

# Weaving Indigenous science, protocols and sustainability science

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## Abstract

The proceedings of the National Science Foundation supported WIS<sup>2</sup>DOM workshop state that sustainability scientists must respect the “protocols” of practitioners of Indigenous sciences if the practitioners of the two knowledge systems are to learn from each other. Indigenous persons at the workshop described protocols as referring to attitudes about how to approach the world that are inseparable from how people approach scientific inquiry; they used the terms caretaking and stewardship to characterize protocols in their Indigenous communities and nations. Yet sustainability scientists may be rather mystified by the idea of protocols as a necessary dimension of scientific inquiry. Moreover, the terms stewardship and caretaking are seldom used in sustainability science. In this case report, the authors seek to elaborate on some possible meanings of protocols for sustainability scientists who may be unaccustomed to talking about stewardship and caretaking in relation to scientific inquiry. To do so, the authors describe cases of Indigenous protocols in action in relation to scientific inquiry in two Indigenous-led sustainability initiatives in the Great Lakes/Midwest North American region. We claim that each case expresses concepts of stewardship and caretaking to describe protocols in which humans approach the world with the attitude of respectful partners in genealogical relationships of interconnected humans, non-human beings, entities and collectives who have reciprocal responsibilities to one another. We conclude with a discussion of the implications of Indigenous protocols for future dialog between practitioners of sustainability and Indigenous sciences.

## Introduction

The WIS<sup>2</sup>DOM workshop, supported by the National Science Foundation, convened a dialog among participants to bridge Indigenous and sustainability sciences (Johnson et al. 2014). The English language concept Indigenous science broadly refers to the idea that Indigenous peoples have their own systems of knowledge for observing, collecting, categorizing, recording, using, disseminating and revising information and concepts that explain how the world works; they use their own knowledge systems to ensure the flourishing of their communities’ health, livelihood, vibrancy and self-determination. The historic origins of Indigenous sciences are unique to each Indigenous peoples and differ from the dominant scientific disciplines found in countries such as the US or Japan. Though today it is not unusual for some Indigenous peoples to incorporate methods from biology, ecology, climate science, among other fields into their own knowledge systems (Johnson et al. 2014 Whyte 2013; Williams and Hardison 2013; Berkes 2008; CTKW2014). The English language term sustainability science has been understood in different ways, such as a scientific field “defined by the problems it addresses rather than the disciplines it employs” (Clark 2007, 1737); exploring “interactions across domains and scales; nature and society; science and democracy; the global and the local; as well as the past, present and possible futures” (Jerneck et al. 2011 70); and addressing the “breakdown” of global ecological, social and human systems and understanding “the linkages among” these systems (Komiya and Takeuchi 2006, 2).

In the workshop, Indigenous participants repeatedly stated that any kind of scientific (i.e., empirical) inquiry—whether Indigenous or sustainability sciences—is inseparable from a protocol. For the participants, protocols are attitudes about how to approach the world. One workshop participant, Kekuhi Keali‘ikanakaole‘oleohaililani (Native Hawaiian) (2014: 77) defines protocol as an “attitude” or “the manner in which one approaches each and every element in our space”. Protocols serve to define the way a group ought to proceed or behave in any given situation. For some of the workshop participants, every society creates protocols as a part of establishing order and maintaining control, and some observed that protocols associated with Indigenous and sustainability sciences can be rather different (Johnson et al. 2014). Consider just one non-exhaustive example: Some sustainability scientists may approach the world as so many resources to be managed by humans; it is then up to the sustainability scientist to determine how to circulate these resources sustainably and for ordinary people to respect scientists’ advice. Komiyama and Takeuchi (2006) claim, for example, that the goal of sustainability science is “a resource-circulating society”, which requires the “implementation of reduce–reuse–recycle policies, the development of manufacturing processes predicated on resource recirculation, and the fostering of resource conserving lifestyles (3)”. They go on to state that “Only when society at large is inspired to act on the basis of their research and conclusions can sustainability scientists lay the foundation for construction of a sustainable society...” (5). While not all sustainability scientists approach the world in this way, we use the example from Komiyama and Takeuchi to illustrate one possible basis for why practitioners of Indigenous science at the workshop claimed that their protocols can be quite different from those of sustainability scientists.

