

# **The Reformative Potential of Traditional Ecological Knowledge in Conventional Environmental Management: A Comparison of the Context, Belief, and Practice Amid the North American Great Lakes Ojibwe, the Brazilian Amazon's Kayapó, and the New Zealand Māori**

**Angelica Ramirez, Environmental Studies**

Dr. Kevin Schanning, Department of Sociology and Social Justice  
Northland College

## **ABSTRACT**

*The management of natural resources faces great challenges in the face of global climate change, population pressure, and the deterioration of ecosystems. As the deficiencies of conventional methods emerges developing alternative methods becomes necessary to achieve ecological sustainability. Traditional Ecological Knowledge (TEKD) provides both new sustainable practices and an alternative way to view and worldview in the management of natural resources. Conventional management has been subjected to the a dominant western worldview that is anthropocentric, dichotomous, reductionist, and inaccessible. Conversely, TEK is characterized by being eco-centered, adaptive, holistic in outlook, commonly shared and accessible, and transmitted and used by those who depend on it for survival. Using a comparative analysis of the context, belief, and practice of the Ojibwe, Kayapó, and Māori tribes we can see that TEK holds an environmental ethic that the conventional management largely lacks. Western scientists and professionals dealing with different ecological issues would benefit greatly from incorporating the TEK of local groups into natural resource policy.*

## **Introduction**

All communities employ practices designed to exert some level of control over their resources and environment (Sutton and Anderson 2004). Attempts to control the environment occur either as large scale environmental manipulation or as small scale resource management. It has become obvious “that resource management is necessary but that it requires fundamentally different approaches, not mere tinkering with current models and practices” (Berkes and Folke 1998). The integration of Traditional Ecological Knowledge (TEK) into conventional natural resource management can provide a solution to many of the problems faced by conventional management given that TEK provides a different way to view and manage natural resources. Alternative methods are necessary to achieve ecologically sustainable management of the environment. Understanding indigenous communities, which have shown to be sustainable over time, can help inform conventional resource management, by providing many examples of sustainable methods of management and a source of “new” knowledge. Using the context-belief-practice framework this paper compares three different indigenous groups who actively practice Traditional Ecological Management, in an attempt to decipher the principles that underlie their ability to make informed sustainable management decisions.

Environmental manipulation can be beneficial or destructive to local ecologies ecology depending on their the manipulation's adaptability to local and temporal conditions and the skills of those the manipulators. implementing them. Manipulation of the environment, in the form of Nnatural resource management, conservation, and restoration, are all is conducted by the application of ecological principles to the natural environment. Though these practices are based on principles discovered by secular science they are in many ways influenced by the cultural worldview under which practitioners, both managers and institutions, function. That A worldview is the shared conceptual framework through which human experience is organized to create a common “reality” for the members that a society (Callicott and Nelson 2004:6). Successful management is then measured and developed by by that worldviewsame perspective. However, as this research shows, various worldview exist and in achieving

sustainability, the management of natural resources faces the challenge of coordinating these human dynamics (worldviews) and the complex systems of nature (ecology).

As we face the consequences of historically incorrectly managing generational mismanagement of our resources and manipulating manipulation of our environment we find that the flaws underlying conventional policy often stem from the way the environment is perceived. Resource management practices are largely informed by the dominant western worldview (DWWV) that supports an unhealthy reliance on the substitution of ecological services by technology and science leading to the uninhibited corruption and exploitation of the environment (White 1967). As global population increases and more people adopt the western standard of living, the consequences triggered by unsustainable resource use previously perceived as immeasurable or unforeseen become more direct, more frequent, more disastrous and consequently less manageable. As our reliance on modern science and technology increasingly proves fallible, policy makers, educators, scientists, researchers, and even corporations have turned to “new” sources of knowledge. These new sources extend from unlikely suspects-indigenous communities struggling to survive against that same paradigm that has socially marginalized, politically disenfranchised, and economically dominated them. Historically, indigenous people have been pitted against development, “civilization,” and technology. Only recently have we begun to recognize the knowledge held by these communities and the potential value it has to help manage the natural world.

Scientists, policy makers, and indigenous people have found important differences between traditional sources of knowledge and the dominant western worldview (Berkes, Folke, and Colding 2000; LaDuke 2004; Harkin and Lewis 2007; Posey 1985; Escobar 1998). These differences can be attributed to how people fundamentally view nature and how that translates into natural resource management. Conventional resource management operates under the assumption that 1) humans are separate from nature, 2) nature is something predictable and controllable, 3) the natural is only valuable in so far as it is useful to humans, and 4) nature should be adapted to meet our needs, sourced from the dominant western world view (Cotton & Dunlap 1978). In contrast, traditional societies 1) recognize an interconnectedness between humans and nature, 2) view nature as possibly erratic or, dangerous and 3) view all things valuable in that all things in nature exist interdependently, 4) and are able to recognize when it's necessary for humans to adapt to the changing states of their the local ecology instead of always adapting the environment ecology to human to their needs (LaDuke 2004, Escobar 1998). Exploring the differences and similarities between Traditional Ecological Knowledge and Scientific Ecology helps to decipher both ways of knowing and how each can best be employed to develop sustainable resource management practices. In effect acknowledging that knowledge empowers the sources from which it's derived, a key toward achieving true sustainability. In addition, recognizing and appreciating knowledge empowers the source of where that knowledge is derived, a key toward achieving true sustainability.

## **Literature Review**

For some, nature is socially constructed. Peterson explains that social construction exists in a literal sense, where nature is physically manipulated by human action, and in a metaphorical sense, where nature is defined abstractly. She states “that ideas about nature are historically and culturally determined. There is no single, essential ‘nature’ that all individuals in all places and times recognize as such or can access outside of the mediations of human culture” (Peterson 88: 2004).

Rooted in ideas of nominalism, Peterson also claims that, social construction means that there is no intrinsic, universal quality that is captured in the terms we use, but rather those terms are conventions of particular cultures and times, loaded with and lucid by reason of the meanings and values of those cultures. (Peterson 2004). The physical objects and attributes of nature are not what are constructed, but rather it is their identities and worth in a particular context (Peterson 2004). In the context of natural resource management, certain values are assigned to natural objects and the ecological processes that produce them which affecting the ways in which they are managed. For example, the designated and misunderstood status of the American Grey Wolf on the endangered species list largely affects sport hunters' view of the animal in Northern Wisconsin. When “endangered” the wolf, seen as rare, is respected and considered a “sight to behold.” But once removed from the endangered species list, the

wolf is blamed for lower whitetailed deer numbers, stigmatized, and killed with no consideration as to whether the wolf population is actually to blame and with disregard to the fact that ecologically the deer population is in some areas unsustainably large.

Social construction can be dangerous, Peterson argues, when viewed as the view is taken that “the natural, as that which is not humanly created, does not in fact exist, or it exists, paradoxically, *only as a human construct*” (89: 2004). This “strong” version of social constructionism has dangerous implications. If nature is viewed as real *only* in the context of human mediation, then we lose our sense of responsibility towards the actual (the physical environment) because we view it as nonexistent. Cultural relativists may also use this argument to make claims that the sustainability of human acts against nature cannot be judged. In response to “strong” social constructionism, a “soft” version has been developed which argues that while it is true that any distinction we make between the reality of nature and its cultural representations is itself conceptual, it does not follow that there is no ontological distinction between the ideas we have of nature and what the ideas are about (Peterson 2004, Soper 1995). This asserts that there is a real nature “out there” while also maintaining a healthy skepticism about our capacity to know it.

