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COLLABORATIVE CONSERVATION: A PHILOSOPHICAL ANALYSIS OF THE EFFICACY
AND COMMENSURABILITY OF TEK AND WESTERN SCIENCE

By

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Thesis

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Abstract

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Collaborative Conservation: A philosophical analysis of the efficacy and commensurability of TEK and Western science

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This thesis seeks to explore the similarities and differences between traditional ecological knowledge and Western science as a way to address long-held misconceptions about the efficacy of traditional ecological knowledge, or TEK. The motivation for this project arose from a deep desire to investigate the historical injustices toward Indigenous peoples in the name of conservation. The goal of this analysis is to illustrate that effective collaboration between Indigenous knowledge holders and Western scientists is not only possible, but desirable. I outline three major barriers from which I draw out three minimum criteria which must be met if collaborative conservation efforts are to be successful. These barriers are the misguided perspective of Western superiority over other systems of knowledge, the cultural and spiritual aspects of TEK, and the potential for exploitation and appropriation. The respective criteria are as follows: (1) there is a need to first give up the idea of the positional superiority of the West, (2) there must be acknowledgment and acceptance of the cultural underpinnings of TEK, and (3) there must be continuous engagement with traditional knowledge holders throughout any collaborative practice. My analysis illustrates that there is adequate cause to be hopeful that just and effective collaborative conservation practices are possible. I conclude by claiming that collaborative conservation has the potential to address a variety of ecological issues in a way that maximizes both justice and effectiveness.

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Introduction

Growing up in rural West Virginia, there were naturally quite a lot of cultures that I was not exposed to as a child. As an adult, however, I like to think that I am fairly cultured for someone my age and I often take pride in that fact. I do what I can to learn about other cultures at any opportunity and I am always the first to jump at a travel opportunity. Moving to Montana at the age of 23 quickly made me realize that in all of my travels and through all my years of formal education, I had been almost completely ignorant of the real presence of Indigenous peoples all across the United States. Of course, I knew there are tribes scattered across the country on reservations and individuals living in cities and towns just like the rest of us. I just had not personally ever had the opportunity to interact with Native Americans, and especially none in which I could learn first hand about their cultures. I cannot even recall ever being taught the history of the Native Americans who resided in my home state before settlers arrived.

Upon realizing this, I had such mixed emotions. I was upset with myself for not having taken it upon myself to be more knowledgeable about the true history of the place I was raised. I was mad at the public education system for failing me in this regard, but even more mad about the lack of representation given to Indigenous peoples in our education system and, more generally, in our dominant culture. Residing in Montana for nearly two years, I have been exposed exponentially more to the cultures and worldviews of Indigenous peoples in my day to day life and through my academic endeavors, which has ultimately helped to develop the questions and ideas that led to this paper.

I came to this project with the broad focus in mind of studying the disproportionate effects of climate change on poor and minority communities which led me down the rabbit hole

of environmental justice literature. This led me to the issue of abhorrent and wholly unjust conservation practices worldwide and an interest in the displacement of Indigenous peoples. As I began to study the facts of the matter, I realized just how paradoxical and problematic these practices were, and also that the issue of justice in conservation has been well addressed in the literature. Instead, I chose to focus on finding ways in which Western conservation practices could work together with Indigenous peoples on the protection of the natural world rather than against them.

Although they make up less than 5% of the global population, Indigenous peoples are currently successful stewards of 80% of the remaining biodiversity on Earth (Raygorodetsky). An extensive study conducted by World Wildlife Fund International (WWF) and Terralingua¹ mapped a strong and direct correlation between cultural diversity among indigenous populations and critical biodiversity around the globe (Oviedo, 1), yet Western² conservation practices have historically excluded and displaced Indigenous populations in order to provide areas for recreation and tourism to be used by others (Taylor, 2016: 356-358; Whyte and Cuomo, 2016: 6). Unjust exclusion and displacement have been justified by the dominant global conservation paradigm which has always been top-down with a focus on preservation of “pristine” landscapes and “virgin” wilderness (Taylor, 2016: 356; Shultis and Heffner, 2016: 1229). As a result of conservation projects such as forests, parks, and game reserves, Native peoples were removed from their ancestral lands and the newly protected landscapes were depicted as untouched

¹ Canadian nonprofit dedicated to supporting the integrated protection, maintenance and restoration of the bio-cultural diversity of life.

² I use the term “Western” throughout this paper to refer to the underlying framework of thought, culture, and science which is, at its core, influenced by modern European ideals and perpetuated by U.S. settler colonialism.

“virgin” territory (Taylor, 2016: 358-360). There is a large body of evidence which suggests that places conservationists have historically deemed “pristine” and untouched wilderness were actually well managed landscapes under the care of Indigenous peoples (Shultis and Heffner, 2016; Dowie, 2009). For this reason, it is sensible to claim that Indigenous peoples have typically been able to live on their land in such a way that protects the environment. If so, then there is much to be learned from Indigenous peoples about how to live sustainably in the world without the need for more exclusive protected areas.

The primary goal of this paper is to show that collaborative conservation practices between Indigenous peoples and non-Indigenous organizations/governments have the potential to be more just and more effective than current, dominant, Western conservation practices alone, because it has the potential to promote the goals and interests of both Indigenous peoples and Western scientists. This paper focuses on ways in which proper implementation of research strategies can lead to more just and effective conservation work in the context of good-faith collaboration between Western scientists and Indigenous knowledge holders. I must acknowledge that there is a genuine possibility of bad-faith collaboration which would continue to exploit and potentially harm Indigenous peoples. However, my intention is to delineate the conditions necessary for appropriate and just collaboration, and dishonesty does not fit that bill. Assuming that collaborators are working from a place of genuine intention, I argue that, because the two systems of knowledge are actually more complementary than is typically assumed, they can work together to produce better conservation outcomes than either would be capable of alone. I provide examples of successful forestry and fire use practices implemented by Native Americans to show how Indigenous peoples have been able to maintain critical biodiversity and

healthy ecosystems while also creating and maintaining economically successful land use practices. Providing this evidence undermines the West's historically perceived need to remove peoples from their land in order to protect it. If Western conservationists make a concerted effort to learn from Indigenous peoples, adopt practices similar to theirs, work more respectfully with them, and engage more fully with their cultures, then this unfounded need for empty landscapes disappears. In this paper, I explore what it can look like to maximize efficiency in forest management and conservation projects through the use of both Modern Western science and traditional ecological knowledge (TEK) in a way that is respectful of Indigenous cultures and systems of knowledge. My main claim is that in order to reach this goal, conservationists must include Indigenous peoples in the process and trust that they have valuable skills, knowledge, and traditions to bring to the table. There is a need first to learn about and gain understanding of various systems of traditional knowledge, and second to figure out appropriate ways of applying it to the ecological problems we face. Any integrative scientific model or collaborative practice will need to focus on facilitating cross-cultural collaboration, dialogue, and understanding in meaningful ways.