Different from seeing scientists as having privileged knowledge of how to circulate resources, some Indigenous scientists express protocols that often represent humans as respectful partners or younger siblings in relationships of reciprocal responsibilities within interconnected communities of relatives inclusive of humans, non-human beings (i.e., plants, animals, etc.), entities (i.e., sacred and spiritual places, etc.) and collectives (i.e., prairies, watersheds, etc.). The Indigenous participants used English language terms such as stewardship and caretaking to describe the protocols associated with their practices of scientific inquiry—whether Indigenous or sustainability scientific inquiries. McGregor (2014, 82) states that, “As an Indigenous scientist, you are expected to come to know, and to care for, creation and its processes, just as one comes to know and care for one’s human relatives”. Wark (2014, 100) discusses how Indigenous science “For my culture... encompasses ‘stewardship’ (i.e., being the land’s ‘caretaker’ rather than its ‘owner’), hospitality and sharing, clan relationships and historical Knowledge...”. Cajete (2014, 36) describes Indigenous science as bound up with a sense of community, which at “its very heart and soul,” is the “non-monetary exchange of value; things we do and share because we care for others...”.

In the collective experiences of the authors facilitating dialogs across different sciences, we feel that the Indigenous ideas just described of protocols, stewardship and caretaking may perplex sustainability scientists who are unaccustomed to considering how these ideas would fit within their expectations about the nature of any rigorous scientific inquiry aimed at understanding important issues such as resource circulation and conservation. In the spirit of lessening at least some of the potential perplexity, we will seek to elaborate for sustainability scientists two further cases that—in our view—highlight some of the ways in which practices of Indigenous science involve weaving protocols of stewardship and caretaking with scientific inquiry as part of the approaches of particular Indigenous nations to sustainability. Using references to Indigenous scholars and writers alongside the two cases, we then discuss caretaking and stewardship in more detail as describing protocols focused on relationships, frequently with humans as the younger sibling within a vast array of genealogical connections. This interrelated web does not confine the role of the caretaker or steward exclusively for human members of communities but may conceive of non-human beings, entities, and collectives as protectors of the many relationships making up communities. We cover these references and concepts to shed further light on the broad contours of certain protocols that some Indigenous peoples see as integral to processes of Indigenous scientific inquiry. We conclude with a discussion of the implications of Indigenous protocols for future dialog between sustainability and Indigenous scientists.

## Cases

The following two case descriptions intend to illustrate how Indigenous protocols—described using English language terms such as caretaking or stewardship—fit within the practice of Indigenous science in two Indigenous nations. In each case, it is important for readers to keep in mind the broad understanding of Indigenous science expressed in the first paragraph of this case report. In this understanding, Indigenous science refers to knowledge systems unique to each Indigenous people that are used to ensure the flourishing of community health, livelihood, vibrancy and self-determination. While the historic origins of Indigenous sciences are distinctive to each Indigenous people, it is not unusual today for some Indigenous peoples to incorporate methods from biology, ecology, food/agricultural sciences, among other fields, into the practice of their own knowledge systems. In each case, the practice of Indigenous science involves the work of a particular program supported by an Indigenous people’s government and that addresses a sustainability issue.

## Nmé (Lake Sturgeon) stewardship program

The Little River Band of Ottawa Indians’ Nmé (Lake Sturgeon) stewardship program expresses a case of how protocols are interwoven with scientific inquiry in the practice of Indigenous science. The Band, located in the Great Lakes region of North America, is Anishinaabe and has a Natural Resources Department composed of tribal and non-tribal members which performs a range of scientific research to address issues ranging from water and air quality to native species conservation. Department Director Jimmie Mitchell describes the work of the department as guided by the Anishinaabe cultural system called Baamaadziwin, which translates into “living in a good and respectful way” (Mitchell 2013: 21). Baamaadziwin serves to motivate people to do more than fulfill rule-based obligations or “instructions” to be “good and just,” rather, it motivates people “to being servants, devoting ourselves to making a difference in all that has occurred and may still be occurring within our respective communities and environment... (which) includes restoring the balance of our shared natural environment and of all inhabitants who are dependent upon a robust ecosystem” (Mitchell 2013: 22).

