

# Waking from Paralysis: Revitalizing Conceptions of Climate Knowledge and Justice for More Effective Climate Action

By

KIMBERLY R. MARION  
SUISEEYA,  
MARGARET G. O'CONNELL,  
EDITH LEOSO,  
MARVIN SHINGWE BINESS  
NEME DEFOE,  
ALEXANDRA ANDERSON,  
MEGAN BANG,  
PETE BECKMAN,  
ANNE-MARIE BOYER,  
JENNIFER DUNN,  
JONATHAN GILBERT,  
JOSIAH HESTER,  
DANIEL E. HORTON,  
DYLAN BIZHIKIINS JENNINGS,  
PHILOMENA KEBEC,  
NANCY C. LOEB,  
PATRICIA LOEW,  
WILLIAM M. MILLER,  
KATIE MOFFITT,  
AARON I. PACKMAN,  
MICHAEL WAASEGIHZHIG  
PRICE,  
BETH REDBIRD,  
JENNIE ROGERS,  
RAJESH SANKARAN,  
JAMES SCHWOCH,  
PAMALA SILAS,  
WESTON TWARDOWSKI,  
and  
NYREE ZEREGA

Despite decades of climate science research, existing climate actions have had limited impacts on mitigating climate change. Efforts to reduce emissions, for example, have yet to spur sufficient action to reduce the most severe effects of climate change. We draw from our experiences as Ojibwe knowledge holders and community members, scientists, and scholars to demonstrate how the lack of recognition of traditional knowledges (TK) within climate science constrains effective climate action and exacerbates climate injustice. Often unrecognized in science and policy arenas, TK generates insights into how justice-driven climate action, rooted in relational interdependencies between humans and older-than-human relatives, can provide new avenues for effectively addressing climate change. We conclude by arguing for a shift toward meaningful and respectful inclusion of plural knowledge systems in climate governance.

*Keywords:* climate justice; traditional ecological knowledge; climate change; science; Indigenous Peoples; climate governance

Our discussion of climate change began with music.<sup>1</sup> In front of a Zoom room of community members, tribal leaders, scientists, engineers, social scientists, and humanists, three boys—not quite yet teenagers—waited

*Kimberly R. Marion Suiseeya is an environmental social scientist in the Department of Political Science at Northwestern University. She specializes in global environmental politics, environmental justice, and political ecology. She is also a faculty fellow with the Center for Native American and Indigenous Research, coleads the Presence to Influence project, and coleads the Buffett Institute's Working Group on the Disproportionate Impacts of Environmental Change.*

*Margaret G. O'Connell is a PhD student in the Department of Chemical and Biological Engineering at Northwestern University. She uses lifecycle and techno-economic analyses to study water systems and is interested in conducting transdisciplinary work that integrates the connections among issues of water, climate change, and justice into these analyses.*

Correspondence: kimberly.suiseeya@northwestern.edu

DOI: 10.1177/00027162221095495

---

*Edith Leoso is a member of the Bad River Band of Lake Superior Tribe of Chippewa in Wisconsin and has worked as the Tribal Historic Preservation Officer since 2005.*

*Marvin Shingwe Biness Neme DeFoe is a member of the Red Cliff Band of Lake Superior Chippewa, where he also serves as Tribal Historic Preservation Officer.*

*Alexandra Anderson is an undergraduate student studying political science and environmental policy and culture at Northwestern University. She is a Farrell Fellow and research assistant with the Presence to Influence project.*

*Megan Bang is a professor of the learning sciences and psychology at Northwestern University and is currently serving as the senior vice president at the Spencer Foundation. She is of Ojibwe and Italian descent.*

*Pete Beckman is a distinguished fellow at Argonne National Laboratory and the codirector of the Northwestern University/Argonne Institute for Science and Engineering.*

*Anne-Marie Boyer is a PhD candidate in the media, technology, and society program at Northwestern University's Department of Communication Studies. She is a graduate assistant with the Buffett Institute's Working Group on the Disproportionate Impacts of Environmental Change.*

*Jennifer Dunn is a professor of chemical engineering at Northwestern University. She coleads the Buffett Institute's Working Group on the Disproportionate Impacts of Environmental Change.*

*Jonathan Gilbert is the director of Biological Services Division (BSD) of the Great Lakes Indian Fish and Wildlife Commission, providing technical advice to member tribes on subjects such as fish and wildlife management, forestry, invasive species, wild rice, climate change, pipelines, and mining.*

*Josiah Hester is an assistant professor of computer engineering at Northwestern University. He works toward a sustainable future for computing, informed by his Native Hawaiian heritage.*

*Daniel E. Horton is an assistant professor in the Department of Earth & Planetary Sciences at Northwestern University.*

*Dylan Bizhikiins Jennings is a professor at Northland College and a Bad River Tribal Member.*

*Philomena Kebec is the community development officer for the Bad River Band of the Lake Superior Tribe of Chippewa Indians. She is a Bad River Tribal Member.*

*Nancy C. Loeb is a clinical professor of law and the director of the Environmental Advocacy Clinic at Northwestern Pritzker School of Law.*

*Patricia Loew is a citizen of Mashkiizibii—the Bad River Band of Lake Superior Ojibwe—and is a journalism professor and the inaugural director of Northwestern University's Center for Native American and Indigenous Research.*

*William M. Miller is a professor of chemical and biological engineering and director of the Center for Engineering Sustainability and Resilience at Northwestern University.*

*Katie Moffitt is a recent graduate of Northwestern University, where she worked as a Farrell Fellow and research assistant on the Presence to Influence team.*

*Aaron I. Packman is a professor of civil and environmental engineering at Northwestern University and director of the Northwestern Center for Water Research.*

*Michael Waasegizhig Price is the traditional ecological knowledge specialist at the Great Lakes Indian Fish and Wildlife Commission headquartered in Odanah, Wisconsin.*

*Beth Redbird is an assistant professor in the Department of Sociology at Northwestern University. She is also a faculty fellow with the Institute for Policy Research and the Center for Native American and Indigenous Research.*

for their grandfather to cue them to begin sounding their drums and singing. Most of us had our cameras on as this song, and the Ojibwe prayer that followed forged our new relationships in connection to the past, present, and future. In the prayer, Dylan Büzhikins Jennings called upon our more-than-human relatives, requesting partnership and pity, offering our respect and willingness to listen. These songs and prayers remind us of our connections to those generations who came before, bring us together in the present, and ask us to embrace our obligations to the future. We began each of our listening sessions with these invitations to listen, reflect, and pause from thinking of whatever expectations or goals we might have had for the meeting. Collectively joined together, fully present, we sought to better identify, understand, and confront the complex challenges before us: how should Ojibwe Nations strengthen their resilience in the face of climate change?