Rolston advocates a “harder” realism regarding nature (1997). Physical nature in this view is not constructed by the human mind but rather “nature” is a generic word for real objects and the forces and process that produce them. It follows that if our construction of nature reflects the actual physical world and there are many ways to construct it, then some constructions are more accurate than others. This assertion, though, must be viewed with caution as it risks falling in line with views of absolutism, universalism, and ethnocentrism. The adoption of more practical forms of constructionism, analogous to Hayles “constrained constructivism” (1995), profits from the tension between realism and constructionism. A position of constrained constructivism strives to combine the idea that our views of nature are conditioned with the idea that there does exist a real unconditioned nature “out there.” It does not deny the existence of a “real world” unmediated by human thought.

The way in which people construct nature is largely informed by culture and society. The variation in resource management practices under the dominant western world view and the indigenous paradigm of TEK is shaped by varying social constructions of nature. Social construction occurs in a variety of ways but is largely informed by the cultural mechanism of religion and ethics.

### **Belief and Social Construction**

White states, “Human ecology is deeply conditioned by beliefs about our nature and destiny—that is, by religion” (1967). In the west, secular society attempts to portray religion as a private personal practice that can be separated from daily life. But religion is a socially constructed institution through which ethics are disseminated (Durkheim 1912). Western secularists attempt to distinguish religion from environmental ethics, as the latter may be informed by scientific thought and reason. However, in traditional indigenous communities religion is viewed differently, it permeates life ways and the dominating worldview. Religion, in indigenous societies and many other non-secular societies, can be understood more broadly as a “sense of human recognition of superhuman controlling power” (Berkes 2001). Additionally, religion permeates traditional societies allowing them to successfully maintain productive resources over time by providing a central organizing “myth” that includes emotionally powerful cultural symbols for the moral code that informs management (Berkes 2001). Rapport’s early studies of the kiako ritual of the Tsembaga Maring of the mountainous interior of Papua New Guinea showed that religion functioned not only to bind the community through socially shared symbols but to regulate pig populations, the frequency of war, and the ratio of people to the land, all having measurable effects on ecosystems (Townsend 24-29: 2009).

Religion dominates as the social institution through which ethics are taught, consequently influencing how nature is socially constructed. However, there are three cautions in viewing religion as determining a society’s or an individual’s actual practices. First, generalizations are always risky as cultures are complex, complicated, and variable within themselves. Secondly, there is invariably a gap between “the ideal” and “the actual.” Religion produces a code of ethics, however, ethics are only

principles that inform how people ought to behave and are not necessarily how they actually behave. Finally, religious traditions-passed down through generations-are anciently sourced, and have an intangible nature that often prevents them from being thoroughly understood. Traditions change and adapt as they are orally transmitted. Furthermore, in recording, accounts on different traditions are often based largely on an outsider's perspective (Berkes 2001). Resource managers and ecologists must consider these cautions discrepancies between religion and actual behavior as they attempt to integrate Traditional Ecological Knowledge into conventional resource management.

Western ethical traditions have been resolutely-some even militantly-anthropocentric (Callicott and Nelson 2004:3). Much of the West's failures in environmental and natural resource management can be attributed to the dominating western worldview, informed by the same ideas underlying the dominant religious beliefs in the west. Western societies tend to hold the view that humans are separate from the "natural" environment which itself must be overcome and conquered (Sutton and Anderson 2004: 1). In the Christian-Judeo tradition, the bible has been interpreted to give humans a "master" or "steward" role toward the environment. In the "mastery" interpretation, humans have the God-given right to exploit nature and are given dominion over it. In the "stewardship" interpretation humans are given the right and privilege over nature and are ascribed duties and responsibility toward it (Berkes 2001). Regardless of the interpretation, the Judeo-Christian worldview is still seen as strongly anthropocentric and objectifying of nature (White 1967). This attitude underlies the religious worldview of the Middle Ages, but further stems from the replacement of animistic beliefs with transcendent monotheism which reduced nature to a lower order of creation under humans. It also stems from ancient Greek and Roman thought which reduced the environment to an object of thought and rational analysis whose importance was measured only by its usefulness to human kind (Hughes 1-2: 2004). Human commodification of nature reached its zenith at what Polanyi calls "The Great Transformation" a time marked by social changes and ideas that arose from the Age of the Enlightenment and the Industrial Era which viewed nature externally and analytically ([1944] 2001). The creation of the West's religious traditions, social, and economic paradigm have no doubt complemented each other and created a world "with a fundamentally altered relationship with nature" (Berkes 2001).

While the world's dominant economic and social system have been permeated by this worldview, Berkes claims "traditional societies retain elements of pantheism, the 'original religion' of all humankind" (2001). It is in these societies where separation between environmental ethics and religion does not exist. Their differing worldview along with strong religious sanctions such as taboos has invoked direct support for biodiversity conservation. Acts respecting ecology are indoctrinated in the individual.

Indigenous Knowledge refers to culture-specific systematic information that is commonly shared, accessible, and remains in the informal sector. It is usually unwritten and is preserved in oral tradition rather than text and is mainly attributed to indigenous and tribal groups (Brush 1996). The traditional in TEK is understood differently than in conventional use, in which it connotes a fixed body of knowledge slowly eroding in modernity. Instead, tradition refers to viable cultural wholes, or lifeways, that have been continually transforming in ongoing encounters with other indigenous and non-indigenous peoples. (Grim 2001:37). Accordingly, "indigenous traditions refer to actual, dynamic societies whose identities are embedded in land, language, subsistence practices, kinship, narratives, and time-honored customs" (Grim 2001:39). Though some have used it interchangeably, TEK is different from Indigenous Knowledge (IK), in that it is explicitly limited to ecological knowledge and is instead a subset of IK which may include TEK but also many other fields of ethnoscience (Berkes 1999).

The value of traditional ecological knowledge is not attributed to the romanticized view of native people's as "ecologically noble savages" (Redford 1991). There is a rational, scientifically established reason why TEK exists and works that is not attributed to an otherworldly "something" inherently found in traditional societies. Romanticizing indigenous people as somehow inherently "noble" to the ecology robs them of their humanity and denies their complexity and diversity as real human communities with practical needs, the desire to grow and develop, and the capacity to make mistakes (Lu Holt 2005). It makes them susceptible to unrequited criticisms when they do not meet the ideal imposed upon them by the west as "ecological." Traditional societies, like all human societies, have exceptions and do not

always fit the ideal. However, that should not discredit the knowledge they do have thereby prevent the formation of structures necessary for it to be explored, retained, and built upon. The potential benefits of exploring that knowledge are immense, but equally, the use of TEK should be viewed critically case by case, as should the use of any kind of practical knowledge.

### **The Reformative Potential of TEK**

As a knowledge-practice-belief complex, traditional ecological knowledge includes a component of local knowledge of species and land, a component of practice in the way people carry out their livelihood (fishing, hunting, agriculture), and a component of belief in people's perceptions of their role within ecosystems and how they interact with natural processes (Berkes 1999). TEK develops through a set of adaptive responses to selective pressures that have evolved over time from the continuous occupation and resource use of a particular area (Berkes 1999). However, indigenous people may not recognize TEK as the scientific interpretation of being "biological adaptations."

