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Centering Indigenous Knowledges in ecology and beyond

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There is a resurgent enthusiasm for Indigenous Knowledges (IK) across settler–colonial institutions of research, education, and conservation. But like fitting a square peg in a round hole, IK are being forced into colonial systems, and then only as marginal alternatives. To address this mismatch, the Traditional Ecological Knowledge Section of the Ecological Society of America (ESA) hosted a 2-day workshop—entitled *Elevating Indigenous Knowledges in Ecology*—at the 2022 ESA Annual Meeting, which was held on Kanien'kehá:ka (Mohawk) and Ho-de-no-sau-nee-ga (Haudenosaunee) territories in Montreal, Canada. This gathering of 21 interdisciplinary Indigenous ecologists included scholars from across the career and professional spectrum. By consensus, workshop participants (including the authors of this article) identified four emergent themes and respective guiding questions as a pathway toward the transformation of settler–colonial institutions into IK-led spaces. We highlight this pathway to support actions toward systemic change, inspire future directions for Indigenous and non-Indigenous ecologists, and nurture stronger relationships between Indigenous communities and the Western sciences, toward actualized decoloniality.

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Indigenous Knowledges (IK) have been in practice for millennia. Their validity is evident in generations of ground truthing, and the adaptability of the relational lifeways and communities that embody them (Atleo 2011; Varghese and Crawford 2021). Moreover, their effectual impacts have been demonstrated across diverse fields of ecological research and policy (NMFS 2017; USFS 2018; PMNM 2021). IK have been defined as "Indigenous peoples' systems of observing, monitoring, researching, recording, communicating, and learning that are required, as for any group, to support survival and flourishing in an ecosystem and the social adaptive capacity to adjust to or prepare for changes" (NCA4 2018). Notably, IK possess their own (1) keen observations of Earth's physical processes and cycles of change recorded over millennia; (2) theory and application of ontology, cosmology, eschatology, axiology, praxeology, and epistemology; (3) standards of hypothesis testing, replication, data management, research ethics, and peer review; and (4) mechanisms of intergenerational Knowledge transmission guided by Elders through the modalities of experiential learning, storytelling, art, music, and ceremony (Cajete 1995; Whyte *et al.* 2016; Berkes 2018). These scientific methodologies and the Knowledges they produce are embodied in the reciprocal relationships of Indigenous communities with their ancestrally stewarded ecologies (or "living processes"; Nelson and Shilling 2018; Nelson 2020). Despite colonialism and its institutions of erasure, IK continue to elevate Indigenous communities to higher levels of ecological consciousness (Blanchard *et al.* 2022) in geography (Smiles 2023), land tenure (Doan-Crider *et al.* 2013), plant and animal ecology (Ecoffey 2009; Ignace 2019), data governance (Jennings *et al.* 2023), identity (Montgomery 2017), education and research (Deloria and Wildcat 2001; Armstrong *et al.* 2007; Black Elk 2016; Page-Reeves *et al.* 2019; David-Chavez *et al.* 2020; Tsosie *et al.* 2022; Doan-Crider *et al.* 2023), sustainability and conservation (Krosby *et al.* 2023), and climate adaptation (Nursey-Bray *et al.*

In a nutshell:

- It is essential that Indigenous Knowledges (IK) become a central paradigm institutionally and culturally
- Although enthusiasm for IK in ecology has been growing, centering IK requires holistic structural and cultural changes in settler–colonial institutions (SCI) that are informed by the ecological sciences
- We present four themes of progressive change, along with their guiding questions, as a pathway toward actualizing the transformation of SCI into IK-led spaces
- Within these Indigenous-led ethical spaces, diverse ways of knowing, including Western science, would be treated with equal value to promote discovery and problem solving

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2022). The mere survival of IK is testament to the resilience of the communities blessed by its practice.