Throughout the paper, I outline three major barriers to successful collaboration between TEK and Western science and draw solutions to overcome them. These barriers include an unfounded worry about the effectiveness of TEK which stems from Western misunderstanding of TEK, the difficulty of Westerners in grappling with the cultural and spiritual aspects of TEK, and the disconnect between TEK and Western science in regards to modes of knowledge transmission. The solutions I posit for overcoming each barrier act collectively as a set of three criteria which must always be met in order for collaboration to be respectful and successful. The

first criterion is that it is imperative for Westerners to let go of the historically misguided and assumed superiority associated with the worry about TEK's effectiveness. The second criteria is that no attempt should be made to separate scientific knowledge from cultural knowledge, as these two things are inherently intertwined in many Indigenous worldviews (Kawagley, 1998: 134). The third criterion is that Westerners must engage with Indigenous knowledge holders continuously throughout the process of their work so as to not exploit or appropriate Indigenous cultures.

The structure of the paper is as follows. The first section addresses the first barrier by showing that the worry about TEK's effectiveness is rooted in false, harmful, and outdated neo-colonial ideals. I provide examples that give evidence against this assumption by first outlining examples in which TEK has proven to be more successful at achieving specified goals than Western science. I then provide examples of injustice experienced by Indigenous peoples at the hands of well-intentioned Western conservation policies and practices. Finally, I examine evidence of similarities between the two systems of knowledge which explains why we should expect TEK to be quite effective, even by Western standards.

The second section is devoted to the issue of how the second barrier can be overcome if no attempt is made to separate scientific knowledge from culture. I draw on analyses by various scholars in order to show that it is precisely some of the more holistic practices of TEK — specifically, those aspects of TEK which tend to be looked down upon by Western science — which make TEK so effective for conservation and forest management projects. I use the example of sustainable forestry practices of the Menominee in Michigan to illustrate how the cultural aspects of Menominee forestry play a vital role in both the economic and ecological

success of the project. I go through this case study analysis in detail in order to illustrate that the key features which contribute to the success of Menominee forestry are prevalent throughout many Native American cultures and rely on so much more than simply empirical scientific data. Section three addresses the final barrier and associated criterion: that successful collaboration requires continuous engagement with Indigenous knowledge holders. This section reveals how collaborative projects which meet the third criterion can work to overcome the third barrier regarding knowledge transmission and the risk of exploitation. I discuss potential difficulties in both the transmission and acquisition of traditional ecological knowledge by Westerners alongside the risk of exploiting both the knowledge holders and the knowledge itself. In this section, I argue for non-exploitative collaborative practices which not only value TEK as a technological and empirical resource, but also work to legitimize the theoretical and methodological aspects of TEK. I then review a study conducted by the United States Forest Service and Portland State University in conjunction with the Confederated Tribes of Warm Springs; the primary research goal was to generate knowledge about traditional fire use and cultural fire regimes in the Pacific Northwest. This final case study analysis is intended to illustrate what an appropriate process for engaging with and learning from Indigenous knowledge holders can look like. My conclusion is that, based on my analysis, there are significant advantages to embracing the differences between Western science and traditional ecological knowledge and working together to achieve forest management and conservation goals more effectively in the future.

Overcoming the Idea of Western Superiority

The first major barrier to genuine collaboration between holders of TEK and Western science is the problematic assumption underlying Western methodology that Western science is superior to other forms of knowing and, therefore, solutions must arise from the Western framework in order to be effective. I use the term “effective” throughout the paper to mean “successful both at predicting natural systems’ behavior and at manipulating these natural systems so as to reach some given practical goals,” such as landscape, species, or natural resource conservation and management. Western science emphasizes controlled experimentation, replicability, and objectivity, which has resulted in a history of success that provides ample evidence for its effectiveness. In other words, there is no question that Modern Western science is effective; rather, the questions are whether it is always more effective than other systems of knowledge and whether it is always more effective alone rather than integrated with other systems of knowledge.

The worry about the ineffectiveness of Indigenous systems of knowledge dates all the way back to the earliest European conquests and has been continually rooted throughout the history of settler colonialism (Smith, 1999: 60). In her book, *Decolonizing Methodologies*, Linda Smith (1999) writes that during the European conquests of “new” worlds, Indigenous peoples were studied as subjects and classified alongside flora and fauna (59). Colonial ideas which perpetuated injustices towards Indigenous peoples were rooted in Christian conceptions of rights, duties, and obligations pertaining to relations between superiors and inferiors (Garrett, 2011:64). Aaron Garrett (2011) discusses the fact that a common reading of Christian scripture was that “God created man in part to be the master of nature” (64). If Indigenous peoples were classified alongside flora and fauna (nature), and Christianity was used as a means of justification for the

conquering of nature, then Christian ideals were used to justify the exploitation of Indigenous peoples and their lands. Smith (1999) argues that colonial ideas, images, and experiences about the Other worked to shape and delineate differences between Europeans and everyone else, as well as set the stage for “positional superiority” of the West (60). Commenting on the various atrocities associated with colonial expansion in regards to Indigenous knowledges, Maurice Bazin — French born science educator who settled in Brazil and, later, San Francisco — claimed that “Europeans could not even imagine that other people could ever have done things before or better than themselves” (Bazin, 1993: 39). His powerful essay titled “Our sciences, their science” dives deep into the perceived positional superiority of Europeans over those they conquered by outlining a multitude of cases in which Indigenous practices and technologies, from a technical perspective, were just as effective, if not more so, than similar European practices and technologies of the time. As Linda Robyn has noted, the worry about the potential ineffectiveness of TEK stems from the legacy of colonial thought which places TEK into the categories of primitive, simple, “not-knowledge,” or folklore (Robyn, 2002: 571). She writes: “colonial-style policies and practices concerning the environment and sustainability were formulated with false assumptions that the people of the Americas were primitive uncivilized savages who impeded the growth of technology and progress” (570).