Recognition of the value of TEK has led many anthropologist and ecologists to the recognition that TEK shares many similarities with western science. Like western science, TEK is based on an accumulation of observations. It tends to accumulate incrementally, be tested by trial-and-error, and be transmitted from generation to generation. Unlike science, TEK carries a set of beliefs (though many argue that western science does too), is holistic in outlook, and is usually transmitted orally and through shared experience. TEK, unlike most of western science, is transmitted by those who regularly use it and depend on it for survival making it more responsive to changes in the ecology and in need of less red tape.

The similarities between TEK and science point to the capacity of TEK to be complimentary to western science, and to some extent reformative. Western science has failed communities by becoming overly technical and bureaucratic. It has become impractical. Western science has also failed by functioning under obdurate assumptions that are hardly mirrored in nature. For example, principles and terms such as ecosystem stability or equilibrium contradict the real chaotic and discordant nature of the environment. Western science has been permeated by linear models that emphasize maintaining predictable yields and focus on primarily quantitative techniques. Traditional Ecological Knowledge functions under different assumption and principles; irregular harvests, circular models, and chaos in nature, and the unpredictability harvests are understood and adapted to. Understanding TEK can lead to important reforms in western science. This project will set the groundwork for future analysis of TEK that can inform western science.

### **Methods**

The methodology used in this paper involved an extensive literature search, followed by the application of a comparative analysis using a framework encompassing context, belief, and practice (2004). Developed by Woodley, this framework is meant to categorize TEK into separate practical components. However because the framework identifies TEK as categorical in ways that have not been developed in the literature for the three groups studied, this work uses 22 different articles published between the years of 1967 to 2009 related to topics about the natural resource management of indigenous people, religious and ethical influence, social construction, and the protection and distribution of traditional knowledge.

The author reviewed literature on each tribe to describe the context in which each tribe has developed, the belief and rituals held by each tribe and a single practice from each tribe that uses TEK. All the TEK held by a particular tribe has not and possibly cannot be described; consequently different practices were described. Although this analysis breaks TEK into three different categories it is important to note that they are not static distinct hierarchical categories. Feedback and linkages exists among each category giving them a dynamic relationship meaning that if one changes, changes may follow in the other to maintain stability within the system. Following compilation, The information on each tribe was then compared and conclusions were drawn.

The analysis of traditional knowledge was conducted at three interrelated levels of analysis using the context, belief, and practice (CBP) framework (Woodley 2004). TEK can be better understood as

knowledge that emerges from a dynamic interplay of a complexity of variables that can be viewed as a complex of context, practice and belief (CPB). Based on the assumption that by understanding the whole, properties emerge that are not evident in the component parts, Woodly's framework allows TEK to be portrayed as contextual knowledge, knowledge as practice, and knowledge as belief to better organize and help identify the different emergent variables in TEK.

The context of TEK refers to the history, demographic factors, and the biophysical features of place. Context refers to the biological, historical, political, and other factors that have shaped the way the tribe and its practices have evolved. A distinctive aspect of TEK, separating it from other forms of knowledge, is belief. TEK is shaped and supported, or vice versa, by the spiritual concepts and values developed by a culture which dictate how people ought to act within their ecosystem. This aspect of belief is shaped by the worldview developed by each tribe, of which many have the shared aspect of maintaining a worldview advocating increased human connection and understanding of the environment.

This study involved a review of literature concerning the resource management practices of three different Indigenous groups, the Ojibwe of the North American Great Lakes Region, the Kayapó of the Brazilian Amazon, and the Māori of New Zealand. The three groups were chosen specifically from distinct regions to discount any similarities that may have arisen from possible contact or interaction. The grounds for comparison stem from a similar colonization history and the availability of documented TEK. All three groups had similar problems with western colonizers. They have campaigned for land and treaty rights, protection of indigenous knowledge, and have been successful in maintaining some degree of autonomy. The areas which these groups call home remain rich in natural resources and have been sought after for industrial and agricultural development.

## **Data**

### ***Ojibwe***

**Context.** The Ojibwe are one of the largest Native American groups north of Mexico and are located throughout the north Mid-west in the United States and south-central Canada in Ontario. Population estimates vary from 70,000 to 104,000 in the United States with a similar number in Canada (Daeg de Mott 1998; Reid 1991). The Great Lakes climate on which most Ojibwe live is subarctic. The Ojibwe face long cold snowy winters and short hot summers. Their language belongs to the Algonquian family of Native North American languages and unlike many North Native Americans the traditional Ojibwe developed a system of writing and record keeping by painting pictographs on birch bark (Daeg de Mott 1998). The Ojibwe are descendants of the Anishinabe (original people) who originally occupied an extensive area north of Lake Superior and Lake Huron. European arrival directly and indirectly pushed their migration onto the lands surrounding Lake Superior; stretching west into Minnesota and the Dakotas, south into Wisconsin and Michigan, and north into Canada (Daeg de Mott 1998).

After many economic and political encounters with Europeans, the traditional Ojibwe had been eventually forced onto reservations by 1854. Reservation life was not compatible with their traditional life style leading to a plaguing , poverty plagued the Ojibwe., and Aafter WWII many left reservation life to live in cities. However, many had lacked the skills and cultural background to survive in the European-dominated world (Daeg de Mott 1998). Despite facing various hardships, many Ojibwe still live on their tribal lands and continue modern day battles over the use of natural resources and treaty guaranteed rights. A fisheries conflict in 1983 lead to the federal court case known as the Voigt Decision, which gave 13 distinct Ojibwe tribes responsibility for regulating natural resources on treaty guaranteed lands. This lead to the formation of the Great Lake Indian Fish and Wildlife Commission an organization that has become heavily involved in representing tribal concerns on Great Lakes environmental policy and resource management in general (Daeg de Mott 1998; Vernuum [1988] 2004).

After early contact with Europeans, the Ojibwe began to migrate along the shores of Lake Superior, driving out other indigenous people, until finally moving into inland into northern Wisconsin and westward into Minnesota's into wild rice habitat. Manoomin (wild rice) has played a central role in Ojibwe culture. Wild rice has been a principle harvest of the Ojibwe for almost three centuries. Further European expansion has stimulated trade, scattering the Ojibwe around the western great lakes into

Canada, and into North Dakota and Montana. Such geographic dispersal created distinctly different lifeways, prompting tribes to adapt to the biophysical nature of each newly occupied territory. The Ojibwe have been involved in a number of subsistence activities; however, the southwestern Ojibwe have been the principle wild rice gatherers practicing a diversified economy that involved seasonal migration to the hub of particular resources (Vernum [1988] 2004: 1-4).

Wild rice has been a staple food in Ojibwe culture; it has been credited as marking the final destination of their migration in legends and while using it for subsistence has made their occupation of the western and southern ends of Lake Superior practical. This staple has been endowed with special spiritual attributes and a story of mythical discovery (Vernum [1988] 2004: 2). It has been used for food, in ceremonial practices, and for social gatherings.

Because it is an annual, wild rice requires yearly reseeding with about only half of seeds sprouting the following year. Seeds are heavy, lack natural buoyancy, and sink immediately, heavy end down, settling next to its parent plant spreading slowly downstream. Any stirring of the soil creates aeration of the muddy alluvial bottom, promoting growth and naturally “cultivating” nutrients from sediments upstream (Vernum [1988] 2004: 14).