One of the largest confederations of Indigenous Peoples in the United States, Ojibwe Nations in the Lake Superior region exercise tribal sovereignty on reservations and throughout their ceded territories spanning three U.S. states (Michigan, Wisconsin, and Minnesota; Figure 1). Like other tribal nations, Ojibwe Nations are leading climate actors in environmental stewardship and adaptation, including granting rights to species like *manoomin* (wild rice, *Zizania palustris*), an annual aquatic grass that produces highly nutritious seed en masse each fall, whose existence is threatened by the changing climate. Decades of Ojibwe work generating knowledge on how climate change impacts manoomin, long overlooked by the scientific community, now drives and leads new scientific research into climate change in the Great Lakes Region, like the University of Minnesota's wild rice research initiatives (Cusick 2020).<sup>2</sup> Yet like other Indigenous communities around the world, Ojibwe Nations today are among the groups most vulnerable to the negative effects of climate change (UN Special Rapporteur 2017). These include threats to food, water, and cultural security that are rooted in Ojibwe relationships to place and their relationships with manoomin.

---

*Jennie Rogers is an associate professor in Northwestern University's Department of Computer Science.*

*Rajesh Sankaran is a staff researcher with the Mathematics and Computer Science Division, Argonne National Laboratory, the NAISE Fellow with Northwestern University, and a senior CASE Fellow with the University of Chicago.*

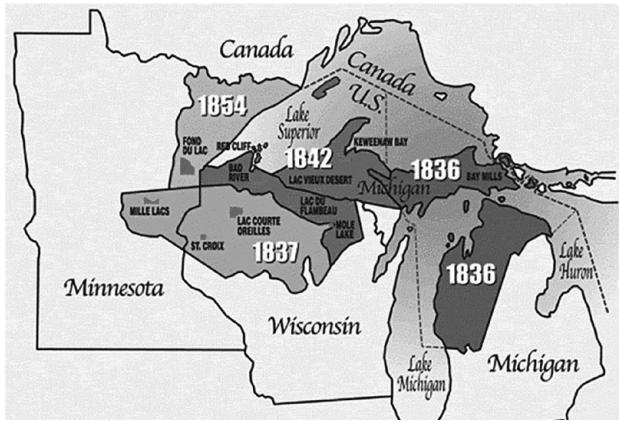
*James Schwoch is a professor in the School of Communication and the science in human culture program at Northwestern University. His most recent book is *Wired into Nature: The Telegraph and the North American Frontier* (University of Illinois Press 2018.)*

*Pamala Silas is an enrolled member of the Menominee Tribe and descendant of the Oneida Tribe of Wisconsin, and is associate director for outreach and engagement for Northwestern University's Center for Native American and Indigenous Research.*

*Weston Twardowski is the program manager of Diluvial Houston at Rice University, where he develops transdisciplinary environmental partnerships. He is an adjunct professor in Rice's Center for Environmental Studies and Theatre Department.*

*Nyree Zerega is a professor of instruction in plant biology and conservation, herbarium director, and conservation scientist at Northwestern University and the Chicago Botanic Garden.*

FIGURE 1  
Great Lakes Indian Fish and Wildlife Commission (GLIFWC) Member Tribes and Their Ceded Territories and Reservations

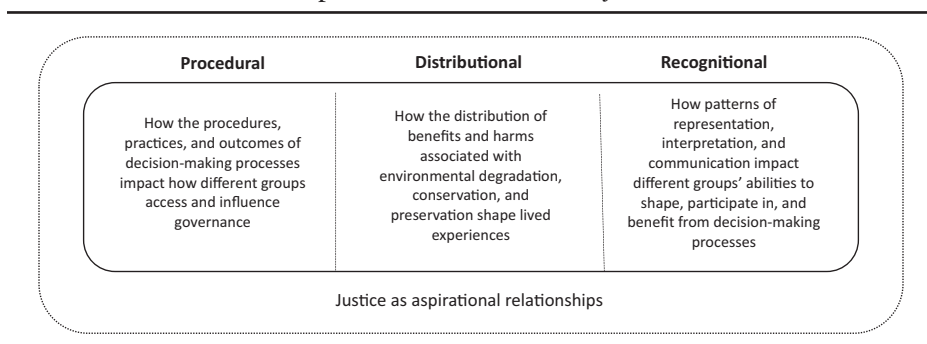


SOURCE: GLIFWC.

Specifically, climate change, habitat loss, and degraded water quality pose increasingly dire threats to the well-being of manoomin, the “food that grows on water” that brought the Ojibwe to the Upper Great Lakes. Threats to manoomin manifest as multiple, cascading modes of climate injustice that undermine Ojibwe political, social, economic agency, and especially epistemic agency, which challenges Ojibwe Nations’ abilities to generate effective, practical solutions (e.g., Whyte 2020). Manoomin extirpation in the Upper Great Lakes would not simply be a loss of a traditional food source or sentinel species. Its loss would precipitate the displacement and ultimate decline of Ojibwe identities, lifeways, ways of being, and ways of knowing, the very existence and practices that are spiritually rooted in manoomin: how can the Ojibwe peoples exist if manoomin no longer exists?

Referring to the ways in which climate change, its drivers, and its solutions disproportionately affect different communities, both human and older-than-human, climate justice is a phenomenon that includes three core dimensions: distributive, procedural, and recognitional (see Figure 2; Schlosberg and Collins 2014). To understand the role that climate justice plays in shaping our collective abilities to effectively address climate change, we draw from our ongoing collaborations working with Ojibwe partners. By examining Ojibwe climate knowledge, environmental governance, and experiences of climate change in the northern Great Lakes region of the United States, we demonstrate how multimodal climate injustice is one of the greatest threats to addressing climate change in two interconnected ways: first, by marginalizing and devaluing Indigenous knowledge, dominant climate science and policy arenas artificially circumscribe the range of potential solutions; and second, by extricating the problem of climate change from the lived experiences of climate change, climate scientists and policy-makers institutionalize climate injustice.

