

models of community get to the heart of social and natural relationships as an expression of human biophilia and the reality of human society as a part of, rather than separate from, nature. These are ancient ideas, but they are also timeless ideas. Native Science, Indigenous community, and the kincentric universe must be allowed to rise in our collective consciousness once again. In the perilous world of the twenty-first century, it may well be a matter of our collective survival. Indeed, *The "Indigenous Mind" Is Rising!*

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Mishkos Kenomagwen, the Lessons of Grass: Restoring Reciprocity with the Good Green Earth

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Introduction

When we look about us on the earth, what we see is colored by our worldview and the languages that we use to describe our observations. A landscape of streams and lakes, mountains and rich valleys, shared by thousands of species of plants and animals, is understood through the lens of the western materialist worldview as a wealth of ecosystem services or natural resources. In contrast, through the lens of traditional Indigenous philosophy the living world is understood, not as a collection of exploitable resources, but as a set of relationships and responsibilities. We inhabit a landscape of gifts peopled by nonhuman relatives, the sovereign beings who sustain us, including the plants.

In the ancient teachings of the Anishinaabek, it is said that when Nanabozho, the original man was placed upon the earth, he was filled with wonder at the strangeness and the beauty of the world, which was at that time, unknown to him. The Creator had instructed him to wander to the Four Directions, as a humble student, learning all that he could from the others who were already living there in harmony with one another. He was given the responsibility of speaking with every kind of being and learning from them what gifts they had to share with the people who would be coming. Every plant he encountered taught him of its worth, the way its roots could be eaten, the medicines it made, how its bark was ready to become lodges, its branches baskets, its berries to sweeten life. From these teachings, he followed the Creator's instructions and bestowed a name on every species. As he traveled the earth, the plants took care of him, providing him with the materials for his canoe, the cordage for his fish net, food for his belly and medicines to protect him. In each of the sacred directions, he encountered a powerful plant that would be his teacher. (Benton-Banai, 2010)

The Nanabozho stories from the beginning of the world reflect the understanding of humans, not as dominators, but as humble students of the earth's other beings. Nanabozho was instructed to respect all the beings of the earth, and in ways both comical and profound he learned many lessons of what that meant. A fundamental tenet of traditional plant knowledge is that the plants are understood, not as mere objects or lower life forms as the western "pyramid of being" might suggest, but as nonhuman persons, with their own knowledges, intentions, and spirit. Not only are the plants acknowledged as persons, but they are also recognized as our oldest teachers. It is said that the plants have been here far longer than we have; they know how to make food and medicine out of light and air and then they give it away. They unite the earth and the sky and exemplify the virtues of generosity, providing us with all that we need to live. They heal the land and feed all the others in creation, i.e., the ecosystem. No wonder they are revered as teachers by we humans who are just learning how to live on the earth. In fact, humans, who lack the generous gifts of plants and animals, are often referred in Indigenous cultures as "the younger brothers of creation." If plants are our teachers, what are they teaching us and how can we be better students? These are among the responsibilities of humans. Traditional plant knowledge is the product of this orientation to humility, to careful attention to being a student of plants. This essay explores, in a small way, some lessons learned in that ongoing process, through listening to teachers, both human and plant.

Plants clearly embody the flow of gifts that sustain the animal world, including humans. In some Anishinaabek teachings plants are recognized as the second level of creation, on whom all other life forms rely. Rocks, soil, and water, upon whom the plants depend, comprise the first level, animals the third, creating a chain of being that reflects contemporary scientific principles of trophic pyramids of energy flow. In my culture, it is said that every being has its own gifts and the Creator instructed the plant people to use their gifts to help the humans who were coming. As Nanabozho, the culture hero, trickster, and great teacher of the Anishinaabe learned, plants have continued to fulfill that responsibility. In fact, in our language, *min*, the word for "berry" and the word for "gift," are closely related.

Acknowledgment of human reliance on the gifts of plants is incapable in a subsistence economy, where daily needs of food, medicine, tools, clothing, containers, shelter, and more, are met by the plants. The calendar months in the growing season are often named for what the plants are providing at that time – for example, the strawberry moon,

the maple sugar moon, the blueberry moon, wild rice moon, blackberry moon. Seasonal cycles of ceremony honor those life-sustaining gifts. The people were guided by the powers of the sacred herbs and healed by the medicines. From the willows of the cradleboard to the cedar of the grave, plants offer their gifts to people. In other ways, simultaneously material and spiritual, people understand their debt to the plants. So close is the reliance that plants are honored in many creation stories, as the origin of the people, like the Wabanaki who emerged from the ash tree, or Mayan peoples made of corn meal. In these cultures plant-human relationships had a central place in the life of an individual, the family, the community, and the nation – a profound connection that is difficult to visualize in an industrial society in which plants, if acknowledged at all, are often viewed only as commodities or adornments to the built landscape.

This orientation to the world as an ongoing gift exchange between the human and the more-than-human world is foundational in Indigenous environmental philosophy. It raises the question, "How does one respond to a world made of gifts?" The answer is likely very different from the response engendered by the notion of a world of commodities or property. Gift economies generate cultures of reciprocity in which humans have a moral, spiritual, and material responsibility to reciprocate the gifts received. Native peoples of the eastern deciduous forest share elements of a creation story that is emblematic of the question, "What is our responsibility in return for the gifts of the earth?"

In the beginning, there was the Skyworld, where people lived much as they do on earth today. There grew the great Tree whose branches bore all the seeds, fruits, medicines, grasses, every kind of plant. One day, a great wind came and toppled the tree, opening a hole in the Skyworld where its roots had been. In curiosity, a beautiful young woman, called Gizhgokwe in our language, the Skywoman went to the edge of the hole to look down. She lost her footing and began to slip, grabbing on to the Tree branch to stop herself.

She fell like a maple seed pirouetting on an autumn breeze. A column of light streamed from a hole in the Skyworld, marking her path where only darkness had been before. But in that emptiness there were many, gazing up at the sudden shaft of light. They saw there a small object, a mere dust mote in the beam. As it grew closer, they could see that it was a woman, arms outstretched, long black hair billowing behind as she spiraled toward them.

The geese nodded at one another and rose as one from the water, in a wave of goose music. She felt the beat of their wings as they flew beneath and broke her fall. Far from the only home she'd ever known, she caught her breath at the warm embrace of soft feathers. And so it began. From the beginning of time, we are told that the very first encounter between humans and other beings of the earth was marked by care and responsibility, borne on the strong wings of geese.

The world at that time was covered entirely by water. The geese could not hold Skywoman much longer, so they called a council of all beings to decide what to do, loons, otters, swans, beavers, fish of all kinds. A great turtle floated in the watery gathering, and he offered to let her rest upon his back and so, gratefully she stepped from the goose wings onto the dome of the Turtle. The others understood that she needed land for her home. The deep divers among them had heard of mud at the bottom of the water and agreed to retrieve some. The loon dove to get a beakful, but the distance was too far and after a long while he surfaced with nothing to show for his efforts. One by one, the other animals offered to help, the otter, the beaver, the sturgeon. But the depth, the darkness and the pressures were too great for even these strongest of swimmers who came up gasping for air and their heads ringing. Soon, only the muskrat was left, the weakest diver of all. He volunteered to go while the others looked on doubtfully. His little legs flailed as he worked his way downward. He was gone a very long time. They waited and waited for him to return, fearing the worst for their relative. Before long, a stream of bubbles rose from the water and the small limp body of muskrat floated upward. He had given his life to aid this helpless human. But, the others noticed that his paw was tightly clenched and when they opened it, there was a small handful of mud. Turtle said "Here, put it on my back and I will hold it."