Wild rice is the only cereal native to North America. It is technically not rice but a grass (*Zizania aquatica* or *palustris*) and unlike most old world staples it had not been improved scientifically by selection and breeding for commercial production until the 1950s. Genetic differences are attributed to differences in light, water levels, and water and sediment quality and make up. Two strains are known to exist. The *Z. aquatica aquatica*, a tall wide-leaved strain found in southern and western parts of the wild rice range, and *Z. aquatica angustifolia*, a strain with narrower leaves and shorter, thicker kernels, in northern areas. Both variations may be found in the same rice bed. Growth is dependent on the circulation of mineral-rich water and is impeded by chemical pollutants, especially sulfates in concentration greater than 50 ppm. It grows best in alkalinity exceeding 40 ppm. Pollination occurs primarily by wind, ensuring genetic diversity with some self-pollination and pollination by bees and birds feeding on worms. Water levels are the primary determinant in maturation. Ripening occurs over a ten-to-fourteen day period beginning in August to mid-September, with rice in shallow lakes ripening early. (Vernum [1988] 2004: 14).

**Belief.** General Ojibwe beliefs are focused on two categories; stories that inform living human beings of practices and taboos and stories related to the manitos (spirits) and the deceased. According to modern Ojibwe beliefs, Kitchi Manido (Great Spirit) created the universe out of four basic elements; rock, fire, wind, and water and organized it into the Four Wind Directions-Waubanoong (east), Shawanoong (south), Nangabianoong (west), and Keewatinoong (north) and into the Sky and Earth. Many of cultural stories feature the trickster Wenabozhoo, the first man (also called Nanabush), born of Earth Mother and Father Sun.

The story of the creation of Wenabozo begins with a world where there are no trees and animals, one unlike today. In that time, there only existed two women, a young girl and her mother. The mother did not need a male to conceive but the young girl, Akki (earth), was a human. The girl's mother, to be known as Nokomis (Grandmother), cautioned her daughter against facing the wind a certain direction while sitting. The girl disobeyed and as a consequence the wind blew up her dress allowing the Sun (a spiritual being) to shine in the spot where her dress should have covered. The girl, now a woman, became impregnated giving birth to several spiritual beings. She died in birthing her final child, a male by the name of Wenabozhoo who was a manito, or spirit (Erdoes 1984; Vecsey [1983] 1993). From Wenabozhoo came the modern man, he is also the creator of all the beings and objects on earth as they are now. The Ojibwe see him as an intermediary between humans and the spirit world, sent to teach traditional ways. He is the protagonist of many stories used as teaching techniques explaining how different elements of traditional life came about and how important staples were created.

The importance of wild rice goes beyond that of merely being a food staple, it is central to many Ojibwe stories, legends, ceremonies and its use is regulated by proscriptions and taboos. According to Vernum, stories attributing the discovery of important tribal staples to the supernaturals, who in turn

gave them to the Native people, are found universally amongst Native American groups ([1988] 2004). For the Ojibwe, wild rice is central to many stories imbedded with allegory and symbolism, recounting interactions between the supernatural, animals, and humans. The Ojibwe incorporated their most deeply held religious beliefs, ethical codes of conduct, and explanations for natural phenomena into stories featuring their culture hero Wenabozhoo. This story, taken from the version found in Vernuun's Wild Rice and the Ojibway People, reflects the need for food and the means of obtaining it ([1988] 2004).

Wenabozhoo's discovery of wild rice occurs during his spirit quest. During this puberty fast a young boy is sent out without food to fast in the woods until he receives a vision, often after fainting from weakness. In the visions a spirit appears before the young boy to make a covenant, making each one unique and personal. Wenabozhoo was told by Nokomis (Grandmother) that to prove his manhood and become accustomed to hardship he should embark on a long journey without food. During Wenabozhoo's quest wild rice appears, the first ever seen. He does not initially understand its value as food, but admires it for its beauty. He returns to his grandmother to inform her of his discovery. He uses bark from a large pine to make a canoe and together, Wenabozhoo and his Nokomis sow wild rice seeds from the lake of origin into another. Corresponding with the belief that wild rice was deliberately spiritually sown from its original source into other bodies of water and cannot be sown by humans. He continues his journey and is tempted by bushes to eat their roots, after which he becomes ill for three days as a consequence of violating the taboo against eating during a vision quest. After learning his lesson, he continues on his quest avoiding other plants until he stumbles upon wild rice. It speaks to him, telling him it is called "manoomin" and is edible. He succumbs to eating, but does not become sick; he realizes it is the same plant he had sown with his grandmother. Wild rice is now viewed as a special gift because it was given to the native people after Wenabozhoo violates the proscription against eating during his vision quest.

**Practice.** The Great Lakes Indian Fish and Wildlife Commission, an intertribal council representing eleven Ojibwe tribes published a supplement to the quarterly *Mazina'igan* magazine detailing how "twenty-first century manoomin harvesting is a lot like it was hundreds of years ago" (David, Rasmussen, and Erickson 2008). Traditional harvesting encompasses the use of a canoe, a pair of ricing sticks, and a push pole. Ricing involves a team of two the "poler" and the "knocker." The poler slowly propels the canoe through the manoomin with a long push pole while the knocker uses one ricing stick to bend the manoomin stacks over the side of the canoe and a second to lightly stroke the seed heads, releasing the ripe grains. Traditional ricing is a gentle time consuming process that calls for light "knocking" allowing unripe manoomin, whose release is more difficult, to remain for ripening. Good harvesting involves scouting, experience, and coordination.

Tribal communities often rely on rice chiefs, who closely examine manoomin beds and officially open selected lakes and waterways only when the grain is ripe (David et al 2008). In modern times state and tribal biologists are additional sources for locating good rice beds and knowing when particular sites are ripe. Successful ricers frequent sites to monitor the progress of manoomin stands during the summer. They work on good rice patches methodically making neat parallel passes along rice beds, developing a rhythm between the poler and knocker. Like many Native American tribes, the Ojibwe offer tobacco when harvesting wild rice to show respect, they believe all nature is interconnected and everything in nature has a *manido* (spirit) (Daeg de Mott 1998).

### **Kayapó**

**Context.** The Kayapó are one of the many indigenous Amerindian groups remaining in the Amazon jungle, occupying a vast area of central Brazil between the Tocantins and Xingu rivers. Before European colonization, there were about 5 million indigenous Amerindians with only about 200,000 remaining today (Pitchon 1998). There are approximately 3,000 Kayapó remaining after a series of population declines due to disease and war brought about by direct and indirect contact with colonizers (Vidal 1991). The Kayapó refer to themselves as "Mebengnôkre" or people of the big water, possibly referring to the Rio Araguaia an important ancestral geographical boundary. The Kayapó are divided into autonomous



groups, with their language “Kayapó” being the most common shared ethnic characteristic. “Kayapó ” belongs to the Gê Language Family (Vidal 1991).

The Kayapó occupy land made up mostly of tropic rainforest and savanna. Villages are preferably built preferably near rivers or other waterways, but in well-drained terrain. These areas are rich in game, fish, and forest products and are well suited for horticulture (Vidal 1991). The Kayapó practice horticulture characterized by slash-and-burn practices to plant sweet potatoes, yams, bananas, sweet manioc, cotton, urucú, cupa and maize. Until recently, all Kayapó s were seminomads, they followed a fixed exploratory migration pattern throughout the year always returning their village for the most productive season.