In this paper, we focus on the transformation of settler–colonial institutions (SCI) that are informed by the ecological sciences into IK-led spaces. These may include academic institutions, government agencies, conservation organizations, private companies, civil movements, and even Indigenous entities that have been shaped by SCI values. SCI are defined as entities that operate through a lens of extractive personal gain, the control and maintenance of such gain, and the physical, spiritual, and epistemic superiority of the settler (Tuck and Yang 2012). This is accomplished in part by propagating settler-centric science as the only valid epistemology and utilizing education as a tool to shape the Indian in the image of the settler (Grande 2004; Smith 2012). This monocultural structure of knowledge production disallows (Gusa 2010), others (Roothaan 2019), or assimilates IK through epistemic exploitation (Berenstain 2016), in what has been called epistemicide (Hall and Tandon 2017). Unfortunately, in continuing to center settler science, SCI remain complicit in the maintenance of colonial exploitation, which is harmful to Indigenous communities, ecologies, and Knowledges (Moreton-Robinson 2004; Simpson 2017).

Because IK are embodied in the cultures, ecological relationality, and presence of Indigenous Peoples, any effective attempt at the centering of IK within SCI requires systemic change in the culture, values, protocols, and leadership that constitute SCI. Our goal, therefore, is to provide guidance for the needed shifts in SCI for IK to be rightfully centered as the systems of Knowledge most adapted to Earth's ecosystems through eons of relational science. We use the terms Indigenous, Indian, and Tribal interchangeably to refer to the first stewards of any land that is currently occupied by settler–colonial states and their institutions. Although there are important nuances and contexts between these terms, these are not particularly pertinent to this paper.

In a growing positive movement within SCI, there has been a resurgence of interest in IK in recent years. This is evident in the increasing number of publications in mainstream scientific journals that focus on the contributions of IK (as reviewed in Jessen *et al.* [2022]). Moreover, recent national and international ecological assessments now include IK as an information source, despite that information often being relegated to separate sections within those reports (Baptiste *et al.* 2017). In addition, IK are represented in national and international summaries such as the Intergovernmental Panel on Climate Change reports (IPCC 2022) and US National Climate Assessments (NCA4 2018). Even the US White House recently issued a memorandum "ensuring that Federal agencies conduct regular, meaningful, and robust consultation with [T]ribal officials in the development of federal research, policies, and decisions" (OSTP 2021), which was followed by a guidance document on IK that was itself developed based on consultations with Indigenous Peoples (OSTP 2022).

Although these developments have created exponential interest in IK across SCI, along with funding for partnerships with Indigenous communities, caution is warranted. The White House memorandum "recognizes that the Federal Government should engage with ITEK [their acronym, Indigenous Traditional Ecological Knowledge] only through relationships with [T]ribal nations and Native communities and in a manner that respects the rights of knowledge holders to control access to their knowledge, to grant or withhold permission, and to dictate the terms of its application". The memorandum goes on to state that whenever ITEK is involved, the Federal government is obligated to ensure that its use benefits "Tribal nations, Native communities, the United States, and our planet". These declarations are critical, illustrating that the current presidential administration is aware of the importance that Indigenous communities place on meaningful relationships, mutual respect, building trust, and reciprocity to one another and the Earth. SCI agencies or persons who have attempted to implement IK on their own, or with misdirected guidance, have often propagated additional harm to Indigenous communities (Jacobs *et al.* 2022). Thus, access to IK must be controlled by the Knowledge holders themselves and any good-faith collaborations with Indigenous communities must be led by those communities from conception to final product (Carroll *et al.* 2022).

Across SCI, a fundamental issue hindering Indigenous-led collaboration and mutually beneficial partnerships is the continued lack of exposure to IK in SCI academic curricula and training (Battiste and Youngblood Henderson 2000). Although attempts have been made to develop theoretical frameworks and guidelines on the interfacing of IK and SCI epistemologies (Bartlett *et al.* 2012; Popp *et al.* 2020), most SCI ecologists will never encounter them unless their coursework, research, or job requires it. This exclusion of IK in the academy can be particularly damaging because of the cascading generations-long impacts. SCI graduates in STEM (Science, Technology, Engineering, and Mathematics) fields, including ecology, go on to influence many aspects of SCI policy and values. This often results in a lack of consultation and implementation of IK in decision-making and educational processes, which perpetuates the cycle of ignorance and exclusion (Bohensky and Maru 2011; Mazzocchi 2018). Therefore, at all career stages, SCI university researchers, government scientists, and natural resource managers may have a limited understanding of IK, the communities that embody them, and those communities' unique place-based histories (Pierotti 2010). Moreover, given that the growing interest in IK is a relatively recent phenomenon, established SCI personnel may also lack experience in working with Indigenous communities and lack awareness of the concerns that those communities have in sharing their deeply rooted Knowledges (Hudson *et al.* 2023; Jennings *et al.* 2023).