Mitchell (2013: 23) discusses how Baamaadziwin involves intricate understandings of “our respective responsibilities.” People, depending on their clan and other aspects of their identities, “are charged with various tasks and responsibilities within the communities: some possess the role of teachers, others protectors, hunters, and healers, and through the clan system a well-balanced community was ensured”. Finally, Mitchell connects Baamaadziwin to larger earth-scale responsibilities. It involves the idea of Wegemend Aki, mother earth, which is sacred. “As our tribal nations begin to grow strong again, we have not forgotten our primary role: to mend the circle of life that has fallen so far out of balance... original caretakers of the lands...” (Mitchell 2013: 22–24). Though Baamaadziwin is itself not an English term, Mitchell uses terms such as caretaking and stewardship to characterize it.

One example of Baamaadziwin is the Nmé (Sturgeon) stewardship program, which seeks to restore Nmé populations in the Big Manistee River. Nmé are on the decline due to historic overharvesting by Settler Americans, dams, stocking rivers with other species for tourists and sport fishing, and environmental change. Nmé is an important species for Anishinaabe as it figures as a source of food but also as an integral part of clan identity. An elder, Jay Sam, refers to sturgeon as “The grandfather fish (sturgeon),” and that it would “sacrifice” itself “so the people would have food until the other crops were available”. Sturgeon is a clan spirit and leaders would sign their names in treaties with the images of the clan spirits such as sturgeon (Holtgren 2013: 135; Holtgren et al. 2014).

To reconnect Anishinaabe peoples and Nmé, the department sought to restore Nmé populations and to use the restoration process to further encourage humans in the region to be more responsible in how they share the watershed. The department started a cultural context group made up of a diverse range of tribal members and biologists that would develop goals and objectives for restoration. Biologist Marty Holtgren (2013: 135) describes the cultural context group as facilitating “a voice” that “was an amalgamation of cultural, biological, political, and social elements” that were all both “important” and “often indistinguishable.” Holtgren describes that the goal was to “restore the harmony and connectivity between Nmé and the Anishinaabek and bring them both back to the river... Bringing the sturgeon back to the river was an obvious biological element, however, restoring harmony and connectivity between sturgeon and people was steeped in the cultural and social realm.

Each meeting began with a ceremony, and the conversation was held over a feast” (Holtgren 2013: 136; Holtgren et al. 2014).

Ultimately, the Department established a riverside rearing system that ensures young sturgeon are protected before they are released each fall. Though too early to tell given sturgeon take many years to be restored, some initial observations seem to indicate that the restoration process is on track to being successful. Every September, a public release ceremony occurs involving a pipe ceremony and feast that commemorate the renewal of the human relationship with Nmé. Each of the now over 300 attendees guides a young sturgeon back to the river. The new relationships become stronger as the members of the relationships realize their own responsibilities to Nmé. The 2013 release ceremony (which one of the authors observed) featured participants, including many children, according to their own ways, feeling a sense of responsibility to Nmé and the watershed. Attendees typically comment that they now have come to realize that it is people who are also stewarded by Nmé—not just the other way around. Nmé have the capacity to establish relationships among people and kindle a sense of responsibility in humans as stewards of a shared watershed. This is no small feat in a watershed where the relationships among people have been under stress as a product of U.S. settler colonialism. The participants do not have to adopt the specifically Anishinaabe understanding of the world; rather, the stewardship program helps them have sense of themselves as relatives in a shared watershed and a mutual responsibility that respects Nmé as a relative (Holtgren 2013; Holtgren et al. 2014).