The Kayapó are known for being fierce warriors resistant to assimilation. Division between the Kayapó has resulted from a long process of social and spacial mobility (Vidal 1991). Steady direct contact with Europeans did not occur until the 1950s. Contact-often violent- with loggers, miners, squatters, and the Brazilian government has brought about a struggle to maintain the traditional way of life. In the 1960s cattle ranches and plantations began operating in the traditional forests of the Kayapó. Two decades later, gold prospecting and lumber mills were established (Vidal 1991). Deforestation, the greatest ecological threat to the Kayapó way of life, is blamed primarily on the slash-and-burn practices of the local indigenous population, however the vast deforestation did not begin until logging and cattle ranching were brought by Europeans. Mining operations have lead to the characteristic problems of boom and bust towns and heavy mercury pollution of the water and atmosphere. As a result of poverty, population expansion, and these new economic activities, the Kayapó traditional way of life and the ecology on which it depends is greatly threatened. In 1980, the Gorotire branch of the Kayapó made contact with gold miners. It initially began as a violent conflict, but ended when a contract was formed between the miners and Kayapó, giving the tribe part of the mining profits. Revenue from mining and lumber companies has allowed the tribe to travel Brazil and abroad to lobby for Indigenous land and resource rights (Flowers 1991).

**Belief.** Social insects are central to the Kayapó belief system as seen in one of the most significant Kayapó myths; the story of the ancient fight with the giant rhinoceros beetle. In the story as retold by Darrell Posey, the Kayapó, who previously lived in the sky and understood animal languages, were weak and did not live in villages or have societies (1983). They were inferior to other animals including beetles who under the leadership of their “chief” waged war against men. The Kayapó believe they learned to organize into groups and villages from social insects, or ñy, and went into battle against the chief beetle. Once they defeated the chief, man was established as a creature more powerful than others due to 1) the power that came from social organization and 2) the great strength and valor of the warrior that they learned from the wasps. The Kayapó learned the secret of aggressive fearless attacks by observing wasps’ behavior. The tribe commemorates this event through an important ceremony in which wasps are symbolically fought. This is viewed as “a re-affirmation of their humanity, a statement of their place in the universe, and a communion with the past” (Posey 1983).

The wasps nest is also of cultural importance as it is seen as symbolic statement of unity. Its three-dimensional shape illustrates the relationship between the ovate and elongate forms of the classification morphology. Its structure is also seen as a model of the universe. The hive is divided into parallel plates: the upper, middle, and lower. The upper reflects the sky realms where humans originated, the middle plate is where they live now, and the lower plates is that of “worthless men” where termites, considered worthless, weak, and cowardly, also live. Ants also live in the middle plate and like wasps have “special powers.”

**Practice.** In 1983 Posey published data on the taxonomic features of the folk entomological classification system of the Kayapó people. Although there is a 1:1 relationship between folk groupings that correspond with insects and the scientific class Insecta, the Kayapó classification system of specific taxa and sub-species are few with the exceptions of Sequence 4 species called “ñy” containing termites, ants, wasps, and bees (Posey 1983). The Kayapó have developed an elaborate classification system for social insects

that is directly related to the Kayapó belief system about the origins of society, the composition of the world, and the unifying concept of the universe (Posey 1983). These insects also serve as models for social organization.

The term “ñy” refers to the social nature of these insects which are seen to be in a special relationship with man due to their communal nature. The Kayapó have observed that these species live in organized family units, have warriors, and produce sounds likened to Kayapó movements and singing. Insects observed to be solitary that exist under the classification ñy, are seen as socially aberrant types. They are likened to Kayapó who have gone off alone on spirit quests or to “true” shamans who are solitary by nature. These solitary insects serve as special ingredients in the medicinal concoctions of shamans and are associated with the manipulation of spirits (Posey 1983).

These insects have various practical uses as seen in Posey's studies. For example, ants are used in concoctions to make hunting dogs unafraid to sniff the ground and be aggressive. Azteca ants are used in soil mulch as they repel leaf-cutter ants and the Kayapó manually spread and colonies by transplanting them from location to location. Bees are sources of honey and wax. The importance of bees and ants is evident through Posey's studies; however the relationship of other social insects to the tribe has not been studied or published.

### ***Māori***

**Context.** The indigenous inhabitants of New Zealand, the Māori, are descendants of migrants from the Polynesian islands that arrived in A.D. 950, 1150, and 1350. The Maori refer to themselves as tangata whenua, meaning people of the land. The term whenua first evokes the Earth-mother, Papa-tuanuku, and then refers to the placenta (Grim 2001:41). They settled primarily through North Island, New Zealand and sparsely on the South Island. Their native language is part of the Polynesian Group of the Eastern Oceanic Branch of Austronesian languages (Latham 1991). Two branches of Māori are recognized, the archaic and the traditional. The archaic refers to the initial settlers who relied on the moa for sustenance and hunted it to extinction. The final pre-European migration occurred in 1350 by a great fleet that assimilated with the original inhabitant by marriage and conquest to develop into the present day traditional Māori.

European settlement began with the arrival of Captain Cook in 1769, at which point the indigenous population numbered between 200,000 and 250,000. It declined heavily due to war and disease (to about 42,000 in 1896) brought about by the Europeans. Today modern estimates vary from 300,000 to 525,000 people (Latham 1991, Williams 1998). After the arrival of missionaries and settlers, the Europeans signed the Treaty of Waitangi on February 1840, in which many indigenous chiefs relinquished sovereignty (though the exchange was not expressly understood) over New Zealand land for British recognition and protection, as well as guaranteed rights to native lands. The British later confiscated Māori lands and forced the indigenous population onto reservations. Government policies have been more favorable for the Māori after WWII. After much activism and many legal battles Māori representation in government has increased leading culminated to a settlement in on October 1996 that returned land to the Māori, restored some traditional fishing rights, and included a repayment of \$117 million (NZD) (Williams 1998).

Harakeke is one of New Zealand's most important native flowering plants. This flax, only named “flax” due to early European trader's confusion due to the similarity in fiber with true flax, belongs to the Phormiaceae family endemic to New Zealand and Norfolk Island. The Māori recognized only two varieties, the smaller Phormium cookianum and the larger Phormium tenax though there exists much more variability due to extensive hybridization. Phormium cookianum is the smaller mountain flax thriving in harsh coastal and alpine sites. Called wharakiri, it has droopy leaves and yellow-tone flowers with twisted seedpods hanging off the scapes (leafless stalks). Phormium tenax, or common flax, is an evergreen found in lowlands or swamps thriving in richer soils and more hospitable climates to produce fibers superior to wharakiri. It grows in upright clumps producing waxy red, yellow, and orange flowers with seed pods pointing upwards on the scapes (Hindmarsh 1999).

**Belief.** The Māori worldview is based around “the belief in an original singular source of life in which that life continues as a force which imbues and animates all forms and things of the cosmos” (Henare 2001) and is centered on ideas of vitalism and cosmology. Vitalism refers to the doctrine that biological systems are governed by forces that are not physico-chemical (Brigandt & Love 2008). Oral traditions support archeological evidence that the Māori migrated from the Pacific Ocean and are Polynesian people. At the heart of the Māori worldview is a religious cosmology that describes existence as originating from a surge of primal power, “Tapu” akin to the prevailing western cosmological theory of the “big bang.” The religion is characterized by a distinctive observable phenomenon involving rituals, ceremonies, religious objects, sacred place and sites, art and carvings, people places, myths, legends, customs, beliefs and practices (Henare 2001).