Skywoman bent and spread the mud across the shell of the turtle. Moved by gratitude by the gifts of the animals, she sang in thanksgiving and then began to dance, her feet caressing the earth with love. As she danced her thanks, the land grew and grew from the dab of mud on Turtle's back. Like a good guest, she had not come empty-handed. She had in her hand, the broken branch from the Tree of Life and so over the new land, she spread the seeds from the Tree in the Skyworld, sowing the land with the gift of the plants. And so, the earth was made. Not by one alone, but from the alchemy of the plant and animal gifts, and human gratitude and reciprocity. Together they created what we know today as Turtle Island. The following is a rephrasing of a story from Kimmerer:

Our oldest teachings remind us that gratitude is the thread that binds us together. They were her life raft at the beginning of the world, and now so much closer to the end, we must be theirs (Kimmerer, 2013a).

Creation stories offer us a metaphoric glimpse of the principles that guide interactions of traditional Indigenous peoples with the natural world. The goal of this chapter is to explore the ways in which the relationships of human reciprocity with the plant world are manifest. Consider how the thinking and practices developed by our ancestors can be a guide for our path forward. The approach must be both ancient and urgent in order to meet the challenges of human societies facing unprecedented levels of anthropogenic environmental change and uncertainty. By reflecting on ancient teachings, we aspire to find strategies that enable us to heal our damaged relationships with the more-than-human world, so that we might all continue.

Cultures of Gratitude Lead to Cultures of Reciprocity

Native environmental philosophy acknowledges that our human lives are utterly dependent on the lives of other beings and thus our first responsibility is for gratitude. As the Skywoman story suggests, recognition of the world as gift is an invitation to thanksgiving, and indeed many Indigenous cultures have been characterized as "cultures of gratitude."

The expression of gratitude may be emotional and spiritual but it also engenders very practical outcomes, with adaptive evolved survival values. The practice of gratitude can in a very real way lead to the practice of self-restraint, avoiding rampant exploitation. The evolutionary advantage of cultures of gratitude is clear. Indigenous story traditions are full of cautionary tales about the failure of gratitude. When people forget to honor the gift, the consequences are always both spiritual and material. In story, the spring dries up, the corn doesn't grow, the animals do not return, and the legions of offended plants and animals and rivers rise up against the ones who neglected gratitude. The western storytelling tradition is strangely silent on this matter. So we find ourselves in an era when centuries of overconsumption have depleted natural resources and left human societies materially and culturally impoverished by a deep disconnection from the living world.

Gratitude is most powerful as a response to the earth because it provides an opening to reciprocity, to the act of giving back. How do cultures engage in reciprocity with the more-than-human world? How do we give back in return for the gifts of the earth? As the Skywoman story and millennia of lived experience attest, this was a central question for our ancestors, as it is for us today. Traditional knowledge is rich with teachings about how to reciprocate. The imperative of reciprocity is explored in what Melissa Nelson refers to as our "Original Instructions," i.e., ethical systems that govern relations with the human and the more-than-human world. The exercise of reciprocity can take many different forms.

Ceremonies are a form of reciprocity that renews bonds between land and people and focuses intention, attention, and action on behalf of the natural world, which is inclusive of the spiritual world. From the First Salmon ceremonies of the Northwest to the great Thanksgiving Address of the Haudenosaunee, ceremony represents a ritual gift of spiritual energy, power, and beauty that is offered in reciprocity for the gifts, and contributes to a balance between humans and the more-than-human world. Plants, of course, often play vital roles in ceremony, as ritual foods and objects, and as vehicles for interface with the sacred. Consumption

of plant foods in ceremony reinforces the appreciation of the ways that plants and animals give up their bodies to feed our own, in a sacred transaction of life for life.

It is important to remember that spiritual ceremonies, in addition to their power in unseen dimensions, may also have important immediate, direct effects on the physical world and thus constitute a form of "practical reverence." For example, the traditional four-day ceremony to honor the ripening of wild rice includes a prohibition on gathering during that ritual time. The abstention from harvest during ceremony yields pragmatic consequences for the flourishing of the rice, which benefits from four days of seed-drop to reseed the rice beds, before people come to gather. Likewise, salmon ceremonies that permit the salmon to run upriver without impediment, welcoming them back to their natal waters, ensure that an adequate number of fish return to the spawning grounds.

Prescriptions of Reciprocity: The Honorable Harvest

Of course, acknowledging the complete dependence of humans on other beings creates tension. It is understood that humans must take other lives in order to sustain our own, so the way in which plants and animals are harvested becomes very important, and they should be taken in such a way that the life received is honored. This inherent contradiction, implicit in our heterotrophic biology, is resolved in Indigenous philosophy by practices of reciprocity, by giving back.

In the western worldview, plants are seen as either "wild" and therefore free for the taking, or they are owned as "property" that can be bought and sold. From this perspective of plants as "natural resources," whatever protocols exist to govern harvest are typically oriented toward maximizing efficiency. In the best management practices, harvesting is done in a way that does not damage the resource for future harvest, ensuring its sustainability. However, when plants are valued not as commodities but as sovereign persons who generously offer their gifts, additional protocols arise as part of traditional harvesting practices.

As clever consumers, we humans recognize our own tendency to take too much, to confuse our wants and our needs. Traditional Ecological Knowledge is rich with teaching stories explaining the consequences of taking too much. All too often Nanabozho ends up with an aching belly, but sometimes the negative result extends to others. When Heron taught Nanabozho a new fishing technique, he passed along a caution: "This way is so quick," Heron said, "it's easy to take too many, so catch only

what you need for supper." But Nanabozho, so pleased with his new technology, filled his drying racks with more fish than he could ever eat. He went yet again to the lake to get even more, and while he was gone, Fox came and devoured every last bite of dried fish. It was a hungry winter for Nanabozho, and when he went to replenish his stocks the lake was now empty (see Johnston, 1995).

Such teaching stories are part of the Honorable Harvest, a set of unwritten guidelines, both ethical and practical, which govern human consumption. The canon of the Honorable Harvest guards against over-exploitation, protecting the future of the plant or animal, as well as the human future. These ancient practices resonate today, prescribing an alternative to the dominant consumptive materialist worldview in which humans are understood primarily as consumers and not as contributors to the well-being of other organisms.

Plant harvesting practices of the Honorable Harvest provide examples of reciprocity between culture and plant populations (Kimmerer, 2013a). Naturally, harvesting protocols differ among cultures, bioregions, and different kinds of plants. However, within this great, locally adapted diversity, traditional harvesters of wild plants often share similar teachings, passed down between generations, about the proper ways to gather so that the plant people and the human people will both continue to flourish.