FIGURE 2  
Multiple Dimensions of Climate Justice<sup>6</sup>



SOURCE: Marion Suiseeya (2021).

In what follows, we examine the ways in which knowledge systems shape both our understanding of the climate change problem and the range of policy solutions available to address the problem. Knowledge systems refer to the diverse ways in which knowledge is produced. One such system is knowledge that comes through the scientific method, another is knowledge produced in a context of application, and yet another is embodied knowledge generated through multiple generations of experience (Berkes 1993; Hessels and van Lente 2008). In this article, *science* refers to knowledge produced through the scientific method, and *traditional knowledge* (TK) refers to knowledge produced through direct application and experience. TK is embodied and, like science, is built on the generations of experiences leading up to the present. To identify the role of knowledge systems in climate action, we begin by reviewing the differences in how TK and science conceptualize the climate change problem. While scientific consensus exists that anthropogenic climate change is happening, there is neither consensus on *how* to address it nor widespread recognition that historical and ongoing climate injustices act as the *fundamental cause* of climate change and continued climate inaction. By exploring holistic understandings of climate change and placing lived experience at the forefront of climate action, we examine how inclusion of plural ways of knowing can overcome the current limitations to effective climate policy generated by dominant scientific paradigms. Through a multidimensional justice framework, we demonstrate how climate justice is a driver—not simply an outcome—of climate action.

## The Climate Change Problem

Recognized as perhaps the most salient “super-wicked” problem we confront, climate change has generated a massive scientific enterprise to understand and address it (Levin et al. 2012).

Reflecting consensus among climate scientists that greenhouse gas emissions drive climate change, policy-makers have focused most of their attention on reducing emissions. Despite these efforts, climate policy responses remain weak (Nordhaus 2020). As the most recent Intergovernmental Panel on Climate Change (IPCC) report noted, we are already beyond the point of significantly avoiding the consequences of climate change (IPCC 2021). Nationally determined contributions to emissions reductions made under the Paris Agreement do not bring us close to a level of emissions that would limit global temperature rise to 2°C (UN Framework Convention on Climate Change [UNFCCC] Secretariat 2021). Moreover, while many of the technologies needed to drastically reduce emissions already exist and continue to be developed, most remain largely unimplemented at the scale required to make a difference (Wilkinson et al. 2020).

Conventional explanations for this ineffective policy response often point to climate change denial and the proliferation of misinformation and malinformation campaigns; this politicization of science, scholars argue, makes it harder to generate actionable climate information and implement climate solutions (McCright and Dunlap 2011). Other scholars suggest that the incentives currently in place are unable to generate the types of behavioral and structural changes required to address climate change, and policy-makers face political challenges to overcoming the scalar mismatch between their own shorter-term horizons and the extended time frame required to see the effects of any climate policy (Chakrabarty 2014). The broad consensus in this literature is that politicization of climate change results in the suppression of science in policy arenas, limiting opportunities for effective climate action (e.g., Kahan et al. 2012; Bolsen and Druckman 2018). The implications suggest that addressing climate change requires first its depoliticization, by drawing on communication strategies that reframe the climate problem to better align with peoples' interests and values (e.g., Moser 2016).

For many communities experiencing the effects of climate change, emissions reductions and depoliticization of climate change are not only insufficient for addressing climate change but may reproduce and entrench climate injustice (Whyte 2020). Depoliticization, in effect, advances a narrower understanding of the issue area, actively suppressing certain knowledge systems, such as Indigenous Peoples' extensive knowledge and understandings of the Earth and Creation that emerge from their interdependent relationships with older-than-human relatives. Conventional approaches see climate change as an emissions problem, instead of approaching climate change as a problem of the erosion of relationships and relational integrity with older-than-human beings. The Ojibwe worldview identifies the root cause of climate change itself as injustice—injustice inflicted on all human and older-than-human relatives by dominant science and policy arenas that fail to include such relational perspectives. The distinction here is significant: a relational understanding of climate change considers the underlying and multidimensional forms of injustice that drive climate change, whereas a focus on depoliticization and emissions reductions directs attention only to the symptoms, rather than complex drivers, of climate change (e.g., Hulme 2019).



## Four Orders and Climate Change

The urgency with which climate science has developed in the past 30 years belies the extensive, centuries-long knowledge of climate change developed in many Indigenous communities (e.g., Smith and Sharp 2012). Menominee elders in the Great Lakes region, for example, have kept historic records of weather patterns going back to the mid-1800s, showing how more rapid and extreme cycling of temperature impact sugar maple production (Loew 2013). And in contrast to most climate science that views climate change as a problem *for* society, Indigenous communities across the world have for centuries approached the problem of climate change as a problem *of* society (Belfer, Ford, and Maillet 2017). In 1854, Chief Si'ahl of the Duwamish Tribe (n.d.), leader of a six-nation confederacy in central Puget Sound, well known for his leadership and advocacy, was already frequently drawing attention to how settler-colonizers' disrespect and disregard of Creation would wreak havoc on the Earth, suggesting that European colonizers were “numb to the stench” of the fouled air that resulted from their industrialized exploitation of the Earth (Si'ahl in Smith 1887).<sup>3</sup> Chief Si'ahl and other Indigenous leaders pointed out that settlers approached the Earth as distinctly separate from and subordinate to humans, allowing them to continue polluting without consideration for the short- and long-term effects on their older-than-human relatives. This contrasted sharply with Duwamish views of Creation as all beings—living and nonliving—that compose the Earth:

This we know; The earth does not belong to man; man belongs to the earth. This we know, all things are connected like the blood which unites one family. All things are connected. (Chief Si'ahl, Namesake of the City of Seattle)<sup>4</sup>

Here Chief Si'ahl elucidates a *relational* lens to guide how humans should know, experience, and steward the Earth as a being of interconnected, interdependent relationships that span time, space, and scale. Relational understandings of the world draw insights from knowledge that is embodied, rooted both in place and lived experience. They also center on responsibilities and reciprocities—those commitments of care for other beings that constitute relationships. Such forms of knowledge are often referred to as TK. As a knowledge framework, TK offers guiding questions for examining worldly relationships, responsibilities, and reciprocities (Tribal Adaptation Menu Team [TAMT] 2019; Kirkness and Barnhardt 1991). Examples of climate change TK include the long-term observations of variations in sea ice and weather predictability that Arctic Indigenous Peoples generate and share that illuminate the connections between global climate change and adverse local impacts (ACIA [Arctic Climate Impact Assessment] 2004; Martello 2008). For these communities, the problem of climate change is not simply one of greenhouse gas emissions; rather, it is a problem of injustice. Approached through a relational lens, climate change is neither a surprising nor new phenomenon: it is the inevitable result of human disregard for other relatives.