The vitalism seen in Māori culture is defined as “the belief in an original singular source of life in which that life continues as a force that imbues and animates all forms” (Henare 2001). There are 5 intricately and co-dependent components known as *mauri*, *tapu*, *mana*, *hau*, and *wairua* that define existence. In Māori cosmological beliefs, all things are imbued with *mauri* the vital spark originating from the Io, the supreme comic being that existed before Sky Father and Earth Mother. Tapu is a cosmic power imbued in all things that originally came from Sky Father and Earth Mother, was passed onto their children, and exists in all things. Tapu often refers to restriction and prohibitions on behaviors. Once something exists, has tapu, it also becomes a being with power of potential, or mana. Mauri is transmitted by Hauora, one of the children of the creation parents, also responsible for hau or “the breath of life.” Wairua is the spirit akin to a soul, it established intelligence and is necessary for the existence of the tinana, or the body.

For example, a seed of a tree contains the mauri and hau of Tane, a child of the creation parents. As it exists it has the potential to be living, the mana of Tane. The seed is transformed into a trunk, a body that has wairua a spirit bounded by mauri which if separated causes the tree to die. Hau is the very essence of vitality, a part of life that influences the whole, liked to mauri whowho’s purpose is goodness. The hau is what must be protected and honored for fertility and productivity. The idea of reciprocity is based on “feeding the hau” which entails making offerings of the first catch or crop to the sea, river, lake, or forest. Belief in hau established a complex system of obligatory gift exchange in traditional Māori society. Though each of these components are individual, they are co-dependent and relational so that Māori must reverie creation as a whole. Their ethic encompasses a whanaungatanga (kinship) with other beings, a sacred regard for the whole of nature and its resources (seen as gifts from the spirits), a sense of responsibility for these gifts as the appointed stewards and guardians, and a convention of utu (reciprocity) (Henare 2001).

According to Manuka Henare, an indigenous Māori scholar, the creation of the world began after Sky Father and Earth Mother, two inseparable lovers locked in a permanent embrace, where separated by their own children in a period known as *te whei ao* (2001). During Ranginui (Sky Father) and Papa-tua-nuku’s (Earth Mother) age-long embrace they were said to have many children who lived between them and became the spirit beings of the sea, winds, forests, wild foods, crops, and humanity. Living in continuous darkness and limited space, Tane Mahuta, the guardian and father of the forests and all things that live in the forests and a child of the parents, thrust Ranginui far above Papa-tua-nuku and let the light come between them. In a burst of primal energy the world of light was created. Thus the Māori see themselves not as separate from nature. They are descendants of Earth Mother and belong to the earth. While humans can harvest the bounty of Earth Mother, they do not own them but rather have “user rights” also given to animals, birds, fish, and trees. Tane Mahuta became the father of all the natural beings who live on Papa-tua-nuku. He sought out Pakoti and together they became the parents of Harakeke, the flax used traditionally in weaving. Of this union arose two children, Harakeke Muka and Harakeke Wharariki. Of these two came many children each with its own name and purpose.

The techniques of weaving and plaiting are traditionally believed to have been acquired from a *patupaiarehe* (fairy) named Hine-rehia. According to the story as retold by the Hindimarsh’s article, this fairly fairy was an expert in textiles and was married to a mortal working only at night in the fashion of a fairy. She put her work away at dawn, as her skill and work could be undone by the sun. Māori women of

Motuihe wanting to learn her skill used a tohunga to confuse the fairy's sense so that she would continue to work once the sun rose. Once Hine-rehia realized she had been tricked and the women had learned her skill, she sang a sad farewell to her husband and children before a cloud bore her away to the Moehau Range. The importance of flax is also seen in another popular Māori myth featuring the culture hero Maui and his brothers. According to the story, Maui and his brothers snared the sun with a rope made of harakeke, forcing it to traverse the sky more slowly than had been its custom, thus proving more hours of daylight.

**Practice.** Māori have developed much TEK involving the use of harakeke, or New Zealand flax espoused by myth and rituals. Part of Māori ritual and ceremony was initiating weavers that would become experts into Te Whare Pora (Puketapu-Hetet 1999) Te Whare Pora was a 'state of being' in which the weaver falls into a relaxed clear minded state with raised consciousness opening them to understanding the deeper knowledge of weaving and its spiritual aspects (Puketapu-Hetet 1999: 33). In the ceremony the student would begin by holding prepared fiber while the tohunga (expert) recited karakia (incantations). She stooped forward and bit the upper part of the turuturu (cloak weaving) and then used the prepared fiber to weave aho tapu, the first sacred line. Next the student was removed from her work in haurihanga takapau, the turning of the first mat. Diving aid and tThe karakia endowed the student with a receptive mind and retentive memory so that she could quickly understand and retain the knowledge of weaving.

Flax was widely used in traditional Māori daily life. The processing, plaiting, and weaving of flax was usually carried out by women but was sometimes done by men, especially in the making of weapons and large communal projects such as fishing nets. There are strict rules for the gathering and harvesting of harakeke. The plant is divided into three sections, the central leaves are called the rito, the middle leaves are called awhirito and serve as support and protection, and the end leaves are called pakere and are extracted for weaving. Awhirito and rito are never cut but are left for continued healthy growing. Cuts are made in downward slopes away from the awhirito to guide rain water away. Though some of the cut leaves are not always suitable for growing, they are still removed, clearing old growth and creating space for new growth.

Harakeke was initially used for plaiting and weaving mats and basket, but was later transformed into platters, buckets, building fortifications, lines and nets for fishing, rope, sails for canoes, and even babies rattles (Hindmarsh 1999). Many parts of the flax plant, leaves, gum, rhizomes, and stalks were used medicinally and as an antiseptic. The flowers nectar was used as a food and beverage sweetener. In a process called haro, harakeke was drawn across a sharp edge to scrape off the backing layer and be left with soft, silky inner fibers known as muka to be used in creating beautiful elaborate garments (Hindmarsh 1999). New Zealand's colder climate prompted the Māori to fashion protective garments initially used for practical purposes and later made intricately to honor those of high rank (Smith, Jill and Peter 2001). Beyond practical functions, special cloaks such as the pakupuku (war cloak) and kahu kuri (dog skin cloak) were fashioned by expert weavers with the finest materials, making them taonga, or treasures. The garments came to embody the great power and prestige derived from the artists, the ancestors invoked in its making, and the final owner and wearer.