However, there have been many reported cases where TEK and Western science have come into conflict and TEK has proven to be more effective. In fact, many Indigenous scholars have argued that TEK is better situated to be more effective at understanding and adapting to the natural world than Western science (Wildcat, 2009; Kawagley, 1998; Kimmerer, 2013). Western science often lacks deep contextual understanding of local environments. While traditional

ecological knowledge is based on multiple generations — hundreds and thousands of years — of interactions with ecosystems and larger environments, modern scientific claims are typically only based on a few years to, at most, a few decades, worth of data collection (Wildcat, 2009: 74). For example, as Linda Robyn (2002) notes, Indigenous peoples in the Belizean rainforest produced edible palm oil from a native tree by using various simple, local technologies based on knowledge passed down for generations, while at the same time, twenty-five separate projects from Western researchers attempting to accomplish the same goal over a period of one hundred years all failed (571). Other examples are featured in Mark Dowie's work, such as the way in which the Canadian government's hunting regulations for the Peary caribou, musk oxen, and bowhead whales came in conflict with Inuit hunting practices in Canada (Dowie, 2009; 112). In all three cases, the multi-generational knowledge of the Inuit proved to be correct and their practices more effective than the Canadian government's at maintaining healthy species populations (112). Evidence against the assumption of Eurocentric superiority over "uncivilized savages" dates back as far as 600-700 AD. In *Red Alert!*, Daniel Wildcat writes, "For those who insist on characterizing societies in the Americas before the arrival of Europeans as primitive — in other words, organizationally simple, subsistence societies — it is obvious they have little knowledge of Hohokam and her two contemporary North American cultural centers, Chaco Canyon and Cahokia" (Wildcat, 2009: 82). Native Peoples in the American southwest at this time were already developing advanced and complex sociocultural systems. The Hohokam built one of the most extensive and sophisticated irrigation systems in the world, requiring substantial labor and food surpluses as well as sophisticated understanding of scientific principles of engineering and physics (80-84). Suzanne K. Fish (2000) writes that the Hohokam "endured as

an archaeologically recognizable entity for more than a millennium” (254) by continually testing the “delicate balance between fragile arid ecosystems and the impingements of sustained agriculture” (252). Arguably, then, it is simply misguided to consider Indigenous peoples of the past or present as having been or being nothing more than uncivilized savages incapable of living intelligently, deliberately, and sustainably³. As a result, one can confidently affirm that the worry regarding the potential ineffectiveness of TEK is largely addressed by an extensive body of empirical evidence. It is genuinely counterproductive to view TEK as “primitive” and impeding progress since its application has often led to sustainable life-enhancing social institutions and cultures.

A critical topic for examination which gets at the heart of the issue at hand is the historic struggle between Native American tribes and the U.S. Forest Service in regards to Indigenous fire use practices and Forest Service fire suppression and exclusion policies. This subject not only touches on the issue of effectiveness, but also provides critical insight into the injustices and harms faced by Indigenous peoples at the hands of colonial style policy and practice. A substantial body of evidence shows that Indigenous fire use practices tend to be significantly better for ecosystem health and functioning than the forest management practices of the U.S. Forest Service, as well as abounding evidence of the serious negative impacts of U.S. Forest Service policies on Indigenous ways of life (Norgaard, 2014; Kimmer and Lake 2001). In a 2012 report, the U.S. Department of Agriculture admitted that fire exclusion has had serious measurable impacts on Native American cultural identity and traditional ecological knowledge

³On the other hand, at no point in this paper am I, in any way, intending to imply or gesture towards the idea that any Indigenous group or person should be thought of as the stereotypical “ecological Indian” (Krech).

(USDA, 2012). Fire exclusion policy was, and still is, capable of having an effect on cultural identity and TEK because fire use by Indigenous peoples is both a pragmatic and spiritual practice. Norgaard (2014) writes about the ways in which the Karuk tribe of northern California historically regulated forests and fisheries through ceremony and fire use practices that enhanced traditional food and cultural use species (74). Functioning within a subsistence economy requires great dependence on and responsibility to the land on which one resides. According to Norgaard, the Karuk peoples used fire to facilitate forest quality for food species like elk, deer, acorns, mushrooms, and lilies, to maintain access to basketry materials like hazel and willow, to keep travel routes open, and to affect inputs to riparian systems in the area (79). Fire policy beginning in the 1920's transformed many North American landscapes through the suppression and exclusion of wildfire which had negative impacts on the overall health of ecosystems, human beings included (Norgaard, 2014: 74; Kimmer and Lake, 2001; McBride et al., 2017). Without controlled burns, larger wildfires burn more aggressively, are more unpredictable, occur more frequently, and fire seasons last longer (Norgaard, 2014: 75; McBride et al., 2017: 44). Fire suppression policy not only negatively impacted the health of the forest, but also created serious social strain on tribes and worked to sever their spiritual relationship with the earth (Norgaard, 2014: 74-75). Denying tribes the right to burn also denied them access to traditional foods and spiritual practices, put their cultural identity at risk, and infringed upon their political sovereignty (74). Norgaard notes that, among other side effects, high fuel loads built up in the forests, healthy habitats for large game decreased, quantity and quality of acorns was reduced, and growth patterns of basketry materials were significantly altered (74). Indigenous fire use practices have consistently proven to be effective at managing forest resources and maintaining ecosystem

health, while Western policies and practices have undermined their time-tested knowledge of fire regimes and had serious negative impacts on the lives of countless Native Americans.

That Indigenous conservation practices are effective should not come as a surprise. While Western science and TEK diverge at many points, they are actually similar in more ways than one might imagine. Even by Western standards, TEK should be expected to be effective. In *Conservation Refugees*, Mark Dowie (2009) notes that they both begin with empirical observations in natural settings, employ inference and prediction, and rely on inquisitiveness, perseverance, honesty, and open-mindedness (109-110). They also both believe in a unified universe, seek verification through repetition, innovate from within while still adapting to external knowledge, seek to manage human activities, and believe that their knowledge is subject to change over time (109-110). Fikret Berkes writes extensively on the similarities between many Indigenous practices and systems of knowledge which are decidedly reminiscent of the adaptive management strategies that are increasingly adopted by Western science (Berkes, 2008). Langer (2011) argues that the overarching goals of TEK and Western science are also quite similar: they both seek to make sense of the world, control it where possible, and to explain uncontrollable phenomena (127-128). It must be acknowledged that TEK systems are both empirically tested and testable understandings of the relationships among living beings and their environments.

However, TEK is still often assumed to be a separate mode of knowledge production than Western science due to its holistic nature (Whyte, 2013; Ludwig, 2018; Bala and Joseph, 2017). And yet, one has to be careful about what is meant by “holistic” here. Ludwig and Poliseli (2018) argue that the division between holistic TEK and mechanistic Western science is an

oversimplified and artificial one. They provide an analysis of TEK and Western scientific heuristics that engages with the similarities and differences between the two in a more in-depth and substantial way. They argue that just because Indigenous peoples do not hold mechanistic worldviews does not mean that they are incapable of invoking mechanistic heuristics involving decompositional analyses in similar ways to those of Western science. To say that TEK is simply not mechanistic often seems to imply that holders of TEK are not able to identify complex ecological mechanisms or intervene through equally complex management strategies (5), when, in fact, the livelihoods of many holders of TEK depend on their ability to do just that. Traditional systems of knowledge can, and do, identify underlying mechanisms in complex ecological systems (3). By this account, it seems that upholding this holistic-mechanistic dichotomy is one way in which the West tends to undermine the legitimacy of TEK.