This lack of awareness of IK is exacerbated by a multitude of SCI structural factors that cannot be remedied by temporary changes in policy positions, funding mechanisms, and JEDI (Justice, Equity, Diversity, and Inclusion) programs, or by cyclical academic interest in IK. For example, a high turnover rate and scarcity of Indigenous employees in SCI workforces create major challenges for meaningful engagement with Indigenous communities and truly reciprocal

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Indigenous-led co-creation of research and stewardship of shared natural resources (Pitts *et al.* 2011). Although federal agencies have attempted genuine efforts to train their staff and consult with Tribes (eg National Park Service [NPS 2020], US Fish and Wildlife Service [FWS 2018], US Geological Survey Southwest Climate Adaptation Science Centers [CSA 2021]), the high turnover rate and ensuing lack of experience among agency staff results in a costly cycle whereby Indigenous communities invest time, effort, and resources into relationship building only to have to repeat the process again and again. Even worse, the ongoing exclusionary tactics of SCI conservation organizations (Coulthard 2014), government agencies (Rudden 2021), higher education (Page *et al.* 2017), and the ecological sciences (O'Brien *et al.* 2020) further erode the trust required for long-term relationship building. Even good faith efforts by allied scholars to engage with Indigenous communities are challenged by rigid SCI academic accreditation and tenure policies, and uncompromising employment standards in federal and state agencies as well as in conservation organizations. Both Indigenous and non-Indigenous personnel are therefore burdened with navigating SCI requirements for their own career advancement while attempting to build genuine relationships with Indigenous communities, without compromise.

Taken together, the lack of knowledge of IK in SCI, the dearth of Indigenous representation in SCI, and the imperative that IK be controlled and taught by Indigenous Peoples all point to the necessity of molding SCI and their ways of knowing into ever-Indigenized spaces. Our goal in this ongoing project is to understand the progressive degrees to which SCI can be restructured to properly center IK and Indigenous Peoples, and the necessary shifts to bring about these degrees of systemic change, toward a vision of reconciliation, co-production, and shared vision. Our method relies on the experiences of Indigenous scholars from across the career span and career spectrum, whose work is informed by IK and SCI ecological sciences.

Gathering of Indigenous voices

The Traditional Ecological Knowledge Section (TEK) of the Ecological Society of America (ESA) convened a 2-day workshop before the 2022 ESA Annual Meeting, which was held on Kanien'keháka (Mohawk) and Ho-de-no-sau-nee-ga (Haudenosaunee) territories in Montreal, Canada (Figure 1). The goal of the workshop was to initiate a conversation among interdisciplinary Indigenous thinkers from diverse backgrounds and perspectives on devising a pragmatic approach to fostering greater competency in IK and collaboration with Indigenous

Figure 1. Creators of the *Elevating Indigenous Knowledges in Ecology* workshop held at the Ecological Society of America's 2022 Annual Meeting. From left to right (and with Tribal affiliations in parentheses), front row: J Gazing Wolf (Amazigh, Nubian, Hunkpapa Lakota), J Rattling Leaf (Sicangu Lakota), R Plenty Sweetgrass-She Kills (Hidatsa, Mandan, Nakota, Dakota), Luke Black Elk (Thiťhuŋwaŋ Lakota), MK Nelson (Turtle Mountain Chippewa). Middle row: R Newman, P Blanchard (Absentee Shawnee, Kickapoo), LL Jennings (Pascua Yaqui, Wixárika), M Montgomery (Haliwa Saponi, descendant Eastern Band Cherokee), J Vergun (Powhatan, Tuscarora, Mohawk, Shoshone), Linda Black Elk (Korean, Mongolian), K DeerinWater (Cherokee), DM David-Chavez (Taíno). Back row: D Wildcat (Muscogee), K Deer (Kahnawake Mohawk), E Simmons (Swampy Cree), G Bridge (Saddle Lake Cree Nation), T Ecoffey (Oglala Lakota), D Smiles (Leech Lake Band of Ojibwe), DD Ignace (Coeur d'Alene). Remote participants: AM Chischilly (Diné), D Doan-Crider (Tepehuán). Image credit: A Sponberg.