Ojibwe conceptualizations and experiences of climate change are best understood within the relational framework of the Four Orders, a worldview rooted in

a “hierarchy of dependence” that is fundamental to Ojibwe beliefs and practices (Johnston 1976; Figure 3). These orders include the Physical World, the Plant World, the Animal World, and the Human World, with the Physical, Plant, and Animal Worlds each comprising relatives that are older and wiser than the humans that depend on them. The Worlds are connected through interdependencies that link their material and spiritual needs required for well-being. These relationships are sacred, and humans—belonging to the newest world—are obligated to learn from the other worlds and steward relationships with older-than-human relatives.

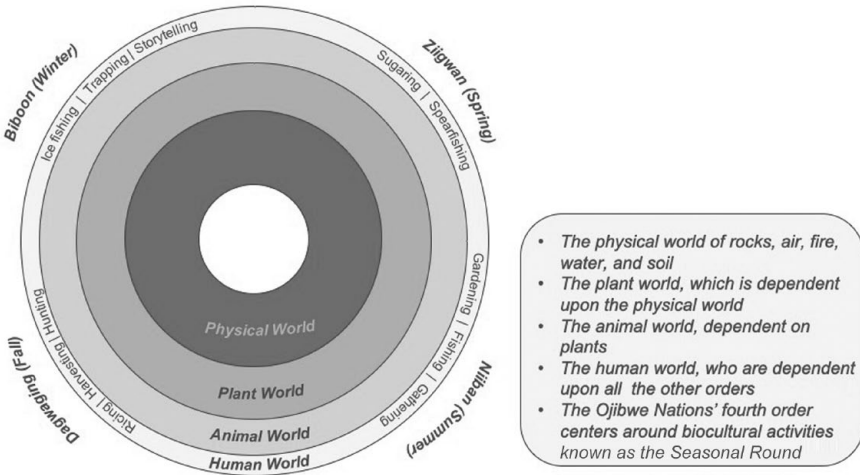
Manoomin—the “food that grows on water” that brought Ojibwe peoples to the northern Great Lakes—illuminates these interdependent relationships. The only cultivated grain native to the Great Lakes region, manoomin requires weather and water conditions conducive to reseeded (Physical World), balance with perennials that can easily outcompete manoomin (Plant World), stewardship by rail birds that feed on plant-damaging insects (Animal World), and seasonal harvesting that facilitates reseeded (Human World) (Loew 2013). Similarly, Ojibwe Nations rely on *Manidoo Gitiganning*, spirit garden or wild rice beds, to provide sustenance; maintain cultural practices; and connect Ojibwe communities across ancient, present, and future relations. Manoomin is prepared as an essential food at every Ojibwe ceremony, where it is offered as part of a spirit dish to the people and the spirits. The increasingly dire threats that climate change, habitat loss, and degraded water quality pose to the well-being of manoomin are also existential threats to all its human and older-than-human relatives.

## Multimodal Climate (In)Justice

In one of our first conversations together, Ojibwe leaders, including authors of this article, talked about the accumulated, adapted, and disseminated knowledge related to climate change that Anishinaabeg (the peoples of Ojibwe Nations) have generated and maintained for centuries. Marvin Shingwe Biness DeFoe (Tribal Historic Preservation Officer for the Red Cliff Band of Ojibwe) coined the term *Anishinology* to describe these centuries of knowledge accumulation, which he explained is a process of learning from elders and life, and what academics might refer to as *embodied knowledge* (DeFoe 2021; see also Bang and Medin 2010; Haraway 1988). DeFoe explained how the experiential, active knowledge acquisition that comes from a life attached to a place allows those who listen—and know—that when frogs’ croaks change, it means the walleye are spawning on a lake 60 miles away. When fish biologists could not understand why, given the lake temperatures, the walleye were not yet spawning, DeFoe and other tribal members explained they had to wait until the cadence of the frog songs let them know the spawning had begun. Weeks later, the frogs were singing at the right cadence, and even though the lake temperature for spawning had been reached weeks prior, they had only just begun spawning. Ojibwe tribes draw from this knowledge to inform governance of different fisheries, ensuring that human fishing activities do not threaten their sustainability.



FIGURE 3  
The Four Orders and the Seasonal Round



SOURCE: Visual developed by authors from knowledge shared by Ojibwe Elders; Defoe and Leoso (2021).

The extensive TK that has long guided Ojibwe relationships informs how Ojibwe Nations understand and respond to climate change (TAMT 2019). Climate change–induced warming and increasing frequency and severity of extreme weather events, for example, are threatening manoomin and its habitat. As waters warm, invasive species are increasingly able to outcompete manoomin, reducing its abundance in traditional locations, while also pushing it northward (David et al. 2019). Large storm events, especially those early in the “floating leaf” season, can rip the rice out of the muck bottom and disrupt an entire season of manoomin. The resulting decline in manoomin threatens not only future manoomin yields but jeopardizes the entire system of relationships that constitute Creation: declines in water quality that supports multiple socioecological systems, impacts on rail birds that feed on manoomin-damaging insects, and the loss of cultural practices and identities that emerge from relationships with manoomin are all climate-driven impacts. These consequences, in turn, can have cascading effects on other relationships that ultimately undermine Ojibwe ways of knowing and being. Manoomin decline, for example, impacts the food sources and habitat for seventeen species of wildlife, including the muskrat. According to the Ojibwe Creation story, the muskrat is a sacred animal: when a great flood destroyed most animals and all of the Anishinaabeg people, the muskrat dove deep under water to grab a handful of Earth so that it could begin anew, dying as he resurfaced with a pawful of mud (Cooper 2009).<sup>5</sup> The soil was placed on the back of a turtle, and Earth, or Turtle Island, was reborn. Without the muskrat, the Ojibwe would not exist. Stewarding these sacred relationships is essential to Ojibwe lifeways. Climate change is a dire threat to the relationships of the Four

Orders: manoomin decline impacts all Ojibwe relations and well-being; and as Ojibwe well-being declines, so too do the relationships they steward.