When considered without the kind of prejudice described above, it becomes clear that TEK's effectiveness should be expected, even by Western standards. However, according to Linda Smith (1999), "globalization of knowledge and Western culture constantly reaffirms the West's view of itself as the center of legitimate knowledge, the arbiter of what counts as knowledge, and the source of 'civilized' knowledge" (63). Therefore, the first necessary step towards successful collaboration between TEK and Western conservation practitioners is for Westerners to let go of the worry regarding TEK's effectiveness and to recognize it as a legitimate way of knowing.

Embracing Cultural Aspects of TEK / Interweaving Science and Culture

Even if TEK resembles Western science on many levels, including methods, strategies, overall goals, and mechanistic thinking, it remains the case that there are crucial differences which cannot be ignored and that constitute an obstacle to successful collaboration. Recognizing the similarities is not enough: acknowledgment, acceptance, and legitimization of the differences is also necessary. In particular, it is true that TEK is “holistic” in ways that Western science is not. This has given rise to a second barrier to successful collaboration — the difficulty for Western science to grasp and come to terms with the many cultural and spiritual aspects of TEK which underlie its scientific principles. More precisely, ecological knowledge can be understood as being holistic in two distinct ways (Ludwig and Poliseli 2018). The first sense is that it attempts to understand “patterns and regularities at the macro-level without trying to explain how specific target phenomena are produced” (11). These types of heuristics are “valuable precisely because they circumvent questions about the organization of entities and activities that is responsible for a target phenomenon” (10). This trend in non-mechanistic holism tends to be tightly intertwined with various cultural aspects of daily life and can be valuable specifically because it avoids complex mechanistic perspectives. By looking at the bigger picture rather than trying to break down a problem to its separate components, this type of holism addresses the dynamics of an ecosystem as a whole. Often times, we cannot make sense of certain complex ecological dynamics, and so it may be more useful to aim at a macro-level understanding of a phenomenon which is embedded in a cultural belief system if it can help to build a predictive model on the basis of patterns and regularities observed over long periods of time (11). Ludwig and Poliseli (2018) also note that, therefore, this type of heuristic model is often preferred in

applied contexts such as conservation management (11) and provide a clear example of these two contrasting approaches:

An academically trained ecologist may analyze a target phenomenon such as the spread of an agricultural pest in terms of a mechanism of interacting components (e.g. intensification and monocropping that create a favorable habitat for a pest, loss of biodiversity that reduces prevalence of parasites and predators of the pest, development of pesticide resistances). In contrast, holders of TEK may employ pest management strategies (e.g. ethical and spiritual requirements of engagement with a forest, agricultural norms regarding polyculture or cropping schedules) in their agroecological systems that are effective even if they do not aim for an explanation of how different components interact in creating pest vulnerability. This way, both TEK and AEK can guide effective strategies of pest management even if they employ very different epistemic strategies. (Ludwig and Poliseli, 2018:4)

On the other hand, TEK is also considered to be holistic in a second sense, i.e. because of the ways in which some metaphysical, spiritual, and ethical aspects are interlinked with scientific understanding. Some sustainable traditional practices are more simply guided by rules of engagement and respect which provide a strategy for sustainable interactions without requiring detailed mechanistic knowledge (13). This type of heuristic strategy both influences and is influenced by specific Indigenous worldviews and the two “shape each other in a way that undermines attempts to isolate epistemic aspects from wider ethical, spiritual, and metaphysical components” (14) of environmental perspectives.

Much of what can be considered TEK is sacred knowledge that is fundamentally intertwined with the life of specific peoples living in a specific place and adapting to the natural world over time (Kawagley, 1998; Wildcat, 2009). While Western science tends to think of knowledge as universal, TEK is generally understood to be relative to culture, place, and time. As Kyle Whyte (2013) notes, Indigenous knowledges are “systems of responsibility that arise

from particular cosmological beliefs about the relationships between living beings and non-living things or humans and the natural world” (5). Ludwig and Poliseli (2018) argue that a divide between epistemic strategies and ways of life are often artificial for Indigenous peoples. The divide between epistemic strategies and ways of life can be thought of as artificial since TEK is emergent from the nature-culture nexus⁴; it is the result of longstanding collaborations with the environment through intimate relationships with the natural world (Wildcat, 2009: 73-75). It can be thought of as a “highly heterogeneous set of mechanistic and holistic heuristics that can guide engagement with local environments under diverse epistemic and pragmatic conditions” (Ludwig and Poliseli, 2018: 14). Differences between the values, technology, and knowledge systems of Indigenous peoples and those of Westerners is part of what has led to confusion and misunderstanding about Indigenous peoples, their systems of knowledge, and their ways of life (Robyn, 2002: 572). Western science has a tendency to want to view all things as “knowable” whereas Indigenous cultures typically understand and accept that universe is full of mystery. Bala and Joseph (2017) argue that in order for there to be a possibility of dialogue between the two, there is a need to rethink the demarcation between Western science and bodies of knowledge thought of as myth, superstition, or pseudo-science due to their spiritual underpinnings (41-47). One way to do so might be to resist the urge to conceive of appeals to the “spirit” of the natural world as necessarily mythical, superstitious, or religious. Kawagley (1998) argues that spiritual understanding of the world can present itself as reverence for the natural world, acknowledgement of humanity’s dependence on and responsibility to our ecosystems, and

⁴ The emergence of TEK from the nature-culture nexus discussed by Wildcat stands in contrast with the development of Western science, which has arguably emerged from a nature-culture dichotomy, helped to give rise to a logic of domination, and viewed science as an independent entity/body of knowledge.

appreciation of the mysteries in the universe (12). I contend that these are all understandings which Western science can adopt without having to worry about intermingling science and religion. Wildcat (2009) argues that “the acknowledgment and respect for the living spiritual foundation of the world speaks most directly to what some rigorous scientists in Western institutions find most problematic in indigenous traditions and knowledges: prayer” (58). What I am suggesting is that by adopting a spiritual understanding of the world as defined by Kawagley, the issue of “prayer” in science would be circumvented and the strict empirical nature of Western science would not be undermined. In short, while recognizing the “living spiritual foundation of the world” as core to TEK is crucial, such recognition does not have to be seen as a problematic intrusion of religious notions into the natural sciences.