I can share here some of what I have learned by listening to plant knowledge holders, paying attention to the teachings of the plants themselves, and through the actual practice of gathering. It represents my limited understanding of what I have gratefully learned, and it acknowledges that there are many different representations of these teachings.

I have been taught that when we go gathering, we don't just seek out a resource-rich patch and begin taking whatever we want. To gather properly, our hearts and minds must be clear of negative thoughts and we go only with good intentions. When we encounter the plant we are looking for, we introduce ourselves and explain our purpose. I was taught to greet the first one, but never to take it, for it might be the last. Instead, it is left alone to perpetuate its family and to carry the knowledge that a respectful person has come seeking. If one does find additional plants, then a traditional gatherer speaks to those plants, asking for permission to harvest, hoping to learn if the plants will share their gift with humans.

If one asks permission, then one must also listen for the answer. This kind of listening may involve many different kinds of perception. It might include the strictly empirical observation of whether the population is

large and healthy enough to support harvest. It may be based on previous monitoring of the patch, its harvest history and population trajectory. The evaluation may also include detailed observations of other signs in the forest that are interpreted as positive or negative responses and often entail intuitive understanding about whether the plant is or is not willing to share itself. This subtle communication, which is readily interpreted by a practiced and attentive harvester, might include the apparency of the plant, the play of light, variations in resistance to harvest, and sensation of an emotional response between plant and harvester.

If the plant is selected for harvest, then the Honorable Harvest calls for a further set of respectful practices. I have been taught that one never takes more than she needs for the expressed purpose. Regardless of need, never take more than half of what is available. I'm told that in the old times, the harvester would somehow mark the patch to indicate to others that it has already been harvested and should now be left to rest. Often, certain patches were known to be the responsibility and gathering ground of a certain family and others would respect those boundaries. The harvesting method employed should be one that inflicts as little damage as possible to the surrounding vegetation, i.e., one doesn't use a shovel if a digging stick will do. If the ground is disturbed, the harvester repairs the damage.

Whatever plants are taken must be fully used and not wasted, so as to honor the gift. Used plant material is returned respectfully to the earth when its purpose has been met. Just as the plant shares with the people, we are instructed to share what we have harvested, for it does not belong to us, but to the plants themselves. The harvester is also obligated to express gratitude for the gift received and to reciprocate the gift. Traditional harvesters often leave a small gift such as tobacco or another valued item. Giving tobacco is the most common practice, which mirrors the giving of tobacco to human elders and teachers, in return for knowledge and as a sign of respect and a vehicle for unspoken communication. Taking without giving back is considered a breach of the Honorable Harvest.

Many plant gatherers also reciprocate the gift of the plant through specific postharvest practices. For example, a harvester who digs a rhizome may break the rhizome into pieces and replant them, or separate small bulbs from large ones and transplant them to new places nearby to spread the population. Often seeds are scattered, the plots are weeded to reduce density, and the soil is aerated by digging and replacing the disturbed soil. Shrubs may be pruned, small trees coppiced, sedge beds weeded and tilled by harvest. These practices exemplify "practical reverence," an action

that has both spiritual and material dimensions which contribute to the well-being and longevity of the plant population.

The Honorable Harvest represents a prime example of the holistic, integrative nature of Traditional Ecological Knowledge (TEK), in which detailed empirical knowledge, material practices, ethical and spiritual responsibilities, and indigenous values of kinship and mutual responsibility are all engaged as a way of expressing a reciprocal relationship with the plant world. This cultural canon, devised by generations of knowledge holders, may seem simple on the surface but in fact represents a sophisticated symbiosis of philosophy and practice, which couples values and actions to yield a formula for mutual thriving, an integration not yet achieved by western models of sustainability. Coupling "taking" to the moral responsibility for "giving back in equal measure" is a missing link in western economic models, in which the good of the human person and the good of the land are seemingly philosophically independent, and the intrinsic good of nonhuman persons is absent from the economic equation.

Kyle Whyte, a Potawatomi professor of environmental philosophy, states, "The intent of indigenous governance is to make the values and relationships in our creation stories manifest" (Amerind seminar, April 2013). The Honorable Harvest serves as an example of "policies" in which the values expressed in the creation stories – of mutual responsibility, of reciprocity, of the coupling of human and nonhuman well-being, and of returning the gift – are actualized. They resonate with the teachings of a gift exchange between people and nature, which underlie the story of Skywoman. The practices are not legislated, but rather are reinforced by living with shared values, where ethical prescriptions are in harmony with biophysical necessity. Contemporary movements that support ecological economics (Costanza et al., 1996; Daly and Farley, 2011; Hawken, 1993) couple patterns of human consumption to ecological principles and ethics, reflecting the same necessities to which our Native ancestors adapted through the canon of the Honorable Harvest.

This exploration makes no claim that the canon of the Honorable Harvest is universally practiced in Indigenous communities. Indeed, there are far too many instances in which the erosion of TEK through the legacies of colonization and imposition of western economic forces have replaced traditional philosophies. Knowledge of these concepts and practices is at risk of disappearing, just when it is most needed. The landscape bears witness to the impact, not only in plant harvesting but also in resource extraction of all kinds. We face a tremendous challenge, and a tremendous need to reclaim the ethic of the Honorable Harvest, not

only in practices of berry picking, but also as constraints and guides on humans' unrestrained consumption of the living world, be it water, fossil fuels, minerals, forests, soil, or plants.

Mishkos Kenomagwen: The Teachings of Grass

The teachings of the Honorable Harvest and concern over disappearing species brought my students and me under the tutelage of a great plant teacher, sweetgrass. Sweetgrass, or *wiingaashk* in the Potawatomi language, bears the scientific epithet of *Hierochloe odorata*, meaning the sacred, fragrant holy grass. Sweetgrass is known as one of the four sacred plants of the Anishinaabe and a plant deeply connected to our creation stories. Benton-Banai writes that when Nanabozho traveled to the North, he met *wiingaashk* and learned that this grass is of the "hair of Mother Earth." Its scent would protect and comfort him on his journeys and bring goodness to his path. Sweetgrass is said by many to be one of the first plants to appear on Turtle Island, perhaps arriving in the hand of Skywoman herself. Strands of sweetgrass are traditionally plaited into braids, just as one tenderly braids the hair of a loved one, as a tangible sign of loving care expressed for Mother Earth. In addition to its respected symbolic value, sweetgrass is used as a smudge, a ceremonial plant, a medicine, and as a component of traditional basketry, often as a decorative counterpart to baskets constructed of black ash splints. So important is this plant, it is known to be a cultural keystone species, write Garibaldi and Turner (2004), for many Indigenous peoples throughout its range.

We were approached by Mohawk basketmakers who reported their observations that the plant seemed to be in decline. Its abundance within known harvesting locales was diminishing, and suitable gathering sites were becoming fewer every year. This case study is the result of research conducted by graduate students Daniela Shebitz and Laurel Reid, with support from our collaborator and traditional practitioner Theresa Burns, a Mohawk basketmaker.