## Meskwaki: Red Earth Gardens

The Meskwaki Red Earth Gardens program is another case that expresses the interweaving of protocols of caretaking and stewardship and scientific inquiry as part of the practice of Indigenous science in addressing food system sustainability. Recognized by the Federal Government as the Sac and Fox of the Mississippi in Iowa, the Meskwaki identify themselves as the Red Earth people. Currently, the tribal government houses an economic development office staffed by both Meskwaki as well as non-Meskwaki employees, directed by Larry Lasley. One of the foundational teachings of Meskwaki people is that “everything the people need has been given, on this earth, everything they need to carry on being Meskwaki is provided, it’s your responsibility as a Meskwaki to take care of it” (Lasley personal communication). As Jonathan Buffalo, director of historic preservation considers the opportunities modern amenities provide for tribes “science and technology are not on the forefront of tribal philosophies, moreover, deeply rooted ideas of responsibility and relationship to community and your family are paramount” (Buffalo personal communication). Science and technology in today’s Meskwaki world are seen instrumentally as useful vehicles for fulfilling one’s responsibility and upholding one’s relationship to community (Buffalo personal communication). The nature of being a steward to those duties and upholding those relationships is the focus (Buffalo personal communication). As the community has begun to expand their businesses, Lasley also continues to remind others that promoting heritage and encouraging community outreach should serve as the foundational premise for business (Lasley personal communication).

The economic development office bolsters one of central Iowa’s top local food enterprises and organic farms called the “Meskwaki Food Sovereignty Initiative” (MFSI) (Lasley personal communication). The goals are “education and outreach around food system control”, and “development of sustainable local farms and farmers”, which is accomplished via the Red Earth Garden, community garden/grower’s co-op, in the Senior Citizen’s Center and Meskwaki Settlement School gardens and a variety of cooking as well as gardening workshops (Lasley personal communication). Cohesively, the role of western science is a part of the relationship building process these gardens are creating, as well as maintain. Both Meskwaki and non-Meskwaki gardeners carry the techniques and principles of “western” science in practice; VISTA volunteers, professional gardeners and community members all share knowledge in the rearing of the garden. The key to understanding the significance of this relationship in the manifestation of the gardens is to fully realize the vision of MFSI, to mold and help shape an inclusive environment of many knowledges, to accomplish a vision, with the foundation being Meskwaki at its core.

Gardening is not a new practice by any means for Meskwaki people: “you can find subsistence gardening throughout our history as a tribe” (Buffalo personal communication). In accounts of Meskwaki people gardening, growing traditional crops of corn, beans, and squash undoubtedly predate the first documented interactions with Jesuit missionaries in the 1640s near present day Detroit. Archeologists and scholars alike have reported how important gardens must have been to Meskwaki people, based on the size alone of various archeological plots which were large enough to feed many families. In the 1830s, the Meskwaki were producing enough corn to trade by the bushel for monetary compensation (Forsyth 1911–12: 46). Over 370 years have passed since Meskwaki’s first interactions with colonial regimes and some families within the tribe have maintained their strong connection to gardening and tribal customs/beliefs that existed long before these first encounters.

Like a number of Indigenous peoples in North America, the Meskwaki have fought hard to keep their cultural beliefs and spirituality in the face of what they have lost due to relocation, assimilation, warfare, disease, and federal policies. Spiritually, gardening is more than planting, raising, and harvesting one’s produce, “even before you plant the garden you put out tobacco (as an offering) because all the spirits like grandmother earth and others will benefit, and help you benefit from corn, squash, and beans; so that’s a part of the spiritual piece that people pray about, before planting” (Lasley personal communication; brackets added by authors). The spiritual connection to the plants in the garden is an ongoing commitment of renewal throughout the year, “in my grandfathers’ time they would measure gardens by the year, meaning they would plant enough food to carry them throughout the year” and “from the moment you seed to the last corn cob you pick you take care of that corn and it will take care of you, if corn is knocked over by the wind you should leave it alone, because if you help it up you’re telling the corn you don’t have confidence in it, and that’s not a healthy relationship, if you leave it alone it will stand up, by itself” (Buffalo personal communication). Therefore, the connection to the garden and plants is that of a spiritual bond in a relationship of reciprocity.