To address climate change, Ojibwe Nations have codeveloped a Tribal Climate Adaptation Menu that aims to achieve parity for all relatives—human and older-than-human—and adopts principles of respect, reciprocity, responsibility, and relationships to guide decision-making (TAMT 2019). This approach diverges from more conventional, Western approaches that emphasize exploration, domination, exploitation, and extraction—principles that seek to control and change the environment rather than adapting to it (TAMT 2019, 9). It also diverges from the sense of urgency that dominates Western decision-making around climate change and instead prioritizes dedicating time to generate more complete and holistic understandings of socioecological change. The Ojibwe view time differently—climate change is not just an issue to be addressed with climate action targets for 2030, 2040, 2050, not just an issue to be addressed election cycle by election cycle. Climate change is an issue of generations, with generations in the future threatened by generations of injustices in the past. Ojibwe worldviews have a seven-generation focus on a responsibility to the Four Orders that extends seven generations into the future and a responsibility to understand the relationships between three generations of the past, three generations of the future, and the generation of now (Loew 2013). This, in turn, can generate dynamic and responsive climate change solutions that attend to both subtle and major changes in the near and long term.

Examples of these include strategies 9 and 10 of the Tribal Climate Adaptation Menu that focus on increasing ecosystem redundancy and landscape connectivity and on maintaining and enhancing genetic diversity, respectively. Strategy 9 tactics include managing habitats and access opportunities across a range of sites and conditions, expanding the tribal land base by reacquiring lands, reducing fragmentation, and creating habitat corridors (TAMT 2019, 19). Strategy 10 tactics include using seeds and other biological materials from relatives of beings across a greater geographic range, favoring local beings whose traits are better adapted to future conditions, and collecting and preserving seeds from at-risk beings (TAMT 2019, 19). Additionally, in 2018, the White Earth Band of Ojibwe enacted the “rights of manoomin,” the first rights of nature law now being used in tribal courts against the Enbridge 3 pipeline in the first rights of nature case, a groundbreaking illustration of the rights of older-than-human relatives to exist and thrive (White Earth Band 2018). We note these here as examples to demonstrate how TK integrates with other knowledge systems to support climate action (see Figure 4). Addressing climate change by simply reducing emissions, the dominant strategy among most climate scientists, neglects to consider the deeper complexities of responsibility and reciprocity in global climate change and, at this stage, will not reverse the current trajectory of climate change.

In recent years, a growing recognition has occurred of the importance of TK for addressing climate change and for generating knowledge that connects global and local climate phenomena (e.g., Petzold et al. 2020; Ford et al. 2016; Bohensky and Maru 2011). The most recent reports from the IPCC, for example, note that TK can enhance resilience and reduce risks of maladaptation (IPCC 2021). The

FIGURE 4  
Four Orders and Climate Science<sup>6</sup>

- *The Physical World* of rocks, air, fire, water, and soil are the oldest relatives that provide the foundation upon which all other worlds rely. Climate science drawing on the Physical World focuses on the effects of anthropogenic greenhouse gas emissions that are substantially changing the composition of the atmosphere, causing an increase in the Earth's temperature, exacerbating droughts, fires, and floods, and intensifying extreme weather events.
- *The Plant World* of trees, grasses, shrubs, bushes, flowers, algae, and fungi relies on the Physical World for life. Additionally, as plants take in carbon dioxide, produce oxygen, and decay and release nutrients and organic carbon to the soil, they replenish the Physical World as well. Climate science related to the Plant World focuses on examining how climate change increases vulnerability to disease and pests, impacts life cycles, and alters the habitability of the Physical World that may both weaken and strengthen relationships between different plant relatives and the Physical World. Plants like manoomin, for example, are struggling as plants like the hybrid cattail, arrowhead, and lily pads are growing more abundant in shared waters.
- *The Animal World* of the invertebrates, birds, reptiles, amphibians, fish, and mammals also has reciprocal relationships with each of the other worlds. Animals rely on the Physical and Plant Worlds to provide life; the Physical World relies on the Animal and Plant Worlds to filter the air and water and aerate the soil; and the Plant World relies on the Animal World to propagate. Climate science related to the Animal World focuses on how climate change increases the vulnerability of many animals, especially those already under pressure, to shrinking habitats, greater nutrient competition, and, for many animals, poses an existential threat. For example, sea lampreys introduced through the release of ballast waters from ships traveling through the Great Lakes from the Atlantic Ocean prey on trout, sturgeon, whitefish, and others, weakening their abilities to survive.
- *The Human World* of people is the newest of the Four Orders. Humans therefore rely on the Physical, Plant, and Animal Worlds for both life and learning, needs that are both physical and spiritual. Like the reciprocal relationships between the Animal, Plant, and the Physical Worlds, humans also have responsibility to care for and consider their impact on all human and older-than-human relatives across the Four Orders.<sup>a</sup> Climate science focused on humans examines how climate change may exacerbate conflict, spur mass migration, weaken the economy, put resources at risk, and make both social and built infrastructures and systems more vulnerable to the effects of climate change on Animal, Plant, and Physical Worlds.

- a. The Ojibwe Creation story introduces the “original treaty,” an agreement in which animal relatives agreed to take care of the Anishinaabeg by providing food, clothing, and shelter. In exchange, animals expected respect and recognition. Today, Anishinaabeg continue the practice of aasema offerings before each hunt as part of fulfilling their obligations to their older-than-human relatives (Cooper 2009).