Drawing on the traditional knowledge of sweetgrass distribution and what appeared to be its decline, we conducted an inventory of historically known sweetgrass occurrences, based upon herbarium records at universities throughout the northeast. These sites were revisited and the presence or absence of current sweetgrass populations was recorded, as well as changes in habitat. Shebitz and Kimmerer's (2004, 2005) recurrence data supported the basketmakers' hypothesis of population decline in previously known sites; many populations of sweetgrass known from

historic records were gone. Shebitz and Kimmerer (2004) examined the trend and attributed the losses to habitat destruction, to successional replacement, and to habitat fragmentation. Sweetgrass is typical of open, early successional habitats and is outcompeted when shrubs and forest encroach. As a rhizomatous perennial, with poor seed viability, it extends its population by vegetative growth, making it highly susceptible to loss from barriers such as roads in a fragmented habitat. Interestingly, Shebitz documented that the pattern of sweetgrass loss among historically known sites was not geographically random. A significant concentration of historically known sites with persistent sweetgrass populations occurred surrounding the Mohawk reservation where numerous basketmakers continue traditional harvest. Her results were suggestive of the oral expression often heard among plant gatherers: "If we don't use it, it will go away. If we use it respectfully, it will stay with us and flourish."

Basketmakers were also interested in the impacts of harvesting on intact sweetgrass populations, expressing their concern that unsustainable harvest levels may contribute to decline and disappearance, and that violations of the Honorable Harvest might be responsible for the reduced populations. The basketmakers described two different and potentially competing harvest methods, referred to as "the traditional and proper method" by different sweetgrass pickers. Some gatherers harvest sweetgrass by pinching individual blades from the base of the plant. Others harvest a few stems at a time by a quick snap and pull at the plant base, which removes a cluster of shoots, often including small roots. These are known as the pinch and the pull methods, respectively.

Graduate student Laurel Reid created experiments to assess the potential outcomes of these two harvesting methods. Using a restored sweetgrass meadow as a research site, she set up a series of experimental harvest plots. Each plot was fully censused prior to harvest to determine stem density, height, and biomass. The plots were then randomly assigned to one of three harvest treatments, representing either pinch, pull, or the unharvested experimental control. In the harvested plots, 50 percent of the grass stems were removed by either pinching or pulling in an evenly distributed pattern throughout the plot, reflecting the basketmakers' dictate, "We never take more than half." After harvest, sweetgrass stems in all plots were individually tagged in order to monitor rates of growth, mortality, and new tiller production through the year. The experiment spanned two full cycles of summer harvest and postharvest monitoring.

The western science paradigm, which regards humans as primarily antagonistic to the success of other species, would suggest that the

unharvested controls would have the greatest growth and reproduction, while mortality would rise with increasing intensity of harvest. However, that was not the case.

In the year following the first harvest, a notable response occurred in the harvested plots. Instead of the harvesting-induced decline anticipated by conservation biologists, an elevated rate of regrowth occurred, which not only replaced all the harvested shoots, but the density of new shoots was nearly 80 percent higher than the control. The plots harvested by both the pull and the pinch method yielded a strong increase in new shoots. The control plots, in contrast, experienced the lowest level of new tiller production and a significant increase in mortality. During the second year of the experiment, the difference in new shoots was even greater, more than doubling the rate of regrowth in the control in the plots where tufts of sweetgrass were pulled. In every case, the harvested plots fully regained the shoots that had been harvested, for a sustained yield over two years, despite harvesting 50 percent of the plants annually. The control plots continued to decline and experienced a higher rate of competition with colonizing forbs. Regardless of harvest type, the harvested plots were much more vigorous than the control. These experimental studies demonstrate that sweetgrass plants respond positively to traditional harvest, resulting in sustained or even stimulated regrowth rates. The only negative outcomes occurred when harvest was absent.

The results of the experiment can be expressed in two different idioms, each consistent with the cultural context of two different knowledge systems. While the results ran counter to conventional scientific wisdom, scientific approaches search for a mechanism to explain the unexpected outcome. The materialist, process-oriented interpretation explains that the stimulation observed in sweetgrass growth is due to a physiological shift known as "compensatory growth," in which the biomass lost to harvest is rapidly replaced by increased growth. This rapid regrowth has been observed in a number of grass species subject to herbivory, where the new shoots arise from subterranean apical meristems, or growing points. The greater stimulation observed after the "pull" harvest may be attributed to breakage of the rhizome, which stimulates tillering from buds located along this underground stem. The postharvest recovery is also associated with reduced resource competition, as light, water, and nutrients become more available when plant density is reduced. The decline in vigor of the control plots is likely to be associated with the accumulation of a mulch of dead, unharvested stems, which may accelerate nitrogen immobilization in the biomass and thus reduce nutrient availability. The mulch layer may also provide a

microclimate favorable for competitors or pathogens. In sum, the mechanistic explanation for the findings can be stated: Harvest causes increased population growth as a result of reduced density, increased resource availability, and compensatory growth following biomass removal.

The relational explanation, grounded in Traditional Ecological Knowledge, recognizes agency of the plants in relation to human attitudes and practices. The experimental results are in full accord with the theories shared by traditional herbalists and gatherers (e.g., Ortiz, 1993), expressed in the oral tradition and repeated here: *If we respect a plant and use it well, it will stay with us and flourish. If we disrespect or ignore it, it will go away.* Not using a plant, failing to gather the gifts it offers, is understood as disrespectful in a worldview that recognizes plants as non-human persons, each with its own gifts and responsibilities. Indeed, the decline of the unharvested control and the stimulation of the harvested plants support this interpretation.

The response of the plants themselves, represented in the data, demonstrates that both cultural interpretations are valid in describing the phenomenon and represents mutually reinforcing explanations. The convergence in interpretation supports the Indigenous teaching that plants are the teachers. In this case, the sweetgrass was the teacher and the lesson could be expressed in two complementary frameworks, in the language of both TEK and Scientific Ecological Knowledge (SEK). The two explanations converge around the understanding that the human activity of harvesting is simultaneously beneficial to humans and plants. The study exemplifies the Indigenous notion of the role of humans as active participants in the well-being of the landscape. In this case, the removal of humans, as often dictated by modern conservation guidelines, would lead to the decline of sweetgrass, as human harvesting is vital to its success. This finding helps to explain the distribution of sweetgrass around Indigenous territories where basketmakers are active.

It is important to recognize that not all plants are capable of compensatory growth, and not all respond positively to harvest. Many slow-growing, long-lived plants of stable habitats have life-history characteristics that make them particularly vulnerable to harvest and overexploitation. Skilled Native harvesters do not uniformly apply the same techniques and harvest levels to all species, rather adjusting the specific protocols based on the Honorable Harvest to the nature of the plant, so that certain species are rarely harvested and when taken are tended in species-specific ways.

The case of sweetgrass is but one of a growing number of studies (e.g., Anderson and Rowney, 2002) in which academic ethnobotanists

are finding that TEK is rich with examples where harvesting activities are linked to the well-being of the plant population, a phenomenon well known to the harvesters themselves. Among elder holders of traditional plant knowledge, one frequently hears expressions such as, "That plant has disappeared because no one picks it anymore," or, "That tree has gone away because people forgot how to use it," or the admonition, "We better go out digging or else there won't be any more for our grandchildren." In this sense, using a plant is a practice of respect, rooted in the notion of the plant as person. In order to maintain reciprocity and the integrity of the gift economy, there must be receivers of gifts, in order to honor the givers. Failure to accept the offered gift, i.e., not harvesting the fruits/roots/seeds that are offered, is viewed as disrespectful.