MFSI is reimagining gardening on a community scale, bringing gardening and sustainability forward for community participation and dialog. They are reaching out to local communities beyond the settlement borders by establishing co-ops as well as making contact with grocery stores and farmer markets. MFSI, in a way, is asking participants to consider their place in relationship to the plants they benefit from, not by lecturing but through action. It is an opportunity for families to reconnect with their heritage, grow crops with professional assistance, learn, and share their experiences with community members from bordering towns. As MFSI seems to have discovered, sustainability is a new yet useful tool for dialog and action, to help strengthen the fundamental teachings of Meskwaki people by imparting responsibility to the relationships the earth offers. Though it may be too early to tell, current initiatives indicate that this program has been successful in creating community action and awareness in gardening. Further, many people now understand that gardening has the potential to bring others together that might not normally come together. This is the power of the type of gardening MFSI is promoting: it seeks to form and mend relationships between humans and nonhumans.

All who participate might not embrace the spiritual side of the plant–human connection, but the opportunity is at all times present to understand better how one relates to plants. One of the volunteers indicated in his own reflections on the positive opportunity Atamina (corn) provided for him to give to elders who can no longer garden. He concluded by indicating his hopes that more tribal members would once again pick-up this practice. Perhaps then this is a part of the relationship Atamina gives to people, a notion of how to take care of one another, and through its spirit, Atamina empowers us with the opportunity to interact as relatives while helping us to protect our relationships and responsibility to community.

## Discussion: Indigenous protocols

The cases just described suggest several important ideas for how protocols, or attitudes of how to approach the world, are inseparable from scientific inquiry for some Indigenous peoples. For both Ottawa and Meskwaki projects, the attitudes involve approaching the world as part of complex genealogical relations with other humans, plant and animal beings, spiritual entities and collectives (e.g., gardens, watersheds, etc.). Humans are

often the younger sibling in these relationships (e.g., Nmé is the “grandfather fish”). Moreover, tribal members approach scientific inquiry as a vehicle for learning about the world in ways that can be used to cultivate and kindle moral relationships between diverse parties, such as different generations of humans, other humans and the watershed, and humans, animals and plants. Terms such as caretaking and stewardship are used to express the strong requirement to be mindful of and tend to these relationships and the responsibilities arising from the relationships. Humans are stewards or caretakers not because they are privileged as knowledge holders, but more because they are in the position of having responsibilities to the many other relatives making up the genealogical community. Importantly, stewardship or caretaking is not necessarily the province of humans only; rather, Nmé and Atamina, for example, are also approached as capable of having responsibilities to humans. Both Indigenous peoples engage in ceremonies and offerings that serve to renew the relationships and responsibilities. Renewal ceremonies are significant in the cases both for recognizing certain moral relationships and responsibilities but also for sparking in other people the desire to seek out what responsibilities they have, such as in the Nmé release ceremony or the use of tobacco in gardening.

The Indigenous protocols in the cases include a number of ways of approaching the world involving genealogical relations that are layered with reciprocal responsibilities, processes of renewal, and an understanding that humans must be humble toward other beings, entities and collectives. Scientific inquiry is interwoven with complex genealogical relationships that are at the forefront of each Indigenous people’s approach to sustainability, from fish restoration to food sovereignty. Acting on the protocols—that is, caretaking and stewarding—guides scientific inquiry and plays an integral part in Ottawa and Meskwaki resurgence as self-determining peoples with vibrant ways of life. Indigenous scientists in the Little River and Sac and Fox Natural Resources and Economic Development departments are guided by the protocols. These scientists, as we prefer refer to them for our purposes here, do not see their research and work so much as the job of figuring out knowledge that people in the community and region should act on regardless of whether these people are motivated to do so; instead, their scientific work represents one dimension of the very activities themselves of creating and renewing morally significant relationships that will perhaps make it more likely for the human groups referenced in both cases to respond collectively to sustainability issues involving the watershed or food system. Practitioners of Indigenous science are not somehow separate or epistemically privileged in relation to the many human and non-human relatives living in Ottawa and Meskwaki worlds.