UNFCCC established a mandate to include TK (see Figure 5). Yet despite this acknowledgement in global policy arenas, TK has been largely excluded from large-scale research and policy solutions to environmental problems; many

FIGURE 5  
Local Communities and Indigenous Peoples' Platform

In 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) signed the historic Paris Agreement, which, among other commitments, established the foundation for the Local Communities and Indigenous Peoples' Platform (LCIPP). From 2016 to 2020, Parties and representatives from civil society, local community, and Indigenous Peoples' organizations worked to develop the scope, goals, and objectives of the LCIPP, culminating in an initial two-year work plan. The LCIPP intends to serve as a space for bringing together diverse knowledge systems to help strengthen our collective responses to climate change through knowledge and best practice exchanges. It is also intended to facilitate deeper engagement of local communities and Indigenous Peoples in UNFCCC processes by helping build capacity and integrating diverse knowledge systems, practices, and innovations in design and implementation of climate actions across multiple levels of governance.

SOURCE: <https://unfccc.int/LCIPP>.

climate scientists (including social scientists) and policy-makers continue to treat TK as folklore or anecdote, rather than the different knowledge system that it is (Berkes 1993; Whyte 2013). Such disregard for other ways of knowing is in itself a form of injustice that produces other injustices.

While the overlay of the Four Orders onto climate science interventions in Figure 4 illustrates some synergies with Ojibwe knowledge, scientific efforts that assume that “individuals can be distanced, or separated, from the physical environment” effectively and actively exclude Indigenous knowledge from informing policies (Tuhiwai Smith 2012, 58). For example, in one of our first conversations together, Ojibwe leaders, including authors of this article, expressed a common frustration about the lack of respect that policy-makers and scientists have for their knowledge. DeFoe described the recent wolf hunt authorized in Wisconsin that is now expected to cause a dangerous decline in the grey wolf population (Wisconsin Green Fire 2021). The Anishinaabeg consider Maa'ingan (the wolf) a brother who also helps to maintain forest ecosystems by controlling the deer population and other sick relatives, contributing to climate adaptation and well-being. In early 2021, the Ojibwe Nations warned the Wisconsin Department of Natural Resources that opening a wolf hunt in February—when many female wolves would already be carrying pups—would be disastrous for the wolf population and their Plant, Animal, and Human relatives. Without, however, longitudinal population studies to show the potential impacts of hunting during breeding season that would legitimize their knowledge in the eyes of the state, their concerns went unheeded. Within four days of opening the hunt, 218 wolves were killed, nearly double the allowable quota of 119, of an estimated total population of 1,100. The quota for the November 2021 hunt is 300 wolves, more than double the state biologist's recommendation of 130. In less than one year, more than half of the 2020 wolf population in Wisconsin could be killed (Treves, Santiago-Ávila, and Putrevu 2021).<sup>6</sup> The short- and long-term effects of this loss on the Four

Orders is not yet fully known; but based on Ojibwe knowledge, this loss will produce an imbalance of different beings, impacting socioecological resilience and effective climate adaptation.

The multimodal, multigenerational injustices (re)produced through this experience include cultural, spiritual, epistemic, and relational displacement resulting from a lack of recognition of Ojibwe ways of knowing, marginalization of Ojibwe knowledge, and limited ability to participate in and influence decision-making. These exclusions lead to existential impacts on the well-being of current and future generations of human and older-than-human relatives and constrain Ojibwe efforts to protect their relationships with manoomin and other relatives. Moreover, the process and outcomes of the wolf hunt decisions extend the legacies of violence that have sought to eradicate Ojibwe Nations and their knowledge (e.g., Child 1998). Finally, devaluing and undermining TK contribute to broader trends of knowledge hierarchies and exclusions in climate science that impose artificial limitations on what it is possible to know—and thus what it is possible to act on—for innovating climate change responses (Orlove et al. 2010). Such restrictions result in unutilized fields of valuable climate knowledge based on local communities and Indigenous Peoples' proximity with specific environments and ecosystems. In many small or remote communities, for example, there is little or no scientific information to inform policy responses for highly localized environmental issues (Alamgir, Pert, and Turton 2014). In these cases, local knowledge is the only option to identify environmental problems and can be very effective in developing climate change adaptation strategies. An example of this is the Great Lakes Indian Fish and Wildlife Commission's climate change vulnerability assessment that identified specific threats and responses relevant to manoomin, drawing on scientific and traditional ecological knowledge and enabling Ojibwe Nations to develop targeted climate adaptation strategies (Hansen and Conaway 2015). The injustices of excluding plural forms of knowledge from the broader climate policy landscape generate multimodal, cascading injustices that impact our collective—not just Ojibwe Nations'—abilities to develop and deploy relevant and effective climate action.

## Conclusion

Like all politics, climate politics are struggles over ideas about how we can, do, and should organize and govern ourselves, and to what ends. Broad scientific consensus that the root of the climate change problem are the human pursuits that generate greenhouse gas emissions has focused policy response, almost myopically, on reducing emissions. These approaches conceptualize the real danger of climate change as crossing an ecological tipping point at which Earth systems' functions are severely disrupted and altered (Rockström et al. 2009). Many Indigenous Peoples, including Ojibwe Nations, understand the climate change problem as a relational problem in which humans actively exclude the needs and rights of older-than-human relatives and disregard the worldviews, voices, and values of relatives who embrace their obligations to all relations, past, present,

and future. The danger, in this view, is in crossing a “relational tipping point” by marginalizing the thousands of years of observations and analysis that emerge from relationships to constitute TK (Whyte 2020). We do not suggest that one knowledge system should emerge victorious. Rather, our intent is to point out that existing scientific and policy efforts operate to oppress other ways of knowing and being, thereby restricting potential solutions to those generated within the same knowledge systems that produced the problem—furthering its super-wickedness (Levin et al. 2012). Relying on climate science alone will, at best, support continued focus on emissions reductions that are unlikely to effectively address climate change and, at worst, continue to obscure the more systemic, structural drivers of climate change and its impacts, allowing continued reproduction of climate injustices. To solve big, complex problems, we need diverse, plural, and ongoing contestations in both science and policy arenas.

The music that opened our exploration of climate change issues in Ojibwe Nations set the tone for our engagement: relationships, respect, reciprocity, and responsibility would serve as our guiding principles. Good research and effective policy-making requires that we respect all our relations—human and older-than-human; past, present, and future generations. It requires that we honor the relational reciprocities that make our Worlds possible. The Ojibwe Nations have long upheld their responsibility as stewards of these relationships; now, settler-scientists must finally recognize and respect the knowledge systems that have enabled Indigenous communities to act as stewards for their older-than-human relatives. To understand the threats that climate injustice poses to effective climate action and to overcome the policy paralysis that characterizes large-scale climate action, we need to understand the processes by which and implications of how Indigenous ways of knowing are routinely left out of climate science. Additional research needs to help us understand how, why, and with what effects the distance between climate science and the experiences of people most vulnerable to climate change impact climate action. How does the exclusivity of science—marginalization of knowledge systems and extricating climate science from climate change experiences—impact climate action? How might policy arenas facilitate the introduction, deliberation, and circulation of plural worldviews and knowledge systems?