Ethnoecologists have documented a great many examples of sustainable harvesting practices in which human needs are met, while preserving and enhancing the regenerative capacity of the plant resource itself. Kat Anderson (2005), in her book *Tending the Wild*, and Deur and Turner (2015) in *Keeping It Living* contend that harvesting relationships between plants and people can maintain and even enhance the vitality of the plant population. The loss of tending relationships with certain plant species has been associated with decline of cultural keystone species.

The experiment clearly demonstrates that to restore sustainable sweetgrass populations, one must also restore the harvesting relationships that enable it to flourish. Restoring sweetgrass, without also restoring the disturbance regime provided by harvesters, would be an exercise in futility, because the well-being of the plants and the people are linked.

This mutualism between harvester and harvested presents an important counterpoint to the dominant paradigm of western conservation practice, which frequently recommends the elimination of harvest in order to protect vulnerable populations, rather than prescribing the restoration of harvesting relationships. Understanding the significance of mutualistic relationships between harvesters and plants of cultural significance can inform a new perspective on restoration in which human relationships, termed "cultural services," become a goal of restoration as well as restoration of ecosystem services.

Restoration: A Contemporary Practice of Reciprocity

Ecological restoration is a potent contemporary response to the question, "How do we enter into reciprocity with the living world?" We can use our considerable human gifts to heal the land, enacting the responsibilities

of the Honorable Harvest in a landscape from which we have taken too much.

Through the relatively recent history of ecological restoration (Cairns and Heckman, 1996), the goals of this healing practice have developed and evolved (Higgs, 2003; Hobbs and Norton, 1996). The goal has greatly broadened from its beginnings as the direct revegetation of damaged land by installing artificial vegetation assemblages, heavily subsidized with inputs of water and nutrients, to emulating nature, with encouragement of self-sustaining communities with intact ecological structures and functions. But it would be a mistake if we confined our efforts to the realm of restoring ecosystem structure and function alone (Nabhan, 1991). Further advances have highlighted the incorporation of human values and biocultural restoration (Egan et al., 2011; Long et al., 2003). Expansion of restoration goals to include the mutualistic role of humans as active participants in land healing through cultural practices has been informed by Traditional Ecological Knowledge (Anderson and Barbour, 2003; Kimmerer, 2000; Long et al., 2003; Martinez, 2003) and is termed "reciprocal restoration" (Kimmerer, 2012).

Reciprocal restoration is the mutually reinforcing restoration of land and culture, such that the repair of ecosystem services contributes to cultural revitalization, and renewal of culture promotes restoration of ecological integrity. In Indigenous communities, these reciprocal relationships may include the return of subsistence activities, the practice of traditional resource management, the restoration of traditional diets, language revitalization, and the exercise of spiritual/ethical responsibility. Concepts of reciprocal restoration also apply to mainstream society by re-engaging people with land, renewing place-based connections, and supporting cultural practices that sustain the land. Integrating TEK can support this new direction in restoration ecology, as a model for restoration of reciprocal relationships.

Restoration of Knowledge: People of the Seventh Fire

After centuries of institutionalized attempts to suppress Indigenous ways of knowing, TEK is increasingly being embraced as a partner to scientific knowledge (Berkes, 2008; Berkes et al., 2000; Drew and Henny, 2006; Martin et al., 2010; Mauro and Hardison, 2000). TEK is also sought out by policy makers and scientists as a source of models for sustainability (Berkes, 2004; Berkes et al., 1995; Huntington, 2000), particularly as the limitations of western scientific approaches become apparent in an era of

increasing uncertainty produced by anthropogenic climate change and resource depletion.

The call to bring traditional environmental philosophy to bear on contemporary social and environmental issues is widespread (Deloria, 1995; Kimmerer, 2013b; LaDuke, 2005; Nelson, 2008; Wildcat, 2009). Environmental leader and Onondaga Nation clan mother, the late Audrey Shenandoah, taught, "This is why we have been able to hold on to our traditional teachings, because there would come a time when all of the world's people will need to learn it for the earth to survive."

The history of knowledge loss and the contemporary responsibility to restore that knowledge is embedded in ancient teachings. Anishinaabe peoples speak of the Prophecies of the Seventh Fire (Benton-Benai, 2010), which describes the migration story of our people, from the time of the First Fire among our Wabanaki relatives at the mouth of the St. Lawrence River. They left in response to a sacred message that counseled the people to move west as a safeguard against the great changes that were to come to Turtle Island. Over many generations, the people followed the guidance to move until they came to "where the food grows on the water," the land of wild rice. The Seventh Fire teachings record the history both of the migration and the changes that befell the people upon the arrival of newcomers. It foretells the time when people will be separated from one another, from traditional lands, from spiritual ways, from language. Teachings speak of the great hardships and losses endured along the path, up to a time when the air is not fit to breathe and we can no longer lift a cup of clean water from streams, to a time when plants and animals turn away from us. All of this has come to pass.

We are told that all the world's peoples, Native and newcomers alike, will stand at a fork in the road and face a choice about the future. One path is the soft green path of life. The other is a burnt path, sharp and black. Elders say these two choices represent the spiritual path that honors life and compassion, and the materialist path of greed and selfishness – stark choices between the world understood as a sacred gift and the world in which Mother Earth is seen as a mere object to exploit. We stand at that crossroads. The prophecies are clear that in this time a new people will arise, the People of the Seventh Fire. These People will need great courage and understanding to lead the way. The teachings say that in order to walk forward on the path of life, we must first turn around and walk back along the trail that our ancestors followed and pick up what was left behind for us: fragments of land, remnants of stories, plant and animal relatives, and our languages and teachings, such as the Honorable

Harvest. With these treasures in our bundles we will be prepared to walk the green path and put the world back together. These teachings of loss and renewal, of gathering and traditional knowledge, speak directly to the covenant of reciprocity – of reciprocity between generations and of a renewed reciprocity between people and the land.

To my mind, the teachings of the Prophecies of the Seventh Fire speak of healing – healing the land and our relationships to land. This is the next step in answering the question, "How do we enter into reciprocity with the living Earth?" We do it by healing the damage we have done through unrestrained consumption, by violating the precepts of the Honorable Harvest. In the spirit of reciprocity and the Seventh Fire teachings we are called to restoration. A wealth of knowledge and practices related to the restoration of the structure and function of ecosystems can help revive the ecosystem services upon which all life relies. However, it is not only the land that is broken but our relationship to it. Our responsibility is not only to restore the land, but also to heal our relationship with land, restoring the covenant of respect, responsibility, and reciprocity.

On many damaged lands, the plants rush in to heal the broken ground. They carry the gifts for colonizing the open space, building soil, reestablishing the food chain and nutrient cycles, and restoring productivity. If we are open to a kind of intellectual biomimicry, the plants provide us with metaphors and models for the work of healing humankind's relationship to land. The plants can be teachers, but we must know how to be students.