Sustainability scientists who are interested in finding out more about such protocols should consult a wide array of literature by Indigenous writers and scholars in public and literary genres that express key ideas. Consider, to begin with, related concepts of possible convergence between the Ottawa and Meskwaki uses of stewardship and caretaking with the New Zealand Māori concept of guardianship or *kaitiakitanga*. The English language term guardianship too can be taken to mean something similar to stewardship or caretaking. Different from the English language usage, Johnson (2013: 129) observes *kaitiakitanga* as “a resource-management regime based within a universe ordered by genealogical descent-time within a kinship-space.” For Māori, the relationship between the *kaitiaki*, or guardian, is one of “reciprocal appropriations” in which the *kaitiaki* invests his/her *mana* into the “preservation of the resource and in turn derives from the resource *mana*, spiritual life, and food to feed his or her community” (ibid). By enacting this guardianship upon the landscape, Johnson has argued that this constitutes a form of Indigenous self-determination, not only aimed at maintaining balance within the ecosystem, but also to a reciprocal relationship between guardian and relatives (ibid).

The Kiowa writer N. Scott Momaday (1976: 80) has described this relationship between humans and their environments also as one of “reciprocal appropriation”. As humans invest themselves into their landscapes and the myriad relationships with non-human others, they are simultaneously incorporating those landscapes and relationships into their personal experience and character. Chie Sakakibara, in her work with the Iñupiat regarding their relationship with whales, has described a notion of collaborative reciprocity as “the belief that humans and animals physically and spiritually constitute one another; that the soul, thoughts, and behaviors of animals and people interpenetrate in the collaboration of life” (2010: 1007). It is through these “moral acts of the imagination” that places, humans and non-humans motivate each other through the innumerable demands we make upon one another (Rundstrom and Deur 1999: 238).

Indigenous writers have noted that this world of relations in which reciprocal appropriation flourishes exists in an interrelated genealogical web within which “nature is understood as full of relatives not resources, where inalienable rights are balanced with inalienable responsibilities and where wealth itself is measured not by resource ownership and control, but by the number of good relationships we maintain in the complex and diverse life-systems of this blue green planet” (Wildcat 2013: 510). This interrelated web constitutes a social reality through which everything has the “possibility of intimate knowing relationships” (Deloria and Wildcat 2001: 2). This intimacy then allows for a depth of knowing and dialog not conceivable in other epistemologies in which people retain a distance from non-humans who are conceived as only objects or animals. Kimmerer discusses this idea as the Earth asking something of humans: “I celebrate the implicit recognition of the Earth’s animacy, that the living planet has the capacity to ask something of us and that we have the capacity to respond. We are not passive recipients of her gifts, but active participants in her well-being. We are honored by the request. It lets us know that we belong” (Kimmerer 2013). Deb McGregor (2009: 37–38) instructs, “We must look at the life that water supports (plants/medicines, animals, people, birds, etc.) and the life that supports water (e.g., the earth, the rain, the fish). Water has a role and a responsibility to fulfill, just as people do. We do not have the right to interfere with water’s duties to the rest of creation. Indigenous knowledge tells us that water is the blood of mother earth and that water itself is considered a living entity with just as much right to live as we have”.

This interrelatedness allows for a sense of stewardship, caretaking, or guardianship that includes an intimate understanding of and interaction with non-human beings and collectives. It is a sense of guardianship founded within a philosophy that is holistic and cyclical; is process oriented; and firmly grounded in place (Littlebear 2000). Indigenous protocols often observe the cycles, phases and patterns of the Earth and universe. These observations based within particular places and sharing multi-generational “deep spatial” knowledges lead communities to understand that if the Earth and universe are to continue, then they must be renewed through ceremony. “Renewal ceremonies, the telling and retelling of creation stories, the singing and resinging of the songs, are all humans’ part in the maintenance of creation” (Littlebear 2000: 78). These renewal ceremonies play but one part in the stewardship, caretaking, and guardianship we are describing here.