The concept of an Honorable Harvest is one culturally significant illustration of a less empirically-minded or mechanistic practice of many Indigenous peoples that relies on close metaphysical interactions with the natural world. Unlike Western practices which focus solely on the biophysical realm, the Honorable Harvest is based on accountability to the physical and metaphysical characteristics of the world (Kimmerer, 2013: 183). Although specific practices and prescriptions vary among Indigenous peoples around the world, general principles of the Honorable Harvest can be identified throughout. Kimmerer defines the Honorable Harvest as the “Indigenous canon of principles and practices that govern exchange of life for life” (180). These principles and practices apply to human interaction with all aspects of the natural world, from plants and animals to rocks, air, soil, water, and even fossil fuels (187); they govern taking from the natural world, shape relationships with the natural world, and work to rein in our tendency to consume (180). The Honorable Harvest is a crux of traditional ecological knowledge which

acknowledges the tension between honoring life around us and taking it to live. The principles of the Honorable Harvest are not regulated by law or written down in books and scholarly journals to be taught in schools. They are sustainability prescriptions which are passed down from generation to generation through stories (179), and this aspect of Indigenous culture is just as important to the preservation of ecosystems as any empirical data set. That being said, in order to harvest honorably, one must use both empirical observations and intuition to make decisions. Kimmerer recalls that when attempting to harvest leeks she “must use both sides of my brain to listen to the answer” and that the “analytic left reads the empirical signs” to assess the well being of the population while the “intuitive right hemisphere is reading something else, a sense of generosity, an open-handed radiance that says *take me*, or sometimes a tight-lipped recalcitrance that makes me put my trowel away” (178). Indigenous peoples believe in the collective wisdom of the natural world and understand the power in assigning personhood to all things. Acknowledging the personhood of the more-than-human realm acknowledges the intelligence, spirit, awareness, and kinship of the natural world (183). The key point of the Honorable Harvest is to take only what you need, but to also take only that which is given (184).

The Honorable Harvest is simultaneously a physical and metaphysical, scientific and spiritual, practice that is based on an ethic of reciprocity, which further underscores the need to fully engage with the various cultural aspects of TEK. It is governed by an ethic which asks one to give back. Kimmerer writes, “Reciprocity helps resolve the moral tension of taking a life by giving in return something of value that sustains the ones who sustain us” (190). Therefore, a harvest is honorable when it sustains both the giver and the taker. This ethic of reciprocity is based on the idea that all flourishing is mutual (20) and an understanding that we must take care

of and protect the more-than-humans which we rely so heavily upon (177). Whyte and Cuomo (2016) write that “Indigenous ethics highlight attentive caring for the intertwined needs of humans and nonhumans within interdependent communities” (1). Indigenous conceptions of care emphasize the importance of one’s place in the web of life and that they understand the moral connections involving relationships of interdependence which motivate reciprocal responsibility (6). Throughout *Braiding Sweetgrass*, Kimmerer writes about the interconnectedness of the material and spiritual wellbeing of all things, claiming that it is this culture of reciprocity which helps us to learn from the land and in return to take care of it (2013, 9).

These practices are not only in place to sustain the lives of those currently walking the earth, but to honor those that came before and to ensure abundance for those that will come after. This idea is understood by many Indigenous peoples as seventh generation thinking (Cajete and Pueblo 2010; Kimmerer, 2013; Trosper, 2007; Whyte, 2017). Seventh generation thinking has been adopted and adapted by Indigenous peoples all over the world, but was founded by the Iroquois nation (Seven Generations International Foundation). By asking that “In our every deliberation, we must consider the impact of our decisions on the next seven generations,” (Seven Generations International Foundation) the Iroquois provided a framework for integrating long-term decision making into daily practices. This line of thought asks that we consider the effects of our actions for seven generations; depending on the context, this could be either seven generations in the future or three prior generations, the present, and three future generations (Whyte, 2017: 1). The example of Menominee forestry I will analyze in greater detail below shows an exemplary stewardship approach to land-use which utilizes seventh generation thinking in sustainable forestry practice. One of their management guidelines is that

the forest managers always “remember that we are borrowing the forest from our grandchildren” (Troster, 1995: 84), which he notes expresses this line of seventh generation thinking (84).

I have argued above that TEK typically interweaves empirically-minded practices with metaphysical views emergent from cultural, ethical, and spiritual realms of engagement with the world. The remainder of this section illustrates why this integration is important and the critical role it plays in TEK’s effectiveness and hence in any successful collaborative conservation projects.

For many decades, Indigenous forestry practices and fire use were misunderstood by European settlers who held different ideas about appropriate land use and value. However, as the need for new forest conservation and management practices arises, Western scientists and government agencies are increasingly turning to Indigenous knowledge holders for advice. Troster (2007) notes that the flow of TEK into mainstream forestry practices can be tracked in Indian Forest Management Assessment Team (IFMAT) reports from 1993 onward (138). The most recent IFMAT report (2013) acknowledges that “Indian forestry has the potential to provide models for sustainable forestry and resource management, and that the influence and techniques of Indian forestry can find application on the federal forest estate” (2). By looking closely at forestry practices of Native Americans, one can see that the cultural practices I am referring to play a significant role in shaping scientific worldviews and guiding scientific practice. I focus specifically on examples of forest management through traditional fire use and sustainable forestry practices.

In order to further illustrate the prominent role that culture plays in Indigenous systems of knowledge, let us look into some ongoing forestry practices of the Menominee Forest Keepers on their tribal land in present day Michigan. Mausel et al. (2017) argue that the Menominee had mastered “vegetation manipulation with fire, sustainable forestry, multiple-use, ecosystem, and adaptive management” before professional forestry arrived in North America in the 1890’s (366). Sustainable forest management did not gain traction until the early 1990’s with the “Forest Principles” being adopted at The United Nations Conference on Environment and Development in 1992 (UNDESA) and the “Ecosystem Approach” making its way onto the agenda of the 1995 Convention on Biological Diversity (Secretariat, 2004: 3). Sustainable forest management was officially recognized to be a concrete means of applying the Ecosystem Approach to forest ecosystems at the Convention on Biological Diversity in 2004 (4). The Menominee have been sustainably harvesting lumber while protecting their forest ecosystem since 1908 (MTE History). It is apparent that the Menominee have been sustainably managing their old growth forest since before sustainable forestry was ever truly considered to be a conservation goal. Menominee forestry is an example of highly successful integration of TEK and Western science that is more effective than either system would be alone. Daniel Wildcat notes how over time, the Menominee have been able to use their “deep spatial experiential knowledge” of the forest combined with modern technology and scientific information to preserve, manage, and protect the forest (Wildcat, 2009: 86-88). To say that the Menominee possess deep spatial experiential knowledge of the forest is to say that “their long residency in the Northwoods has given them a keen awareness of the forest” (86) which simply cannot be captured by modern scientific geographic information systems (GIS). By blending modern forestry science with traditional