Plant Knowledge Revitalization

At the same time that TEK is becoming accepted as a rich source of practices and philosophies for sustainability, the continuing erosion of knowledge in Indigenous communities, particularly plant knowledge, is of significant concern. Many grandparents could identify and use more than a 100 plants, but today it is estimated that the average American can identify fewer than 10 plants, let alone understand the ecological and cultural gifts that they hold. American youth, including Native students, can correctly identify as many as 100 corporate logos, but only a handful of plants (Nabhan, 2003). This is a dangerous form of intellectual colonization that efficiently converts living beings to inanimate products, while undermining knowledge of the life systems that support us.

Loss of plant knowledge erodes ecological and cultural resiliency, as communities without this knowledge can no longer reliably adapt to

resource shortages or ecological and economic shifts through dependence on subsistence resources for food, medicine, and materials. Diminishing plant knowledge impedes a community's ability to observe and detect critical changes in vegetation and thus respond in a timely way to mitigate the impacts. Accelerating uncertainty and disruption induced by climate change compounds the risk.

Decline in plant knowledge is part of a generalized disconnection from the natural world in an industrialized society where the sources of our sustenance are hidden behind industrial processes, rather than visible in the living world. Increased reliance on market sources for foods, medicines, and materials also decreases reliance on the land and the knowledge of how to use it. Replacement of subsistence activities by a wage economy contributes significantly to knowledge loss, as do erosion of familial ties to land.

The societal ills associated with disconnection from nature have been well documented (e.g., Louv, 2008) and can have adverse consequences for physical, mental, and community health as well as ecosystem health. Louv and others have analyzed the widespread factors that undermine acquisition and transmission of land knowledge, primarily in the dominant society. However, Indigenous communities, while retaining cultural ties to the land, are also subject to these harmful influences, as well as the forces of cultural and knowledge erosion engendered by a history of forced assimilation, removal from traditional homelands, and urban relocation policies aimed at deculturation.

As material relationships with plants disappear, access to their lessons and the practices that contribute to knowledge generation also diminish. Plant gathering on the land provides a venue for cultural sharing of knowledge, songs, stories, and values such as those embodied in the teachings of the Honorable Harvest. If people don't harvest plants, the natural settings for sharing practices of mutual responsibility and reciprocity are lost, as are the teachings that contain resonance, meaning, and application far beyond the berry patch.

While our fluency with plant knowledge is diminishing, in both Native and non-Native communities, I have been taught that the knowledge itself is not lost. Humans may have forgotten, but the knowledge is resident in the land itself. Thus, knowledge revitalization depends as much on gaining the skills for learning from the land as it does on transmitting specific information. We need to ensure that we are educating people with the capacity to learn from the land again, to retrieve the knowledge that is held for us by the plants. Ideally, plant knowledge is conveyed by the

plants themselves, through direct interaction. Learning from experienced community members is also a fundamental component of Indigenous pedagogy. Traditional protocols for knowledge seeking, which include careful observation, direct experience, fasting, and conversing with plants, are part of the skill set in knowledge revitalization. This means that language revitalization, restoration of ceremonies, and the protection of intact ecosystems must go forward so that people continue to have access to their teachers, the plants.

Plant knowledge revitalization must also incorporate responsibility for the knowledge. In western modes of scientific inquiry, generating knowledge for the sake of knowledge alone is an accepted, even celebrated, practice. However, in Indigenous pedagogy, knowledge is always coupled with responsibility. Knowledge might be withheld unless the recipient has demonstrated an understanding of the responsibilities attendant to that knowledge.

Much botanical knowledge is meant to be shared, modeling the generosity of the plants who offer their gifts widely, like the fast-growing plants that surround human settlements and thrive with human use. These common, easily regenerated species invite widespread use of their considerable gifts. These plants, like some kinds of plant knowledge, are resilient and less in need of strict protection. However, like rare, slow-growing plants of the deep forest, not all knowledge is to be freely disseminated, due to the risks of misinterpretation, inaccurate transmission, misuse of the knowledge, or because the knowledge is sacred and proprietary. To be properly used, these species, like species of knowledge, require particular protection and deep knowledge for proper use.

Knowledge of plant benefits must be coupled to a cultural context of respect, responsibility, and reciprocity. Without the agreed upon constraints of the Honorable Harvest, a harvest can lead to deleterious consequences for the plants and their users. The disappearance of many medicine plants at the hands of those who commodify them attests to this risk. These are frequently the slow-growing plants of specialized habitats whose homes have been threatened by uncontrolled development and must be harvested with great care. It is imperative that gatherers understand, as our ancestors did, that harvesting protocols differ with different plants. Not all species can regenerate easily after harvest, the way sweetgrass does. Thus, efforts in plant-knowledge revitalization should include careful consideration of the attendant responsibilities for ethical education to protect plants and community knowledge against biopiracy. The cultural exchange cannot be knowledge alone but the wisdom to use that knowledge responsibly.

Restoring plant knowledge and the worldview in which it is embedded is a key element of the practice of reciprocity. Knowledge revitalization is an exercise of intergenerational reciprocity, as well as reciprocity with the plants themselves. When plants are understood as teachers, it is an act of reciprocity to be an attentive student and to pass on the teachings of the plants.

One of the dominant factors that contributes to the erosion of traditional plant knowledge in Native communities is the replacement of knowledge transmission by direct interaction with plants and community knowledge holders with institutions of public education. In most educational settings, if plant knowledge is conveyed at all, it is exclusively through the objective, materialist lens of western science. Revitalization of plant knowledge is made more difficult by educational systems that privilege science as a way of knowing, while dismissing and often undermining Indigenous knowledge. Systematic exclusion of Indigenous knowledge and its integrative worldview from public education also truncates the experiences of every student, limiting the scope of exposure to alternatives to the dominant materialist worldview, producing an intellectual monoculture.

The teaching stories of Nanabozho are memorable because they vividly capture the struggles between spiritual and physical impulses, which all humans experience. Nanabozho often gets into trouble when his physical appetites overwhelm clear thinking, when arrogance and hubris lead him astray. Fortunately, other nonhuman beings step in to put him back on the balanced path. It is said that humans have at least four ways to understand the world – with mind, body, emotion, and spirit. We do not fully comprehend unless we are using all four (see Cajete, 1994). Skilled medicine people engage traditional plant knowledge using all these dimensions. However, scientific plant knowledge intentionally restricts itself to the intellect and tools of physical measurement.

Science itself, a process of systematic inquiry and knowledge generation about the natural world, is the intellectual gift of all people. As I have stated, TEK is “the intellectual twin to science” and indeed Native science was practiced long before the western scientific worldview arrived on Turtle Island (Kimmerer, 2002: 433). Native plant science contributed to generating the deep knowledge of plant medicines, agriculture, land management, and ecological processes that our people employed to survive and adapt.

Scientific approaches are extremely powerful in generating knowledge of mechanisms of action and detecting and measuring phenomena

beyond the scope of human observation – a vital part of higher education. We can legitimately celebrate this way of knowing as a powerful tool for understanding and manipulating the world we inhabit. There are many questions for which science is the most appropriate and effective tool. But it is not the only tool, nor are all important questions amenable to scientific solutions. Science is a tool for knowledge, but not necessarily for wisdom.