## Conclusion

Sustainability scientists who engage in dialog with practitioners of Indigenous sciences should be aware of the significance of protocols for some Indigenous peoples as a necessary dimension of scientific inquiry aimed at addressing sustainability issues. The two examples we have explored, from Meskawki and Ottawa Indigenous traditions, illustrate that protocols are not only about human engagement and protection of Nmé (sturgeon) and Atamina (corn), but about learning from our non-human relatives about how the natural world works. Humans begin to “see beauty in the things and processes that support and produce life” (Mohawk and Barreiro 2010, 10). Just as in any complex network of related individuals, each has varied responsibilities to the other members that can evolve over time and between places. At times, non-human members of this family have lessons to teach their human relations and at other times, humans must take an active role in enacting the lessons we have learned to provide assistance to non-humans. The reciprocal nature of such stewardship, caretaking and guardianship provides for a system connecting the members of this interrelated web where one member is not allowed to dominate, and where everyone—humans in particular—have lessons to learn and attitudes to enact regarding their responsibilities to listen and observe their relatives’ interactions.

Sustainability scientists who—as one example—approach the world as so many inanimate resources to be circulated and privilege their own knowledge of sustainability may be puzzled as to how they can have a dialog with Indigenous scientists who approach the world in the way we have been describing in this case report. Yet in the views quoted earlier from the WIS<sup>2</sup>DOM workshop and the two cases, Indigenous scientists employ a range of forms of scientific inquiry (Indigenous and “western”) to address sustainability issues in their own communities and nations. There are no strong reasons we can identify as to why approaching the world with humility, respect for the diversity of knowledges of humans and non-humans, and a responsibility

to honor other beings, entities and collective as animate, is any less conducive to engaging in dialog with a range of forms of empirical inquiry, including those forms of empirical inquiry in sustainability science. In the cases, biology and food/agricultural sciences are interwoven with Indigenous reciprocal protocols to create powerful sustainability initiatives. Our discussion in this case report respects the reality that sustainability scientists are diverse in the ways they approach the world and in their motivations for engaging in scientific inquiry. Here, our goal is really to express some of our views about how some Indigenous scientists approach the world as caretakers, stewards and guardians using protocols with which some sustainability scientists may be unfamiliar.

Reflecting on the cases and ideas in this case report, it seems Indigenous protocols may approach the human condition as not a struggle to know the universe; the condition rather is to know ourselves well enough so we can act morally in the universe. Forms of scientific inquiry—sustainability or Indigenous—have important roles to play in this process. There is an important space of dialog, then, that exists when sustainability scientists respect Indigenous reciprocal protocols. Perhaps this is a space where lessons can be discussed critically about the importance of scientific inquiry in bringing humans and non-humans together in ways that engender motivation to protect a watershed or establish food sovereignty or achieve a “resource-recirculating society”.

## References

- Berkes F (2008) *Sacred ecology: traditional ecological knowledge and resource management*. Taylor & Francis, Philadelphia
- Cajete GA (2014) Re-building sustainable indigenous communities: applying native science. In: Johnson JT, Louis RP, Kliskey A (eds) *Weaving indigenous and sustainability sciences: diversifying our methods*. National Science Foundation, Arlington, pp 36–39
- Clark WC (2007) Sustainability science: a room of its own. *Proc Natl Acad Sci* 104(6):1737–1738
- Climate and Traditional Knowledges Workgroup [CTKW] (2014) Guidelines for considering traditional knowledges in climate change initiatives. <https://climatetkw.wordpress.com/guidelines/>. Accessed 25 March 2015
- Deloria V, Wildcat DR (2001) *Power and place: Indian education in America*. Fulcrum Publishing, Golden
- Forsyth T (1911–12) Manners and customs of the Sauk and Fox Nations of Indians. In: Blair EH (ed) *The Indian tribes of the Upper Mississippi Valley and region of the Great Lakes*, vol 2. AH Clark Co, Cleveland, pp 183–245.
- Holtgren M (2013) Bringing Us Back to the River. In: Auer N, Dempsey D (eds) *The Great Lake Sturgeon*. Michigan State University Press, East Lansing, pp 133–147
- Holtgren M, Ogren S, Whyte KP (2014) Renewing relatives: Nmé Stewardship in a shared watershed. *Tales of hope and caution in environmental justice*. <http://hfe.wfu.edu/blog/2014/renewing-relatives-nme-stewardship-in-a-shared-watershed/>. Accessed 25 March 2015
- Jerneck A, Olsson L, Ness B, Anderberg S, Baier M, Clark E, Hickler T, Hornborg A, Kronsell A, Lövbrand E, Persson J (2011) Structuring sustainability science. *Sustain Sci* 6:69–82