knowledge, beliefs, and practices, the Menominee have been able to maintain a healthy forest ecosystem which provides a healthy habitat for species diversity as well. The tribe operates an economically profitable and ecologically healthy forestry practice which utilizes qualitative inventory methods and measurements of individual trees to ensure diversity, quality, and quantity of trees throughout the forest (Trosper, 2007: 137; American Forests). They harvest wood all the way from one end of the forest to the other so that by the time the harvest returns to its starting point, the trees are ready to be cut again. Their practice, which works to maintain biodiversity, ensures that there are never more resources taken than are produced within a natural cycle (MTE History). Due to this specific harvesting practice, the entire volume of the forest has been harvested twice and there is still more standing volume today than there was when harvesting began in 1908 (Mausel et al., 2017: 367). Not only are the Menominee an outstanding example of sustainable forestry, they set the precedence for it. They also played a major role in influencing the federal government to implement many ideas that are now popular as part of sustainable forest management: long rotation ages, selection harvest practices, and long-term monitoring (Trosper, 2007: 134). The tribes use an adaptive sustained yield procedure which has been developed over generations and differs from standard sustained yield procedures; rather than clear-cutting, they selectively harvest the oldest trees and select from a larger stock (135). Their selective harvesting practice operates under the prescription of an honorable harvest by first harvesting undesirable trees and leaving the good ones until they are left with nothing but good trees to choose from based on species diversity, spacing, and size (Mausel et al., 2017: 367). They have an "open door" policy of technical exchange with federal, state, university, and industrial forestry professionals resulting in the implementation of cutting-edge forestry

practices⁵. Their forest management plan contains objectives pertaining to both timber and non-timber resources because the ultimate goal of forest management in this case is to “provide for maximum diversity in the forest (species composition, age class distribution, structural diversity both within and between stands), habitat diversity, and to optimize growth and saw log quality of the forest timber resource” (MTE Forest Management Plan). By fostering such a healthy ecosystem with thriving species diversity, important populations of threatened and endangered species, rare natural communities, and endangered ecosystems are also able to thrive in the Menominee forest (Mausel et al., 2017: 368). A unique feature of their practice is that the needs of the forest are always placed above the needs of the mill; economic factors will never outweigh the health of the forest ecosystem. By staying true to their cultural beliefs and practices, the tribe is sure to balance both short- and long-term environmental, community, and economic interests (368).

According to Trosper (2007, 135), the Menominee’s success in sustainably and profitably managing their forest resources for over 150 years can be explained by three features of their ancient tradition. First, interactions with the natural environment of the forest are understood as being among relatives. Second, the Menominee recognize and respect the active spirit of the forest. Third, they maintain the idea of communal possession of and responsibility to the land. The Menominee, and many other Native American tribes, view their interactions with the natural environment of the forest as being those among relatives rather than that of humans extracting resources. In doing so, they collapse the human-nature dichotomy prevalent in the dominant Western framework and acknowledge the responsibility which arises from an ethic of reciprocity.

⁵ See MTE “*Our Forest*” for more information about the various forestry practices being developed by the Menominee in conjunction with federal, state, university, and industrial forestry professionals.

These ideas of responsibility and reciprocity are central not only to the Menominee, but of most Native Americans who acknowledge a balance of power and knowledge between all things living and nonliving, including humans, animals, the environment, the earth, and even the heavens (Robyn, 2002: 571-572). Menominee stewardship of the forest does not express domination of nature; it acknowledges and abides by their care-taking responsibility to the forest. Within this framework — an ethic of reciprocity— it is important to understand that the relationships between and among humans and more-than-human entities and collectives are viewed as being among active agents; nonhuman agents also have responsibility and care-taking roles within an ecosystem (Whyte and Cuomo, 2016; 10). This web of life, Wildcat (2009) points out, “implies that our human intelligence must be framed in the context of learning how to live well and sustainably as one small but powerful part of nature, as opposed to strategizing how to manage nature” (vii). By acknowledging and respecting the animate life force and spirit of the natural world, as well as their interdependence with it, many Indigenous peoples have developed sustainable land-use practices which have allowed them to coexist with the natural world for generations. The life ways and worldviews of the Menominee are simply one illustration of this harmonious existence in the world. By regarding the more-than-human realm as one comprised of active agents, the Menominee recognize and respect the active spirit of the forest, often times through prayer and ceremony which give gratitude to the land for what it provides (Trospen, 2007: 135). Finally, the Menominee have a longstanding idea of communal possession of the forest and, therefore, acknowledge communal responsibility of stewarding the land (135). Whyte and Cuomo (2016) claimed that, to Indigenous peoples, stewardship does not express control over nature in the paternalistic way that it typically does to a Westerner, rather that it

acknowledges the place of humans in the web of life (10). These three aspects provide insight into the worldviews that have allowed the Menominee and other Indigenous peoples across North America to live sustainably on their lands by balancing conservation and land-use.

Each of these tightly intertwined ideas can be found, to some degree, throughout many Native American cultures (Trosper, 2007; Kawagley, 1998; Robyn, 2002; Cajete and Pueblo, 2010; Kimmerer, 2013; Norgaard, 2014). For example, Norgaard (2014) claims that the Karuk tribe of northern California share in the belief that they have a responsibility to tend to and care for food and cultural use species because they are relatives (74). Kawagley (1998) argues that for Yupaiq peoples in Alaska, spiritual understanding of the natural world is a critical aspect of obtaining knowledge, and that understanding the concept of spirit in a worldview increases awareness of the interdependence of humanity with the environment as well as fostering reverence for the natural world and an understood responsibility to protect it (139). They also stand in stark contrast with the aspects of Western conservation which deem it necessary to preserve and protect vacant “wilderness” spaces in the form of national parks and other protected areas. The Menominee’s sustainable practices provide a counterexample to that idea.

In the above section, I have argued that the second barrier to collaboration between Western conservation and TEK is that (1) Indigenous conservation practices’ remarkable success is partially due to the interweaving of mechanistic, empirically minded knowledge with cultural, ethical, and spiritual aspects, while (2) Westerners tend to separate empirical inquiry from cultural, ethical, and spiritual concerns. As a result, I contend that successful collaboration between Western conservation and TEK requires that Westerners make a commitment to understand, respect, and take into consideration these cultural, ethical, and spiritual aspects of

TEK. I will now turn to the third and last barrier against collaboration between Western conservation and TEK and articulate the last criterion for success.

Continuous Engagement with Traditional Knowledge Holders

The third barrier to successful collaboration relates to the difficulties associated with the acquisition and use of Indigenous knowledge by non-Indigenous peoples. These difficulties are at least of two types: (1) some differences in modes of knowledge transmission and (2) a serious potential for exploitation of Indigenous peoples and their respective systems of knowledge. In what follows, I argue that these difficulties point towards the obligation to continuously engage with traditional knowledge holders for any collaborative practice that hopes to successfully legitimize and respect traditional systems of knowledge and their holders.

First, knowledge transmission in TEK and Western science differ greatly. The effectiveness of TEK relies on multi-generational transmission through oral traditions and cultural practices rather than transmission in scholarly journals and publications⁶. Kimmerer and Lake (2001) address this transmission issue specifically in regards to Indigenous fire use practice. They claim that one reason these practices were historically ignored and not accepted is that record keeping took the form of qualitative and anecdotal evidence of success via notes, journals, and oral traditions (38). This obviously stood at odds with Western data gathering and record keeping practices.