We end with a call to settler-scientists to accept responsibility for abolishing the stench of injustice; to break down our disciplinary traditions, boundaries, and expectations; and to listen. Improving climate action requires democratizing and decolonizing the scientific enterprise. TK connects climate justice and climate science, provides the necessary relational basis for climate action, and overcomes fragmented scientific disciplines with ancient teachings of interconnectedness (e.g., David-Chavez and Gavin 2018). TK, though, is not simply another resource to be extracted and exploited; Indigenous ways of knowing are ways of living and therefore cannot and should not be molded to fit Western scientific norms. Subsequently, the aim is not to merge scientific and TK; rather, the goal is to create space where both forms of knowing can coexist, a space where these knowledge systems are respected equally and inform each other in ways that are reciprocal instead of extractive.



## Notes

1. In early 2021, we convened three listening sessions with GLIFWC Staff and Ojibwe Tribal Members as part of a National Science Foundation (NSF)–supported initiative to develop tribally driven research. The work in this article reflects this work. NSF Award No. 2044053.

2. See the University of Minnesota’s wild research initiative; see <https://manoominpsin.umn.edu>.

3. Although the verbatim texts of Chief Si’ahl’s speeches are questioned because they were neither given in English nor in written form, his reputation for drawing attention to European colonizers’ relationships to the Earth and the resulting environmental degradation is irrefutable (Clark 1985).

4. See <https://www.duwamishtribe.org/chief-siahl>.

5. The Ojibwe Creation story introduces the “original treaty,” an agreement in which animal relatives agreed to take care of the Anishinaabeg by providing food, clothing, and shelter. In exchange, animals expected respect and recognition. Today, Anishinaabeg continue the practice of *aasema* offerings before each hunt as part of fulfilling their obligations to their older-than-human relatives (Cooper 2009).

6. At the time of writing, the Wisconsin wolf hunt is in ongoing litigation in federal courts.

## References

- ACIA: Arctic Climate Impact Assessment. 2004. *Impacts of a warming Arctic: Arctic climate impact assessment*. ACIA Overview Report. Cambridge: Cambridge University Press.
- Alamgir, Mohammed, Petina L. Pert, and Stephen M. Turton. 2014. A review of ecosystem services research in Australia reveals a gap in integrating climate change and impacts on ecosystem services. *International Journal of Biodiversity Science, Ecosystem Services & Management* 10 (2): 112–27.
- Bang, Megan, and Doug Medin. 2010. Cultural processes in science education: Supporting the navigation of multiple epistemologies. *Science Education* 94 (6): 1008–26.
- Belfer, Ella, James D. Ford, and Michelle Mailliet. 2017. Representation of Indigenous peoples in climate change reporting. *Climatic Change* 145 (1): 57–70.
- Berkes, Fikret. 1993. Traditional ecological knowledge in perspective. In *Traditional ecological knowledge: Concepts and cases, 1*, ed. Julian T. Inglis, 1–9. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Center.
- Bohensky, Erin L., and Yiheyis Maru. 2011. Indigenous knowledge, science, and resilience: What have we learned from a decade of international literature on “integration”? *Ecology and Society* 16 (4): Article 6.
- Bolsen, Toby, and James N. Druckman. 2018. Do partisanship and politicization undermine the impact of a scientific consensus message about climate change? *Group Processes & Interpersonal Relations* 21 (3): 389–402.
- Chakrabarty, Dipesh. 2014. Climate and capital: On conjoined histories. *Critical Inquiry* 41 (1): 1–23.
- Child, Brenda J. 1998. *Boarding school seasons*. Lincoln, NE: University of Nebraska Press.
- Clark, Jerry L. 1985. Thus spoke Chief Seattle: The story of an undocumented speech. *Prologue Magazine* 18 (1). Available from <https://www.archives.gov/publications/prologue/1985/spring/chief-seattle.html>.
- Cooper, Nancy. 2009. *Fire and water: Original teachings & today’s duties: Ojibwe creation story literacy companion*. Owen Sound: Ningwakwe Learning Press.
- Cusick, Daniel. 1 June 2020. Climate change threatens the ancient wild rice traditions of the Ojibwe. *Scientific American: E&E News*. Available from <https://www.scientificamerican.com/article/climate-change-threatens-the-ancient-wild-rice-traditions-of-the-objibwe>.
- David, Peter, Lisa David, Heidi Kiiwetinepinesik Stark, Keke Jason Stark, Sean Niso-Asin Fahrlander, and Jason Manidoodin Schlender. 2019. Manoomin. In *Gaa-ina’oonwewizid Anishinaabe da-ganawendang (That which was given to the Anishinaabe to take care of)*. Odanah, WI: Great Lakes Indian Fish and Wildlife Commission (GLIFWC).
- David-Chavez, Dominique M., and Michael C. Gavin. 2018. A global assessment of Indigenous community engagement in climate research. *Environmental Research Letters* 13 (12): 123005.
- DeFoe, Marvin Shingwe Biness Neme. 7 January 2021. Knowledge shared at Voigt Intertribal Taskforce meeting.