## **Results**

	<b>Ojibwe</b>	<b>Kayapó</b>	<b>Māori</b>
<b>Context</b>	Location: north-midwest US and south-central Canada Population: estimated over 300,000 Environment: Sub-arctic climate with long, cold, snowy winters and short hot summers	Location: Amazonian jungle in central Brazil Population: 3,000 Environment: tropical forest and savanna	Location: New Zealand, primarily in the North Island and sparsely in the South Island Population: estimated 300,000 to 525,000 Environment: mainly mountainous and coastal
<b>Practice</b>	Wild Rice is an important food staple harvested by two people in a canoe through “knocking” is low-impact and allows for re-seeding	Traditional Insect Classification corresponds with Scientific class Insecta. An extensive classification of the category <i>ñy</i> , social insects, has been developed.	Flax is an important fibrous plant used extensively in traditional life for plating, weaving, medicine and other uses
<b>Belief</b>	Wild Rice was given to the people by Winebozho who discovered it in his spirit quest by breaking a food taboo and re-sowing in a nearby lake.	The Kayapó learned social organization, valor, and strength from the bees, wasps, and ants ( <i>ñy</i> ). The wasps nest is a symbolic model of the universe, divided into three parallel realms; sky, earth; and lower plane.	Flax came from the children of Sky Father and Earth Mother. Māori women tricked a <i>patupaiarehe</i> named Hine-rehia into teaching them weaving. Flax ropes were used by Maui to slow the sun and elongate the day.

## **Discussion and Conclusion**

### *Ojibwe*

Modern day harvesting for wild rice is conducted using methods akin to the traditional Ojibwe fashion, with few technological improvements other than commercialized processing and the purchase of tools made with modern materials such as metal rice sticks. Most modern ricers are Ojibwe. Maintaining the ricing tradition and acknowledging the ecological importance of wild rice has spurred environmental protection for rice lakes (Jones 2009). A good rice harvest is heavily dependent on water quality and water levels. Rice beds provide important habitat and sustenance for wildlife. Tribal authorities have used gaming revenue to re-seed rice beds deteriorated by climate change. Though practices are now enforced by state officials as well as tribal officials they were inspired by traditional practices and are informed by tribal affiliates. Wild rice is not only an important cultural staple but also vital to local ecology.

### *Kayapó*

The Kayapó is the least assimilated of the three groups studied, retaining a great deal of indigenous knowledge and TEK. Their struggles have greatly mounted within the past century, they have lost land rights and with it have become limited in the practice of their traditional way of lifeways. Assimilating to the new economy imposed on them has lent them to criticism of betraying their traditional lifestyle. However, study of the Kayapó TEK has given researchers unique insight into the local ecology. The study of a single practice reveals how they have developed an extensive and remarkable classification of social insects used in many practical concoctions. A unique aspect of indigenous groups such as a Kayapó is their ability to esteem and respect a resource without precluding its use. Though they consider humans high on the web of life, their abilities and courage is attributed to social insects.

### *Māori*

Recently, the traditional harvest and use of Harakeke for arts and crafts has emerged in the culture of modern New Zealand. After initial contact, reliance on western materials goods and resources allowed much harakeke cultivation to die out. However, as modern Maori embrace this traditional resource its potential for increasing sustainability emerges. A naturally proliferate species, harakeke is local and has many practical uses. Reliance on the plant has the potential reduce the import of foreign materials or and cultivation of cultivate non-native species.

The research shows two important possibilities in the emergence of TEK in natural resource management. Exploring TEK can, as in the case of the Ojibwa, and Maori, and to a lesser extent the Kayapó, provide practices and knowledge in using local resources. The Ojibwa wild rice harvesting and other methods of subsistence involving the harvesting local species (such as deer and small mammal hunting or berry picking), can increase sustainability by decreasing the dependence by locals on foods imported out of the region or on pesticide and water intensive foods grown locally that are not viable in the local climate. Similarly, the harvesting and use of harakeke by Maori can increase sustainability through the emergence of products made from an alternative local natural resource thus decreasing dependence on petroleum based plastic products or pesticide and water intensive cotton products. The use of social insect in concoctions by the Kayapó can provide an alternative to chemical inorganic products.

However, the acceptance and use of TEK will require a change in attitude and an understanding of its importance. This directs to the second possibility in the emergence of TEK. The propagation of TEK in local communities exists through the social structures, institutions, beliefs, and world view mentioned by Woodley (2004), Berkes (1999, 2001), Posey (1985), Townsend (2005), Grim (2001), Lu Hold (2005). The practice of TEK requires recognizing the beliefs and worldviews accompanying it at the very least and understanding and accepting them at the most. In the communities in where each TEK is widely practiced, there already exists an acceptance of the underlying beliefs and worldview, the degree to which depends on the communities' exposure to the western worldview.

It is important to recognize the difficulty that comes with using TEK arising that arises from the belief aspects complex. The more general worldview is more easily accepted than each specific belief because the worldview refers to the underlying environmental ethics found in TEK while each belief refers to the specific supernatural creation stories surrounding each practice. It is the worldview and beliefs that scientists and western professionals are quick to deny and reject when exploring TEK. But it is the recognition of those same elements that will lead to the development of sustainable practices because within them there exists an embedded environmental ethics that the western worldview largely lacks. For example, each practice reviewed by this research is given importance beyond its practical use. Each is surrounded by a story that requires respect along with use, given the supernatural origin of each resource (wild rice, harakeke, and social insects).

The purpose of this analysis is not to advocate ending the use of technology and anything of modern origin and replacing it with traditional subsistence patterns. Rather the purpose is to explain how

our environmental problems and the failure of our natural resource practices stem in part from the worldview under which they are developed. The task at hand is not to ask whether people are natural conservationists, as stated by Lu Holt, but to identify the conditions which foster conservation amongst a group of people (2005). Practicing conservation requires “a set of social understanding and behavior patterns that can emerge when there is an agreement by a group of people to temper their resource use in the expectation that others will do the same” (Lu Holt 2005). Current natural resource management regimes must encourage social structures and political institutions that will support sustainable resource use and conservation. Scientists must begin by reaching out and accepting the knowledge of local indigenous cultures before being able to recognize its potential. Understanding TEK requires exploring the indigenous worldviews surrounding it, while remaining respectful and showing reciprocity in the form which is most beneficial for indigenous communities, either by encouraging political protection for land rights, resource use, or cultural conservation.

## References

- Berkes, Fikret. 1999. Role and Significance of "Tradition" in Indigenous Knowledge. *Indigenous Knowledge and Development Monitor* 7 (1): 19.
- Berkes, Fikret and Carl Folke 1998. "Linking Social and Ecological Systems for Resilience and Sustainability." Pp. 1-25 in *Linking Social and Ecological Systems: Management Practices and Social Mechanism for Building Resilience* edited by F. Berkes, C. Folke, and J. Colding. Cambridge, United Kingdom: Cambridge University Press.
- Berkes, Fikret, Johan Colding, and Carl Folke. 2000. "Rediscovery of Traditional Ecological Knowledge as Adaptive Management." *Ecological Applications* 10(5): 1251-1262
- Berkes, Fikret. 2001. "Religious Traditions and Biodiversity." *Encyclopedia of Biodiversity* 5: 109-120.
- Brigandt, Ingo and Alan Love. 2008. "Reductionism in Biology." *The Stanford Encyclopedia of Philosophy (Fall)* edited by E. N. Zalta. Retrieved July 26, 2010 (<http://plato.stanford.edu/archives/fall2008/entries/reduction-biology/>)
- Brush, Stephen B. 1996. "Whose Knowledge, Whose Genes, Whose Rights?" Pp. 1-21 in *Valuing Local Knowledge: Indigenous People and Intellectual Property Rights* edited by S. B. Brush and D. Stabinsky. Washington D. C.: Island Press.
- Burtenshaw, Mike and Graham Harris. 2007. Experimental Archeology Gardens Assessing the Productivity of Ancient Māori Cultivars of Sweet Potato, *Ipomoea batatas* [L.] Lam. in New Zealand. *Economic Botany* 61(3): 235-245.
- Catton, William R. and Riley E. Dunlap. 1978 "Environmental Sociology: A New Paradigm." *American Sociologist* 13(1): 41-49.
- Callicott, Baird J. and Michael P. Nelson. 2004. *American Indian Environmental Ethics: An Ojibwa Case Study*. Upper Saddle River, NJ: Pearson Prentice Hall
- Daeg de Mott, D. K. ed 1998. Ojibwa. reviewed by D. Kavanaugh. *Worldmark Encyclopedia of Cultures and Daily Life*. Ed. by T. L. Gall. Vol 2 (Americas). Detroit, MI: Gale.