Science can tell us how something works, but its strict objectivity is only one dimension in a decision-making framework that must also include values, ethics, and spiritual perspectives. Science is a superb tool for answering true/false questions, but it does not have the capacity to address questions of right/wrong. Indeed, many of the complex issues we face today lie at the intersection of nature and culture, and leaders and policy makers, as well as scientists, acknowledge that science alone is not sufficient to address them.

The protocols of the Honorable Harvest illustrate how traditional knowledge holistically integrates the very dimensions that science seeks to exclude. The harvesting practices are simultaneously based on a strong understanding of the biophysical factors that influence plant regeneration, as well as the ethics of respect, kinship, and reciprocity rooted in a spiritual understanding of the proper relationship between human and plant responsibilities. Incorporation of these values generates an understanding of human-plant interactions that can lead to behaviors and social norms that sustain both plants and people. The science behind plant harvesting can produce descriptive knowledge, while traditional knowledge also produces prescriptive wisdom.

Our cultural evolution toward sustainable societies cannot proceed without examining the limitations of the scientific worldview and its broader application, not just as an inquiry about the natural world, but as the foundation of social and economic institutions. Respectful exploration of the themes fundamental to the Indigenous worldview may enrich our moral imaginations, explaining how we might live in societies based on reciprocity, and modeled for us by plants. Cultivating the conditions for the coexistence of knowledge systems and the adaptive solutions that they may hold should be a priority as humans push against the limits of sustainability. What we need is not the intellectual monoculture of scientism, but an intellectual pluralism. A polyculture of ideas is especially important at this critical time as we search for strategies of resilience in the face of accelerating ecological and cultural shifts of unprecedented magnitude.

How then do we cultivate a knowledge polyculture that supports the revitalization of plant knowledge, the Indigenous worldview, and connections to the natural world that restore the covenant of reciprocity? How do we make the values inherent in creation stories manifest in our relationship with the living world? If we consider the Indigenous notion that plants are important teachers, we can look to them for guiding metaphors. Among the best teachers I know for guidance on pluralism and symbiosis are three wise and beautiful beings, known by many as the Three Sisters – corn, beans, and squash.

The Three Sisters garden is a manifestation of Native science, an innovation that embodies the Indigenous worldview of relationship, kinship, and reciprocity in a polyculture of three different species. Accustomed to straight rows of single species, early colonists who saw the mixed fields of Three Sisters concluded that Native peoples had no real agriculture as William Cronon noted in his classic 1983 environmental history, *Changes in the Land*. In a striking parallel to their disregard for alternative knowledge systems, they judged that the only legitimate agriculture was by definition their monoculture, failing to recognize the power of botanical pluralism in the sustainable Indigenous polyculture.

The genius of Indigenous agriculture was to harness the power of complementarity, by cultivating together three carefully selected species. The corn, essentially a giant grass, stands tall and strong, growing quickly in the summer heat using specialized C₄ photosynthesis. The vertical spiral of leaves up the stem uses light efficiently, yielding easily harvested ears of corn. However, the high productivity of maize also requires a rich source of nutrients. Consequently, nitrogen-fixing beans were planted with corn, providing needed fertilizer by enriching the soil. In return, the corn stalk provides support for the twining bean that climbs the corn and positions its leaves, flowers, and fruit in the open spaces between the corn leaves, creating a tower of food from the reciprocity between beans and corn. The third sister, the squash, spreads large, prickly leaves over the ground at the base of the corn. The shade of the squash leaves suppresses weeds and keeps the soil moist, while the rough leaves discourage herbivores.

Indigenous farmer-scientists created a system in which the three species facilitate each other's growth through cooperation, rather than reducing each other's success in the intense competition found in monoculture systems. Complementarity is also found below ground, where the architecture of the three different root systems occupy different regions of the soil, again promoting efficiency of resource use by avoiding competition

or interference with one another. As a result, the calories produced by this polyculture exceed the yield that would result from planting them alone. The nutrients in corn, beans, and squash are also complementary; eating all three species produces a nutritionally complete diet, while one alone is insufficient for human health. The polyculture forms an archetypal manifestation of the Indigenous worldview, revealed in the practice of sustainable agriculture that fed thriving Indigenous cultures.

Standing in a Three Sisters garden, we are surrounded by a powerful metaphor for a potentially productive relationship between TEK and western science. The principle of complementarity is an essential element of the garden model. The well-documented (Barnhardt and Kawagley, 2005; Berkes, 2008; Petch, 2000; Procter, 2000; Simpson, 2000) dichotomies that distinguish TEK and SEK have long been viewed as a source of conflict and indeed the cultural gulf is wide. But in a garden model, the goal is to use those disparities as complementary assets instead of liabilities, collaborators instead of commensals or competitors. The potential for complementarity between SEK and TEK has been widely recognized (Bartlett, 2005; Bartlett et al., 2007, 2012; Becker and Ghimire, 2003; Kimmerer, 2002, 2013b; Moller et al., 2004).

Corn is a cultural keystone species (see Garibaldi and Turner, 2004) for many Indigenous nations of the Americas, and it is the primary element of the Three Sisters garden. The garden model for a knowledge polyculture acknowledges and honors the historical and cultural precedence of TEK as the "elder" knowledge. Its broader scope, simultaneously encompassing both social and biological systems, material, and spiritual perspectives, enables it to serve as an intellectual scaffold, the primary organizing architecture for knowledge symbiosis. In the garden, corn is planted first, and only when the corn is six inches tall are the beans planted. The elder corn is well established so that its strength and direction can guide the growing bean. This practice can also extend to cultivation of a productive relationship between knowledge systems, by acknowledging the principles of traditional knowledge as foundational to the knowledge of mutualism, rather than relegating them to the status of cultural anecdotes.

Native farmers observed that corn alone is not as productive as when grown with other plants. A diet of only corn is not nutritionally complete, because a complementary amino acid is missing. Beans are members of the legume family, which complements the nutritional value of corn's particular gift: the ability to take nitrogen from the air and manufacture protein. This protein, which is packed into seeds, leaves, and roots, is also

released into the soil, where it acts as fertilizer, promoting the growth of corn and squash. The bean nourishes both people and soil.

Scientific Ecological Knowledge (SEK) is the analog of the bean plant in the knowledge symbiosis. Driven by curiosity, powerful in its understanding and scope, science can deeply nourish our understanding of the physical mechanisms that underlie the patterns and processes of the natural world, for which TEK has reduced capacity. Science can be life-enhancing, engaging our human capacity for wonder, innovation, problem-solving, and meaning-making.

The holism and depth of TEK, embedded in culture and the specificities of place, entails certain trade-offs in focus and capacity. TEK as a body of knowledge and as a process, philosophy, and practice is inseparable from its cultural context. TEK is not designed to illuminate underlying physical mechanisms and extend those causal relationships beyond boundaries of space, time, and cultural context. SEK is designed for testing hypotheses in a controlled systematic manner, which yields a different set of insights, related to validating knowledge in the context of true or false. Its ability to bypass subjectivity and bias, to let us test assumptions and find them lacking, to discard the false in search of the true – all of these capacities are present and essential to expanding understanding of the strictly physical world. The scientific method is conducted with the intention of transcending cultural contexts. (However, the assumption that separation from a subjective, cultural context is possible is itself a cultural construct.)