- DeFoe, Marvin Shingwe Biness Neme, and Edith Leoso. 2021. Knowledge shared at CIVIC-STRONG Listening Sessions, February–May 2021. Sessions supported by NSF Award No. 2044053.
- Duwamish Tribe. n.d. Chief Si’Ahl. Available from <https://www.duwamishtribe.org/chief-siahl>.
- Ford, James, Michelle Maillet, Vincent Pouliot, Thomas Meredith, and Alicia Cavanaugh. 2016. Adaptation and indigenous peoples in the United Nations Framework Convention on Climate Change. *Climatic Change* 139 (3): 429–43.
- Hansen, Mark H., and Jessie Conaway. 2015. *Climate vulnerability assessment: Wild rice*. New Odanah, WI: Great Lakes Indian Fish & Wildlife Commission (GLIFWC).
- Haraway, Donna. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspectives. *Feminist Studies* 14 (3): 575–99.
- Hessels, Laurens K., and Harro van Lente. 2008. Re-thinking new knowledge production: A literature review and a research agenda. *Research Policy* 37 (4): 740–60.
- Hulme, Mike. 2019. Climate emergency politics is dangerous. *Issues in Science and Technology* 36 (1): 23–25.
- Intergovernmental Panel on Climate Change (IPCC). 2021. *Climate change 2021: The physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change*, eds. V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, and M.I. Gomis, et al. Cambridge: Cambridge University Press.
- Johnston, Basil. 1976. *Ojibwe heritage*. Toronto: McClelland and Stewart.
- Kahan, Dan M., Ellen Peters, Maggie Wittlin, Paul Slovic, Lisa Larrimore Ouellette, Donald Braman, and Gregory Mandel. 2012. The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change* 2 (10): 732–35.
- Kirkness, Verna J., and Ray Barnhardt. 1991. First Nations and higher education: The Four R’s—Respect, relevance, reciprocity, responsibility. *Journal of American Indian Education* 30 (3): 1–15.
- Levin, Kelly, Benjamin Cashore, Steven Bernstein, and Graeme Auld. 2012. Overcoming the tragedy of super wicked problems: Constraining our future selves to ameliorate global climate change. *Policy Sciences* 45 (2): 123–52.
- Loew, Patricia. 2013. *Indian nations of Wisconsin: Histories of endurance and renewal*. Madison, WI: Wisconsin Historical Society.
- Marion Suiseeya, Kimberly R. 2021. Towards a comparative politics of environmental justice: Critical perspectives on representation, equity, and rights. In *The Oxford handbook on comparative environmental politics*, eds. Erika Weinthal, Stacy VanDeveer, and Jeannie Sowers. Oxford: Oxford University Press.
- Martello, Marybeth Long. 2008. Arctic indigenous peoples as representations and representatives of climate change. *Social Studies of Science* 38 (3): 351–76.
- McCright, Aaron M., and Riley E. Dunlap. 2011. The politicization of climate change and polarization in the American public’s views of global warming, 2001–2010. *Sociological Quarterly* 52 (2): 155–94.
- Moser, Susanne C. 2016. Reflections on climate change communication research and practice in the second decade of the 21st century: What more is there to say? *Wiley Interdisciplinary Reviews-Climate Change* 7:345–69.
- Nordhaus, William. 2020. The climate club. *Foreign Affairs*. Available from <https://www.foreignaffairs.com/articles/united-states/2020-04-10/climate-club>.
- Orlove, Ben, Carla Roncoli, Merit Kabugo, and Abushen Majugu. 2010. Indigenous climate knowledge in southern Uganda: The multiple components of a dynamic regional system. *Climatic Change* 100 (2): 243–65.
- Petzold, Jan, Nadine Andrews, James D. Ford, Christopher Hedemann, and Julio C. Postigo. 2020. Indigenous knowledge on climate change adaptation: A global evidence map of academic literature. *Environmental Research Letters* 15 (11): 113007.
- Rockström, Johan, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, and Hans Joachim Schellnhuber, et al. 2009. A safe operating space for humanity. *Nature* 461 (7263): 472–75.
- Schlosberg, David, and Lisette B. Collins. 2014. From environmental to climate justice: Climate change and the discourse of environmental justice. *Wiley Interdisciplinary Reviews: Climate Change* 5 (3): 359–74.

- Smith, Henry A. 29 October 1887. Chief Seattle's 1854 speech. *Seattle Star*. Available from <https://web.archive.org/web/20070703094552/http://www.suquamish.nsn.us/chief.htm>.
- Smith, Heather A., and Karyn Sharp. 2012. Indigenous climate knowledges. *Wiley Interdisciplinary Reviews: Climate Change* 3 (5): 467–76.
- Treves, Adrian, Francisco J. Santiago-Ávila, and Karann Putrevu. 2021. Quantifying the effects of delisting wolves after the first state began lethal management. *PeerJ* 9:e11666.
- Tribal Adaptation Menu Team (TAMT). 2019. Dibaginjigaadeg Anishinaabe Ezhitwaad: A tribal climate adaptation menu. Odanah, WI: Great Lakes Indian Fish and Wildlife Commission (GLIFWC).
- Tuhiwai Smith, Linda. 2021. *Decolonizing methodologies: Research and indigenous peoples*. London: Zed Books Ltd.
- UN Framework Convention on Climate Change (UNFCCC) Secretariat. 2021. *Nationally determined contributions under the Paris Agreement. Synthesis report by the Secretariat*. Available from <https://unfccc.int/documents/306848>.
- UN Special Rapporteur on the Rights of Indigenous Peoples. 2017. *Impacts of climate change and climate finance on Indigenous Peoples' rights*. Geneva: United Nations. Available from <https://www.ohchr.org/EN/Issues/IPeoples/SRIndigenousPeoples/Pages/AnnualReports.aspx>.
- White Earth Band. 2018. Rights of Manoomin. Resolution No. 001-19-009 and No. 001-19-010. White Earth, MN: White Earth Band of Chippewa Indians. Available from <https://whiteearth.com>.
- Whyte, Kyle P. 2013. On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecological Processes* 2: Article 7.
- Whyte, Kyle P. 2020. Too late for indigenous climate justice: Ecological and relational tipping points. *Wiley Interdisciplinary Reviews: Climate Change* 11 (1): e603.
- Wilkinson, Katharine, Ryan Allard, Kevin Bayuk, Tala Daya, Chris Forest, Chad Frischmann, Denton Gentry, João Pedro Gouveia, Mamta Mehra, and Eric Toensmeier. 2020. *The drawdown review: Climate solutions for a new decade*. San Francisco, CA: Project Drawdown. Available from <https://www.drawdown.org/drawdown-review?ga=2.125859013.937844716.1634321851-1287850834.1634321851>.
- Wisconsin Green Fire. 2021. *The February 2021 Wisconsin wolf hunt: A preliminary assessment*. Madison, WI: Wisconsin Green Fire. Available from <https://wlgreenfire.org/the-february-2021-wisconsin-wolf-hunt-a-preliminary-assessment>.