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communities across SCI educational programming, careers, and agencies. We—the workshop creators, participants, and authors of this article—seek to propose questions for reflection and provide guidance for both Indigenous and non-Indigenous personnel within SCI. Over the long term, we hope that the conversations and insights gained will lead to the proper centering of IK in the ecological sciences and beyond.

We met with intention and created space for all participants to share stories, experiences, and scholarship. Our group included 21 Indigenous People, who identify with 34 Indigenous communities across Turtle Island (commonly known as North America). Of the 21 contributors, 15 consider themselves as practitioners of IK and three are Elders within their communities. Of the scientists, educators, and conservationists in this group, seven consider themselves early career, 11 mid-career, and three late career, although this concept is generally foreign to Indigenous cultures. Our institutional affiliations included 14 public universities, seven Tribal colleges and universities, six nonprofit organizations, two corporate/private organizations, five community/grassroots organizations, one non-Tribal government agency, and one Tribal government agency. Our efforts were generously supported by allied scholar colleagues and mentors. As an author team with a shared vision, we offer guidance in the form of emergent themes and critical questions to be considered and pursued by SCI ecologists and programs that are working toward systemic change, including the ESA.

Workshop design

The workshop itself and the collaborative efforts that followed, including this article, were designed to be uniquely Indigenous spaces, embodying the multidimensionality of IK and providing an example of the needed changes to transform SCI into IK-led spaces. Both days of the workshop began and ended with an opening story, prayer, and local history from Kevin Deer, a prominent Kahnawake Mohawk Faithkeeper and educator. Gifts made from the bodies of plant and animal relatives were exchanged or placed throughout the room to invite the voices of our ecological kin. Gifts of gratitude were also shared with the Elders present. Two workshop participants attended remotely via Zoom to accommodate their familial responsibilities. The "participants" were not treated as such but as co-organizers, co-creators, and co-authors.

The first day of the workshop included introductions, open dialogue, and some directed discussion. The discussion was guided by the following broadly stated framing questions:

- What does it mean for IK to have equal standing with SCI?
- What role can SCI programs and personnel play in increasing awareness of IK and what kind of training/experience would they need?
- Who should teach IK in SCI contexts, how should it be taught, and should it be included in foundational courses or as a specialized experience?
- How should SCI scientists approach relationship building with Indigenous communities? What protocols should they follow? What are their ethical responsibilities? Who holds SCI accountable to respecting Indigenous communities and caring for these relations responsibly?
- What is the best approach to expanding understandings within the SCI community of realities, such as Tribal, food, and data sovereignty, cultural protocols, and other social and economic priorities?

At the end of the first day, each workshop participant identified an issue or issues that were of the highest priority to them. In total, 26 issues were identified, which were then shared among and collectively discussed by the workshop participants. From these 26 issues, four themes emerged, as identified by the lead primary author of this article. The four themes would be discussed in detail within four breakout sessions (one dedicated to each theme, with each session lasting for 1 hour) to be held on the second day of the workshop, as detailed below. The 26 high-priority issues were reframed as questions (hereafter, guiding questions) within each theme. At the beginning of the second day, the themes, along with their wording, framing, and guiding questions, were reviewed and revised by all workshop participants as a group. The above-mentioned four breakout sessions then commenced and were simultaneously held in the same room but at separate tables (Figure 2). Each breakout group was randomized in terms of the number and makeup of its participants. Members of each group were rotated so that all

Figure 2. Breakout groups on the second day of the *Elevating Indigenous Knowledges in Ecology* workshop. In foreground, clockwise from bottom: K Deer, D Smiles, Luke Black Elk, M Montgomery. Image credit: J Gazing Wolf.

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workshop participants cycled once through each theme. Each breakout group discussion was led by one or more of the seven primary authors of this article, who also acted as note-takers. When groups rotated to a new theme, they were informed of what the previous group(s) had shared and were given the opportunity to critique or expand upon what was shared. Discussions among participants in the breakout sessions, and in the workshop generally, were recorded by multiple devices strategically placed throughout the room.

