowledge Systems in Environmental Governance in Canada. KULA 5, 1–10. https://doi.org/10.18357/kula.148

McMillan, L.J., Prosper, K. (2016). Remobilizing netukulimk: indigenous cultural and spiritual connections with resource stewardship and fisheries management in Atlantic Canada. Reviews in Fish Biology and Fisheries 26, 629–647. https://doi.org/10.1007/s11160-016-9433-2

Milner IV, H.R. (2007). Race, Culture, and Researcher Positionality: Working Through Dangers Seen, Unseen, and Unforeseen. *Educational Researcher,* 36, 388–400. https://doi.org/10.3102/0013189X07309471

Minister of Justice (2019). Fisheries Act. Canada.

Moffat, K., Snook, J., Paul, K., Frid, A. (2025). Inclusivity of Indigenous Knowledge Systems in Fisheries Management. *Fish and Fisheries*, 26, 669–687.

Newell, D. (1993). Tangled Webs of History, Indians and the Law in Canada's Pacific Coast Fisheries. University of Toronto Press. https://doi.org/10.3138/9781442680357

Nikolakis, W., Hotte, N. (2022). Implementing "ethical space": An exploratory study of Indigenous-conservation partnerships. *Conservation Science and Practice* 4, e580. https://doi.org/10.1111/csp2.580

Punt, A.E., Butterworth, D.S., de Moor, C.L., De Oliveira, J.A.A., Haddon, M. (2016). Management strategy evaluation: best practices. *Fish and Fisheries,* 17, 303–334. https://doi.org/10.1111/faf.12104

Reed, G., Brunet, N.D., McGregor, D., Scurr, C., Sadik, T., Lavigne, J., Longboat, S. (2024a). There is no word for 'nature' in our language: rethinking nature-based solutions from the perspective of Indigenous Peoples located in Canada. *Climatic Change,* 177, 32. https://doi.org/10.1007/s10584-024-03682-w

Reed, G., Fox, S., D., L., D., M., Lewis, D., Popp, J., Wray, K., Kassi, N., Ruben, R., Morales, S., Lonsdale, S. (2024b). For Our Future: Indigenous Resilience Report. Ottawa, Ontario. https://doi.org/10.4095/g273616

Reid, A.J., Eckert, L.E., Lane, J.-F., Young, N., Hinch, S.G., Darimont, C.T., Cooke, S.J., Ban, N.C., Marshall, A. (2021). “Two-Eyed Seeing”: An Indigenous framework to transform fisheries research and management. *Fish and Fisheries* 22, 243–261. https://doi.org/10.1111/faf.12516

Reid, A.J., McGregor, D.A., Menzies, A.K., Eckert, L.E., Febria, C.M., Popp, J.N. (2024). Ecological research ‘in a good way’ means ethical and equitable relationships with Indigenous Peoples and Lands. *Nature Ecology & Evolution*, 8, 595–598. https://doi.org/10.1038/s41559-023-02309-0

Sainsbury, N.C., Angel, E., Moore, J.W., Blackstone, K., Christiansen, S., Cox, C., Gillette, F., Johnson, L., Little, A., Ross, D.Sr., Tatoosh, T., Watts, T., Hutchinson, J. (2024). Risks to Salmon in the ha−ha− houlthee of the Nuu−chah−nulth Ha’wiih and connected harm to other life [WWW Document]. URL https://www.watershedfuturesinitiative.com/_files/ugd/54efec_2c3975e087fe49ee98f40cef4f9dedc0.pdf (accessed 2.3.26).