- David, Peter, Charlie O. Rasmussen, Sue Erickson. Fall 2008. "Gathering Manoomin." *Mazina 'igan Supplement*. Edited by J. St. Arnold and S. Erickson pp2
- Durkheim, Émile. 1912. *The Elementary Forms of the Religious Life*. London, Great Britain: Hollen Street Press.
- Erdoes, Richard. 1984. "A Gust of Wind." Pp. 150-151 in *American Indian Myths and Legends*. edited by R. Erdoes and A. Ortiz. New York: Pantheon Books.
- Flowers, Nancy. ed. 1994. Gorotire. *Encyclopedia of World Cultures* Vol. 7, South America. Boston, Mass: G.K. Hall
- Grim, John A. 2001. Indigenous Traditions and Deep Ecology. Pp. 35-57 in *Deep Ecology and World Religions: New Essays on Sacred Ground*. edited by D. L. Barnhill and R. S. Gottlieb. Albany, New York: State University of New York Press.
- Hayles, Katherine N. 1995. "Searching for Common Ground." in *Reinventing Nature? Responses to Postmodern Deconstruction* edited by M. E. Soulé and G. Lease. Washington D.C.: Island Press.
- Henare, Manuka. 2001. "Tapu, Mana, Mauri, Hau, Wairua: A Māori Philosophy of Vitalism and Cosmos." Pp. 197-214 in *Indigenous Traditions and Ecology: The Interbeing of Cosmology and Community* edited by J. A. Grim. Cambridge, MA: Harvard University Press.
- Hindmarsh, Gerard. 1999. "Flax-the Enduring Fibre." *New Zealand Geographic* (42). April-June 1999. pp. 28-41.
- Hughes, Donald J. 2004. "The Ancient Roots of Our Ecological Crisis." Pp. 160-164 in *Environmental Ethics: Divergence and Convergence* 3<sup>rd</sup> ed. edited by S. J. Armstrong and R. G. Botzler. New York: McGraw-Hill.
- LaDuke, Winona. 2004. "Voices from White Earth." Pp. 247-254 in *Environmental Ethics: Divergence and Convergence* 3<sup>rd</sup> ed. edited by S. J. Armstrong and R. G. Botzler. New York: McGraw-Hill.
- Latham, Christopher. ed. 1991. Maori. *Encyclopedia of World Cultures* Vol. 2, Oceania. Boston, Mass: G.K. Hall

- Lu Holt, Flora. 2005. "The Catch-22 of Conservation: Indigenous Peoples, Biologists, and Cultural Change." *Human Ecology* 33(2): 199-215.
- Peterson, Anna L. 2004. "Environmental Ethics and Social Construction of Nature." Pp. 87-94 in *Environmental Ethics: Divergence and Convergence* 3rd ed. edited by S. J. Armstrong and R. G. Botzler. New York: McGraw-Hill.
- Pitchon, P. ed 1998. Kayapos. *Worldmark Encyclopedia of Cultures and Daily Life*. Ed. by T. L. Gall. Vol 2 (Americas). Detroit, MI: Gale.
- Polanyi, Karl. ed 2001. *The Great Transformation: The Political and Economic Origins of Our Time*. 2nd ed. Boston, MA: Beacon Press.
- Posey, Darrell A. 1983. Ethnomethodology as an Emic Guide to Cultural Systems: The Case of the Insects and the Kayapó Indians of the Amazônia. *Revista Brasileira de Zoologia*, 1(3), 135-144.
- Posey, Darrell A. 2008. "Indigenous Management of Tropical Forest Ecosystems: The Case of the Kayapó Indians of the Brazilian Amazon." Pp. 89-101 in *Environmental Anthropology: A Historical Reader* edited by M.R. Dove and C. Carpenter. Madlen, MA: Blackwell Publishing.
- Puketapu-Hetet, Erenora. 1999. *Māori Weaving*. Auckland, NZ: Addison Wesley Longman.
- Redford, Kent H. 1991 The Ecologically Noble Savage. *Cultural Survival Quarterly* 15.1 retrieved June 10, 2010 (<http://www.culturalsurvival.org/ourpublications/csqa/article/the-ecologically-noble-savage>).
- Reid, Gerald F. ed. 1991. Ojibwa. *Encyclopedia of World Cultures* Vol. 1, North America. Boston, Mass: G.K. Hall
- Rolston, Holmes III. 1997. "Nature for Real: Is Nature a Social Construct?" in *The Philosophy of the Environment* edited by T. D. J. Chappell. Edinburgh, Scotland: Edinburgh University Press.
- Smith, Jill and Peter Smith 2001. Making Connections: John Bevan Ford, Maori Artist. Wellington, NZ: Gilt Edge Publishing.
- Soper, Kate. 1995. *What Is Nature?: Culture, Politics And The Non-Human*. Oxford, England: Blackwell.

- Sutton, Mark Q. and E. N. Anderson. 2004. *Introduction to Cultural Ecology*. Walnut Creek, CA: AltaMira Press.
- Townsend, Patricia K. 2009. *Environmental Anthropology: From Pigs to Policies* 2<sup>nd</sup> ed. Long Grove, IL: Waveland Press.
- Vecsey, Christopher. [1983] 1996. *Traditional Ojibwa Religion: And its Historical Changes*. Reprint, Philadelphia: The American Philosophical Society.
- Vernum, Thomas. [1988] 2004. *Wild Rice and the Ojibway People*. Reprint, St Paul, MN: Minnesota Historical Society Press.
- Vidal, Lux, trans. ed. 1994. Xikrin. *Encyclopedia of World Cultures* Vol. 7, South America. Boston, Mass: G.K. Hall
- Williams, J. ed 1998. Maori. *Worldmark Encyclopedia of Cultures and Daily Life*. Ed. by T. L. Gall. Vol 3 (Oceania). Detroit, MI: Gale.
- White, Lynn T. 2004. "The Historical Roots of Our Ecological Crisis." Pp. 119-224 in *Environmental Ethics: Divergence and Convergence* 3<sup>rd</sup> ed. edited by S. J. Armstrong and R. G. Botzler. New York: McGraw-Hill.
- Woodley, Ellen. 2005. Indigenous Knowledge: A Conceptual Framework and a Case from Solomon Islands. *Participatory Research and Development For Sustainable Agriculture and Natural Resource Management: A Sourcebook* 1:65-74 retrieved July 25, 2010 ([http://www.idrc.ca/en/ev-73443-201-1-do\\_topic.html](http://www.idrc.ca/en/ev-73443-201-1-do_topic.html))