- Johnson JT (2013) Kaitiakitanga: telling the stories of Māori self-determination in resource management. In: Johnson JT, Larsen SC (eds) *A deeper sense of place: stories and journeys of Indigenous-academic collaboration*. Oregon State University Press, Corvallis, pp 127–138
- Johnson JT, Louis RP, Kliskey A (2014) Weaving indigenous and sustainability sciences: diversifying our methods. National Science Foundation, Arlington, pp 1–116
- Keali‘ikanaka‘oleohaililani K (2014) Hawaii Environmental Kinship. In: Johnson JT, Louis RP Kliskey A (eds). *Weaving indigenous and sustainability sciences: diversifying our methods*, National Science Foundation, Arlington, pp 77–78
- Kimmerer R (2013) Returning the gift. What does Earth ask of us? Center for humans and nature. <http://www.humansandnature.org/returning-the-gift-response-80.php>
- Komiyama H, Takeuchi K (2006) Sustainability science: building a new discipline. *Sustain Sci* 1:1–6
- Little Bear L (2000) Jagged worldviews colliding. In: Battiste M (ed) *Reclaiming indigenous voice and vision*. University of British Columbia Press, Vancouver, pp 77–85
- McGregor D (2009) Honouring Our Relations: An Anishnaabe Perspective on Environmental Justice. In: Agyeman J, Cole P, Haluza-Delay R (eds) *Speaking for ourselves: environmental justice in Canada*. University of British Columbia Press, Vancouver, pp 27–41
- McGregor D (2014) Theoretical considerations for indigenous scientific traditions. In: Johnson JT, Louis RP, Kliskey A (eds). *Weaving indigenous and sustainability sciences: diversifying our methods*. National Science Foundation, Arlington, pp 81–84
- Mitchell J (2013) N’me. In: Auer N, Dempsey D (eds) *The Great Lake Sturgeon*. Michigan State University Press, East Lansing, pp 21–26
- Mohawk J, Barreiro J (2010) *Thinking in Indian: a John Mohawk reader*. Fulcrum Publishing, Golden
- Momaday NS (1976) Native American attitudes to the environment. In: Capps WH (ed) *Seeing with a native eye: essays on native American religion*. Harper and Row, New York, pp 79–85
- Rundstrom R, Deur D (1999) Reciprocal appropriation: toward and ethics of cross-cultural research. In: Proctor JD, Smith DM (eds) *Geography and ethics: journeys in a moral terrain*. Routledge, London New York, pp 237–250
- Sakakibara C (2010) Kiavallakkikput Agviq (Into the Whaling Cycle): Cetaceousness and climate change among the Iñupiat of arctic Alaska. *Ann Assoc Am Geogr* 100(4):1003–1012
- Wark K (2014) WIS2DOM–Weaving indigenous and sustainability sciences:diversifying our methods workshop. In: Johnson JT, Louis RP, Kliskey A (eds) *Weaving indigenous and sustainability sciences: diversifying our methods*. National Science Foundation, Arlington, pp 101–103

Whyte KP (2013) On the role of traditional ecological knowledge as a collaborative concept: a philosophical study. *Ecological Processes* 2:1–12

Wildcat DR (2013) Introduction: climate change and indigenous peoples of the USA. *Clim Change* 120:509–515

Williams T, Hardison P (2013) Culture, law, risk and governance: contexts of traditional knowledge in climate change adaptation. *Clim Change* 120:531–544