By its very design, SEK helps us understand only those things for which it possesses measuring tools. The best scientists understand that there is much we do not know and cannot measure – yet. True science is based on humility – recognition of the limits of human observation. Technology becomes the tool of science in creating means by which human understanding is freed from the constraints of our own perceptions, enabling us to explore remote galaxies and the inner workings of a cell. However, if science abandons humility, by dismissing what it cannot comprehend, by replacing respect, responsibility, and wonder with arrogance and hubris, then like overgrown bean vines, its very productivity endangers life rather than sustaining it.

Can we imagine a new kind of knowledge generation modeled after the complementarity of a Three Sisters garden, in which the practice of scientific inquiry is embedded in the Indigenous worldview? What would knowledge generation look like, if we created a mutualism in which the climbing “beans” of scientific inquiry are guided by the “maize” of Indigenous principles?

Science Embedded in Indigenous Worldview: Beans Guided by Corn

What are the principles of Indigenous knowledge that have the potential to guide a mutualistic relationship with western science? I think of these principles as the widespread and sturdy leaves of the maize, evenly spaced in a natural, harmonic order that creates around the corn stem a spiral ladder to guide the wandering bean. These principles create a conceptual framework for conducting science from the perspective of the Indigenous worldview. Just as the corn leaves encourage the progress of the bean's exploration, those principles might influence the trajectory of SEK, toward the conduct of science that generates knowledge that promotes the well-being of peoples and the earth.

The corn and beans in a Three Sisters garden symbiotically support and strengthen each other, as TEK and SEK can do in a knowledge mutualism, generating understandings of different kinds, of different aspects of the human experience and relationship with the living world. In the garden model, the mutualism is balanced, which maintains the integrity of each species of knowledge. TEK remains a proudly subjective, qualitative, holistic, long-term, and relational knowledge that encompasses mind, body, emotion, and spirit. SEK adheres to its tradition of a proudly objective, quantitative, short-term, reductionist, and materialist knowledge that privileges its intellectual schema for strictly empirical knowledge. Together, they can create a new kind of knowledge that will lead us to true, embodied sustainability.

The growth and development of a knowledge mutualism, in which SEK and TEK are as balanced as beans and corn, is far from reality. The goal is to plant the seeds and tend them, with that vision as an aspiration. But they do not grow alone.

Squash: Creating the Climate for Wisdom to Grow

At the base of the intertwined corn and beans is a thick cover of squash leaves. Its presence regulates the climate for the symbiosis. The big broad leaves intercept the sunlight that falls among the pillars of corn, so that no energy is wasted. The leaves cast a deep shade that suppresses the growth of weeds and keeps the soil moist. Its fruits are few but large and complement the nutritional ecology through synthesis of vitamins that the others cannot provide. Fed by the bean's nitrogen, the squash canopy provides habitat for a diversity of tiny predators that keep damaging pests in check. The ecological role of the squash is to create the conditions under which the corn and beans can flourish. And yet, the

squash is the slowest to germinate, and when young requires the greatest care. (Kimmerer, 2013a)

In the Three Sisters garden of knowledge mutualism, squash represents the educational climate of mutual respect, intellectual pluralism, and critical thinking in which both TEK and SEK can grow. The layer of squash plants metaphorically creates what Ermine (2000) and Ermine et al. (2004) refer to as the "ethical space of engagement," a place between worldviews that "opens up the possibility for configuring new models of research and knowledge production that are mutually developed through negotiation and respect for cross-cultural interaction." The ethical space ensures that "value systems do not operate in the shadows" (Bartlett et al., 2012). Like the squash, this space can take a long time to root and needs considerable attention in order to grow.

Spiritual understanding is a fundamental component of TEK and must be part of knowledge revitalization if this knowledge system is to maintain its integrity. The importance of creating a space to include and honor spiritual understanding has been identified as a key pedagogical element for integrating TEK and SEK in higher education.

There is another element to the metaphoric as well as pragmatic role of squash in this knowledge polyculture – as an exchange or translational layer between the knowledge generated by humans and the knowledge held by the more-than-human world. Of all three plants, squash lies closest to the earth, at the boundary between the seen and the unseen. Both SEK and TEK, to varying degrees and with different modes, recognize that human knowledge of the natural world is limited by the biases of human perception and experience, by inadequate tools for observation and analysis, by our restricted ability to translate from intelligences other than our own, and perhaps most importantly by the limitations of our imaginations. The shady, weed-free space created by squash can be an analog for an educational space purposefully created to encounter the knowledge of all our relations, seen and unseen. It is a space governed by ethical and moral responsibilities to the human and more-than-human communities. It can function as a boundary or a filter through which Earth knowledge becomes human knowledge – a filter of humility, compassion, respect, and responsibility. The squash layer represents the recognition that knowledge is not our own but is the collective wisdom of the living world to which we are accountable.

As teachers, students, scholars, and practitioners, we are responsible for being the gardeners, for tending to the needs of all the species of knowledge, and, most importantly, for cultivating an intellectual

landscape so multiple species of knowledge can continue to flourish as robust, dynamic individuals.

Higher education should create the space for this garden to develop, and it should strive to train competent gardeners, i.e., students literate in all three species of knowledge, not just in harvesting the fruits of those knowledges but in protecting and regenerating each of them. Just as different species of plants need different kinds of care, fertilization, and protection from pests, each knowledge system needs a specific kind of care. Each needs special tending to enrich its adaptive capacity and regenerative potential in an always changing biocultural landscape. The role of educational communities should be to help provide an environment that strengthens both SEK and TEK, an environment that enables reciprocity and creative synergy between them.

We can say of knowledge, as well as of plants, "If we use it respectfully, it will stay with us and flourish; if we ignore it or disrespect it, it will go away." The plants have taught us this, and humans should humbly remember and return these considerable gifts to the plants and the knowledge they have shared with us, so that we all might continue on this good green Earth.

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What Do Indigenous Knowledges Do for Indigenous Peoples?

Kyle Whyte

Introduction: Indigenous Peoples, Planning, and Knowledges

In this chapter, I aim to engage with the broad community involved in conversations about the ways in which knowledge exchange can occur between Indigenous peoples' knowledge systems and the fields of climate, environmental and sustainability sciences. I will begin with an introduction that is longer than what I would normally write because I feel it is important that I lay out some of the context that matters to me. I will make some connections among concepts of self-determination, Indigenous planning, climate, environmental and sustainability sciences, and Indigenous knowledges before I preview what will come in the rest of this essay. In the end, my argument is that scientists who seek to exchange knowledge with Indigenous peoples should not only understand what Indigenous knowledge systems can do for them, but also have a sense of the significance of these knowledge systems for Indigenous governance today. Hence the question-based title of this essay: What do Indigenous knowledges do for Indigenous peoples?

The context I wish to share starts with the idea that a crucial facet of the self-determination of peoples such as Indigenous nations and communities is the responsibility and the right to make plans for the future using planning processes that are inclusive, well-informed, culturally relevant, and respectful of human interdependence with nonhumans and the environment (Walker et al., 2013). For Indigenous peoples, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) affirms key aspects of *the right* to make plans. UNDRIP's Article 3 states that by virtue

Traditional Ecological Knowledge

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