Emergent themes and guiding questions

By consensus, the four emergent themes were arranged in a stepwise manner as to the degree of change that they would necessitate in SCI. As allied individuals and institutions work through the themes and ponder answers to the guiding questions beneath them, more effort, resources, and systemic structural and cultural changes will be necessary to center IK as the guiding paradigm across SCI. The four themes and their respective guiding questions are presented in Table 1.

A path forward

The emergent themes progressively open SCI personnel and policy to more holistic paradigmatic shifts as they, in consultation with Indigenous scholars and Tribal representatives from local Indigenous communities, address questions within

Table 1. Four emergent themes and 26 guiding questions as identified by the Indigenous Knowledges workshop participants

Emergent themes	Guiding questions
Theme 1. ENGAGE: ethical protocols and guidelines for teaching and research involving IK	1. What is the appropriate role of IK in SCI (eg "integrating", "interfacing", "braiding", and so forth)?
	2. Should there be an IK course that is required for all students? Or should a course be required for some students (undergraduate or graduate) and some majors?
	3. What should be included in a statement of guiding principles for collaborating with IK holders?
	4. What should be included in a document of guiding principles for applying IK in teaching and research?
	5. What is the role of SCI in supporting Indigenous communities and policy making?
	6. How can SCI respectfully request assistance from Indigenous communities and scholars in changing cultural perspectives and values in their institutions?
	7. How can IK holders have the space to share stories and demonstrate the viability and validity of their Knowledges in SCI contexts?
Theme 2. HEAL: addressing trauma inflicted upon Indigenous Peoples by SCI	8. What responsibilities do SCI have to help remedy trauma caused on their campuses to Indigenous students, faculty, staff, impacted lands, and displaced communities?
	9. What can SCI do to help remedy the unethical scientific exploitation of Indigenous communities (both past and present)? What can or should SCI do to potentially regain trust?
	10. How should SCI protect Indigenous scholars and communities from backlash should they refuse to work with potential collaborators for ethical reasons? What are some of those reasons? Is this even possible given the colonial value system of SCI?
Theme 3. RECONCILE: elevation of Indigenous scholars and Knowledge holders within SCI	11. How should SCI go beyond "recruiting" Indigenous students and personnel and create strong mechanisms for systemic, long-term reconciliation and retention?
	12. How can SCI support relationships of reciprocity between Indigenous faculty and Indigenous communities? How can these relationships lead to the valuing of both IK and allied ecological sciences?
	13. What support should SCI provide to early-career Indigenous scholars?
	14. How can SCI help build community around Indigenous scholarship?
	15. What should SCI do to increase the diversity of their personnel and support the persistence of IK in their teaching, research, and conservation efforts?
	16. How can Indigenous Elders be valued and supported in SCI? When do Indigenous communities feel it is the right time to bring Elders into SCI contexts?
	17. How can SCI help improve communication and the sharing of Knowledge between Indigenous communities? How can they support Indigenous unity in environmental and climate action? How can this be done while respecting the place-based and community-specific IK-led cultures of diverse Indigenous communities?
	18. How do SCI become places for IK and Indigenous Peoples to thrive?
Theme 4. CENTER: IK as a central paradigm in SCI	19. Can and should SCI be transformed into IK-led spaces? What aspects of SCI should be completely transformed? What, if anything, should be preserved?
	20. How do SCI shift their understanding of what is considered authoritative? How do SCI scholars realign their relationship with Mother Earth?
	21. How can SCI develop literacy of IK so that Indigenous scholars do not constantly need to validate them in the pursuit of funding, publication, research, teaching, etc? Is this also possible with Indigenous values in general?
	22. How can Indigenous scholars help bring SCI and the general public into long-term, persistent relations (via protocols, processes, and actions) with Indigenous communities to sustain our collective futures?
	23. Should there be local community-led Indigenous centers within SCI to guide science ethics and protocols? What would be the extent of their authority and role? How would they be funded and governed?
	24. Should there be Elder councils in SCI? What would be the extent of their authority and role? How would they be funded and governed?
	25. Can dreams, visions, spirits, ceremonies, observations, and sentience of non-human relatives, which are some of the modalities of IK, ever be respected as equal ways of knowing in SCI? What are the necessary changes for this to happen?
	26. Do spirituality and the sacred have places in SCI? What are the necessary changes for this to happen?