It is important to note that the specific ways in which TEK is transmitted are not marginal but core to TEK's character itself. It has to do with the notion of intimacy which arises

⁶ This is not to say that there is not a multitude of Indigenous scholars publishing works and transmitting knowledge through the Western "peer-review" system, rather than traditional modes of knowledge transmission among Indigenous peoples do not follow the rules of Western academia.

from the intermixing of science and culture that I have discussed above. Whyte and Cuomo (2016) write about the importance of “awareness of the intimacy and multidimensionality of the connections linking humans, non-human beings and entities, and collectives” (8). According to Whyte and Cuomo, these relationships have both intrinsic and instrumental value. They possess intrinsic value as a source of identity, communality, and spirituality, while also retaining instrumental value as sources of sustenance and usable knowledge about biodiversity and ecosystems (8). The vast bodies of grounded knowledge held by Indigenous peoples are a direct reflection of these intimate connections between humans and ecosystems. Now learning about these intimate connections takes deep engagement and consistent practice. Looking to Western epistemology in an attempt to draw a parallel between Western science and TEK can help us to understand why this is the case. Without delving into the particulars of Western epistemology that could potentially bog down the argument, I want to make the loose analogy that this kind of intimacy is not a “know-that,” but a “know-how.” By drawing this analogy between Western science and TEK one can begin to see, from a Western perspective, that intimacy with the natural world is learned through consistent practice. “Know-how” can be thought of as the knowledge one acquires when “learning-by-doing;” it is knowledge which is accumulated with experience over time (Garud, 1997: 84). It is derived from lifetimes of lived experience across generations. Understanding TEK as “know-how,” grounded so strongly in physical and cultural contexts, illustrates that knowledge holders must be *involved* in knowledge production rather than being just the passive recipients of it (Preston, 2003: 25). TEK does not necessarily present itself as a set of general scientific principles in the way that Western science does. However, just because the presentation is different, does not mean that the underlying intention is not the same. In the

case of the Confederated Tribes of Warm Springs, Steen-Adams et al. (2019) found that “the intergenerational transmission of traditional knowledge was largely field-based and informal, with children expected to learn by watching and imitating their elders” (10). These collections of stories and anecdotes, which exemplify a wide array of context-dependent practices, can in fact be prescriptive methods of transmitting general scientific principles. Steen-Adams et al. (2019) also report that “For specialized knowledge such as fire prayers and practices, knowledge was passed on to someone who was recognized by the elders as having a gift for beings a ‘seer’” (10). To sum up, learning TEK requires that one learns about one’s intimate connections to the world and learning about these intimate connections is best accomplished through deep engagement with anecdotes and stories as well consistent, context-dependent practice.

If the above is true, there is a real question about whether Westerners can really become TEK “experts” in the kind of timeframe that scientists and policy makers are typically given. Furthermore, learning the necessary practices and principles which allow for such an intimate understanding of the world would require years of supervised practice which there simply is no time for. However, due to the often sacred nature of ceremonies, rituals, and practices which underlie Indigenous understanding of the world, years of supervised practice might not even be an option for Western scientists if time allowed. One solution to that problem is that TEK holders be given an equal seat at the table and taken seriously as legitimate experts of TEK in the same way that we give credence to experts in any given field of Western science. Whyte insists that “TEK must play the role of inviting cross-cultural and cross-situational learning for indigenous and non-indigenous policy makers, natural resource managers, scientists, activists, elders, and

youth” (2013, 10). This kind of learning is not bound to happen easily and requires continuous and respectful engagement.

We can now turn to the second issue related to the transmission of TEK to Westerners, i.e. the issue of exploitation. This issue arises from a long history of colonial exploitation in which TEK, when it was not being ignored or dismissed, was viewed solely as a technological and empirical resource to be drawn from in order to advance the goals of Western science (Bala and Joseph, 2007: 56). Acknowledgement of this issue is important because of the long and problematic history of exploitation and theft of TEK. Smith (1999) provides an in-depth analysis of historic misuse and abuse of traditional knowledge, claiming that Indigenous contributions to the scientific foundations of Western research have been left out (60). As colonialism imposed Western authority over Indigenous knowledge, languages, and cultures, Indigenous ways of knowing were excluded, marginalized, suppressed, and even silenced (64,69). It is for this reason that ongoing respectful engagement with traditional knowledge holders is crucial for a successful collaboration project. Kyle Whyte has written extensively on this issue as well (2013, 2015, 2016, 2017, 2018). He argues that when TEK is viewed simply as supplemental knowledge it becomes an ethical issue (2017, 3). It is essential that scientists embrace TEK as a whole without attempting to cherry-pick knowledge as if TEK were nothing more than an empirical resource pool to be extracted from. Whyte asserts that in order to exchange knowledge, Indigenous peoples need to be sure that it is respected and protected (2017, 5). If Westerners commit to engaging with TEK holders throughout all parts of a collaborative process, from goal-setting and decision-making to development of research methods and interpretation and dissemination of data, then one can hope that the issue of exploitation will be avoided.

The following case study analysis shows that Western researchers have come a long way from colonial practices in which “Indigenous forms of knowing, systems of classification, technologies, and codes of social life were regarded as discoveries by Western science” (Smith, 1999: 60). I wish to use this case study as an illustration of a successful collaborative research project which can hopefully be viewed as model for other researchers and organizations in the future. In the eastside Cascades of Oregon, the U.S. Forest Service and Portland State University collaborated with the Confederated Tribes of Warm Springs to study the influence of the tribes’ traditional knowledge system on cultural fire regimes (CFR) through the use of fire and associated tending practices, tribal ecological principles, the seasonal round, and culture (Steen-Adams et al., 2019). This was all made possible by the implementation of four key design elements (13) which, if the criteria I propose here are correct, promoted successful collaboration. The researchers first began an open dialogue with the tribes to elicit tribal community goals and potential concerns about the proposed forest science research. They then developed a protocol for protecting culturally-sensitive data which included the signing of a non-disclosure agreement (NDA) and other specific design elements of the GIS map. Much of the data for the research was then collected through an oral history approach to knowledge sharing. Lastly, the study provided multiple opportunities to engage tribal youth in the transmission and documentation of traditional knowledge (13).