Schwartz, M.W., Cook, C.N., Pressey, R.L., Pullin, A.S., Runge, M.C., Salafsky, N., Sutherland, W.J., Williamson, M.A. (2018). Decision Support Frameworks and Tools for Conservation. Conservation Letters 11, e12385. https://doi.org/10.1111/conl.12385

Silver, J.J., Okamoto, D.K., Armitage, D., Alexander, S.M., Atleo (Kam’ayaam/Chachim’multhnii), C., Burt, J.M., Jones (Nang Jingwas), R., Lee, L.C., Muhl, E.-K., Salomon, A.K., Stoll, J.S.,(2022). Fish, People, and Systems of Power: Understanding and Disrupting Feedback between Colonialism and Fisheries Science. *The American Naturalist,* 200, 168–180. https://doi.org/10.1086/720152

Singer, C.L., Routh, M.R., Grabke, M.J., Andrew, L., Carrière, S., Guile, A., Andre, A., Thompson, A., Simmons, D., Cooper, K., Yonge, L., Rabesca, M., Larter, N.C., Jacobsen, P., Nathoo, R., Winbourne, J., Bathe, A. (2023). Equal use of Indigenous and scientific knowledge in species assessments: A case study from the Northwest Territories, Canada. Biological Conservation 281, 109995. https://doi.org/10.1016/j.biocon.2023.109995

Snook, J., Cunsolo, A., Ford, J., Furgal, C., Jones-Bitton, A., Harper, S.L. (2022). The connection between wildlife co-management and indigenous well-being: What does the academic literature reveal? *Wellbeing, Space and Society,* 3, 100116. https://doi.org/10.1016/j.wss.2022.100116

Strand, M., Retter, G.-B., Khan, M., Frid, A., Hudson, M., Leonard, K., Paul, K., Baron-Aguilar, C., Boswell, R., Cisneros-Montemayor, A., Copenhaver, A.E., Costa, Y., Hiwasaki, L., Jones, R., Kelly, B.P., Kosgei, J., Metcalf, V., Moshani, A., Yaa Oduro, G., Scott, Rakotondrazafy, V., (2024). Co-Producing Sustainable Ocean Plans With Indigenous And Traditional Knowledge Holders. Washington, DC: World Resources Institute. https://doi.org/10.69902/8f1075e8

Sumaila, U.R. (2021). Infinity fish: Economics and the future of fish and fisheries. Academic Press.

Swerdfager, T., Rangeley, R., Frid, A. (2025). A Policy Agenda For Pairing Indigenous Knowledge Systems And Western-Based Science To Strengthen Oceans And Fisheries Management In Canada. FACETS 10, 1–13. https://doi.org/10.1139/facets-2025-0184

Tengö, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M., Danielsen, F., Elmqvist, T., Folke, C.(2017). Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for

sustainability. *Current Opinion in Environmental Sustainability*, 26–27, 17–25. https://doi.org/10.1016/j.cosust.2016.12.005

Tomasic, N.(2023). Balancing privacy with access to information for commercial fisheries data: A critical review of Fisheries and Oceans Canada's "rule of five" policy. FACETS 8, 1–11. https://doi.org/10.1139/facets-2022-0153

Trochim, W.M.K. (1989). An introduction to concept mapping for planning and evaluation. Evaluation and Program Planning 12, 1–16. https://doi.org/10.1016/0149-7189(89)90016-5

Whyte, K.P. (2013). On the role of traditional ecological knowledge as a collaborative concept: a philosophical study. *Ecological Processes,* 2, 7. https://doi.org/10.1186/2192-1709-2-7

Wilson, O., Hoover, C., Kristensen, F., Patirana, A., Ban, Natalie C. (2026). Fostering Consensus in Collaborative Fisheries Management: Case studies to inform implementation of the Fisheries Resources Reconciliation Agreement (FRRA). https://osf.io/preprints/socarxiv/4wmjf_v1

Wong, C., Ballegooyen, K., Ignace, L., Johnson, M.J. (Gùdia), Swanson, H. (2020). Towards reconciliation: 10 Calls to Action to natural scientists working in Canada. FACETS 5, 769–783. https://doi.org/10.1139/facets-2020-0005

Wong, C., Ignace, L., Johnson, G. (Mary J., Hicks, K., Swanson, H. (2025). Reflecting on the "10 Calls to Action to Natural Scientists" 5 years later: how do we keep moving forward on reconciliation? FACETS 10, 1–17. https://doi.org/10.1139/facets-2025-0178