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each theme. These shifts would provide for an ever-broader network of Indigenous scholars and Knowledge holders with whom there may be mutually reinforcing ecological research, restorative collaborations, and climate action. Moreover, it is important that spaces supporting bodies of culture and diverse ways of knowing, such as the type of workshop described here, become commonplace for SCI to build their capacity in effectively and ethically engaging with Indigenous communities and their Knowledges. These uniquely Indigenous gatherings and collaborations themselves may serve as mechanisms of reconciliation and transformation of SCI as younger Indigenous scholars see their IK and values reflected in the space, the people occupying that space, and the reinforcing relationships that develop.

Notably, these themes and guiding questions are not meant to be comprehensive; rather, they are simply the priorities raised by the 21 Indigenous People who participated in the ESA workshop. Moreover, they are intended to inspire discussion and reflection toward systemic change, always in dialogue with Indigenous communities and scholars, and never independently. The changes demanded by these questions, however, do require concrete actions. For example, addressing Theme 2 (Heal), Question 8 (What responsibilities do SCI have to help remedy trauma caused on their campuses to Indigenous students, faculty, staff, impacted lands, and displaced communities?) could include such actions as the return of stolen lands to Indigenous communities or tuition-free education for Indigenous students from those communities. Furthermore, the posing of any of these questions in no way implies that there are definitive answers to them, if any answers at all. For example, the very idea of transforming SCI into IK-led spaces is rejected by some Indigenous thinkers, including several who attended this workshop. Moreover, these guiding questions are intended and worded for SCI systems and personnel to act upon to change their systems. The wording can therefore appear as if SCI personnel are being asked to act as "saviors" of Indigenous individuals or communities (eg Theme 2, Question 10; Theme 3, Question 14; and so on), but this is not the case. The intention is for SCI personnel to undertake the necessary resource- and time-intensive heart, mind, and professional work toward actualized transformation in themselves and their institutions. This work, in turn, will support the transformation of institutions of learning and research into IK-led spaces structurally, culturally, and epistemically. Finally, and importantly, centering IK through the transformation of SCI is by no means exclusive of Western ecological science. Within IK-led ethical spaces of learning and research, diverse ways of knowing are treated with equal dignity and value, while being taught by any individuals deemed proficient in them by the standards of those knowledge systems (see Bridge 2023).

Although the workshop participants identified as originating from 34 Indigenous communities, this represents a mere fraction of the Indigenous Peoples across Turtle Island and this Indigenous Planet. Another major limitation for this pilot workshop was the absence of Indigenous undergraduate students, as well as Indigenous Pasifika and Boricuas/Tainos communities under US occupation. Ideally, we would have also included members of non-federal- and non-state-recognized Indigenous communities to give voice to their unique perspectives. However, this ongoing project and ever-growing collaborative of interdisciplinary Indigenous scholars will foster continued discussions and outputs that focus on creating systemic change that centers IK in ecology and beyond.

Future gatherings of Indigenous voices through ESA TEK will expand on this initial work to provide some guidance for the questions posed and a path toward pragmatic reconciliation/collaboration between the diverse worldviews and value systems of IK and SCI. This continuing project and the shifts that it creates will also help prepare current and future allied scientists, educators, and conservationists to engage with IK and be better partners with Indigenous communities through informed, respectful, and reciprocal pursuits of Knowledge (Rattling Leaf 2022). As with other examples of societal progress, we believe that SCI academic environments may serve as cornerstones for the epistemic justice and deliberate acts of Indigenous sovereignty and self-determination necessary for SCI entities to become IK-led spaces (see Appendix S1: Panel S1 for further resources; Orlove *et al.* 2023).

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Data Availability Statement

Data used in this article are sensitive and cannot be provided publicly. Empirical data include recordings and transcriptions of the workshop that produced this article. Indigenous data sovereignty protocols require the express written consent of each individual author and workshop participant prior to the release of any data. To begin the process of requesting these data, please contact the lead primary author, Joseph Gazing Wolf, at shunkaha3@gmail.com.

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