Due to the success of their collaboration with the Warm Springs Tribes, researchers were able to gather historical, cultural, and empirical data about fire use in the area. They found that Indigenous fire use variability in the eastside Cascades was historically driven by its relative ecological appropriateness for maintaining culturally important resources, that is, until traditional

fire use was outlawed by state and federal regulations. These practices were used intentionally to maintain composition, distribution, and spatial extent of plant communities, specifically thinleaf huckleberry (*Vaccinium membranaceum*) in this case (Steen-Adams et al., 3). Thinleaf huckleberry “drew together the tribal community through intergenerational and interfamilial gift-giving, the longhouse religion, as well as gathering by family groups at seasonal encampments, making it a cultural keystone species” (11). Cultural fire regimes (CFR) are an element of historical fire regimes, which refer to the pattern, frequency, and intensity of the bushfires and wildfires that prevail in an area over long periods of time. This study looked at how traditional fire use by the CTWS created a CFR through frequent, low-severity burns distributed in a shifting pattern which helped to maintain forest openings originally created by natural ignitions. Indigenous influence on the drier coastal and montane region of the eastside Cascades of Oregon through fire use helped to maintain these meadow openings to promote desired plant resources and game habitat (4). These small-patch, low-severity burns improved the productivity of berry producing shrubs and fields which in turn increased game populations, both of which are important cultural and material resources for the tribes (5). The tribes were able to control the patch-size and severity by controlling the frequency and timing of their burns (5). Every several years, berry patch burns were timed with early autumn rains or at the beginning of summer before everything became too dry (5). Studying this practice of seasonal round cultivation provided insight into the pattern of annual migration across the area’s ecological zones in order to secure the variety of food and household goods which fulfill social, economic, and cultural needs (3).

Through the use of these integrative methods, researchers developed a participatory GIS (PGIS) technique that was adapted to the CTWS community and protected their sensitive cultural data by aggregating place-specific data into ecological zones. Tribal members were involved in developing an integrative GIS framework through the development of an anthropological-landscape ecological GIS framework and a traditional knowledge database (6). The authors note that one of the biggest challenges to researching CFR's is the "fragmented record and sparse geospatial data regarding traditional fire use" (5). Tribal members were able to use their deep spatial experiential knowledge of the forest and historical awareness of tribal fire use to fill in gaps where standard GIS mapping techniques would have fallen short. Using the data collected via the aforementioned methods, researchers were able to delineate the seasonal round area of the tribes and divide the area into its constituent ecological zones. They then entered the historical resource use sites and migration features such as trails and settlements into the GIS and analyzed elements of the traditional knowledge database by ecological zone.

By taking the time to really understand and process the tribes' specific motivations for specific practices, and then analyze it using modern technologies like GIS systems, the researchers were able to discover that CTWS practices created a patchwork of burn openings and fuel distributions which may have increased historical forest resilience to wildfire (12). The study also notes how modern forestry practices such as silviculture proxy fire treatments have been shown to promote the objectives of forest growth and resource enhancement as defined by the forest agencies, but it fails to replicate the ecological benefits of traditional fire use (12). According to the U.S. Forest Service, silviculture is "the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the

diverse needs and values of landowners and society such as wildlife habitat, timber, water resources, restoration, and recreation on a sustainable basis” (USFS). Methods of traditional fire use are able to enhance cultural foods for tribal members while fulfilling forest stand growth yields and targets designated in the integrated resource management plan. Many tribes have reported that fire performs many ecological functions such as nutrient cycling, reinvigoration of plant sprouting, and control of detrimental insects and diseases (Steen-Adams et al., 2019; Kimmerer and Lake, 2001; Norgaard 2014; McBride et al., 2017). This collaborative approach provided researchers with data that will assist them in better achieving forest restoration goals of government agencies in the future, showed the positive effects of traditional fire use in the area, facilitated cross-cultural collaboration, and gave an equal seat at the decision-making table to traditional knowledge holders.

The success of this cross-cultural collaboration between Modern Western science and TEK is apparent in the revitalization of traditional knowledge among indigenous communities, engagement with traditional knowledge holders, and restoration of forests and culturally-important resources (Steen-Adams et al., 2019:13), which was accomplished through a truly collaborative and respectful approach in which traditional knowledge holders were involved at every step. Based on the above analysis, it is clear that the researchers were successful in circumventing the issue of exploitation. They were extremely respectful of both the knowledge holders and the knowledge itself. The third criterion — that there must be continuous engagement with traditional knowledge holders to avoid exploitation — was met throughout the project as researchers found multiple ways to include various members of the tribal community through the duration of their research. Hence, non-Indigenous researchers were able to gain a

deep understanding of the impacts of the tribes' traditional ecological knowledge on the study area of the Eastside Cascades in the Pacific Northwest.

This work revealed successful protocols which have the ability to “promote productive collaboration between forest scientists, tribal communities, and tribal natural resource managers” (12) and provides a research framework which “accommodates both traditional and Western knowledge” (13). However, it should be noted that the study was published in a Western scientific journal without any members of the tribes listed as co-authors on the paper. This raises a potential concern for Indigenous peoples about who owns the results of the collaborative work. The authors acknowledge and thank the CTWS Natural Resources Branch, the Culture and Heritage Committee, the Culture and Heritage Program, and CTWS tribal elders for enabling data collection and for feedback to the research design and preliminary findings, but no member of the Warm Springs tribes was involved in the publishing. This case study appears, on all accounts, to be an example of good faith collaboration, but it would still be beneficial to know and understand why the publication is authored solely by Western scientists.

Conclusion

From the analysis above, I have drawn three minimal criteria which must be met in order to have successful collaboration between Indigenous and non-Indigenous peoples in regards to improved conservation practices. The first is that Western practitioners ought to let go of the misinformed neocolonial belief that TEK is not empirically minded and rather “primitive” while Western practices are empirically superior and more effective. The second criterion which must be met is that in order to use TEK properly, Western science cannot attempt to separate the

cultural and spiritual aspects from the scientific knowledge of a particular tribe. The third criterion is that Western scientists must continually engage with traditional knowledge holders throughout the collaborative process. Each of these criteria are critical to successful collaboration between TEK and Western conservation practices because they act as stepping stones in the direction of greater cross-cultural understanding.

The eastside Cascades case study revealed protocols that can promote productive collaboration between forest scientists, tribal communities, and tribal natural resource managers, while the Menominee case study provides an example of extremely successful and effective integration of the two systems of knowledge. Both of these case studies show ways in which it is possible for effective collaboration to occur. In different ways, they each use a combined approach to conserve both biological and cultural resources, actively work to bridge the cross-cultural and cross-situational divides mentioned by Kyle Whyte (2013), and provide evidence for the possibility of a more effective collaborative methodology. The research goal of the eastside Cascades case study was to develop one possible protocol for collaborating with traditional knowledge holders as a way to respectfully gather information and attempting to integrate the two systems of knowledge. Due to its recent success and the West's growing acknowledgement of TEK as legitimate, it seems promising that the U.S. Forest Service and other non-Indigenous organizations and individuals can begin working towards the development and implementation of management and conservation practices that are as effective and successful as the Menominee forestry example, but that arise from the Western framework rather than an Indigenous one.

One proposal for increased collaboration with Indigenous peoples in regards to natural resource management comes from Norgaard (2014). She suggests the need for formal

acknowledgement of Indigenous involvement in natural resource management at both the federal and state level. She asks that tribes be officially designated as land managers at both levels and that they be involved in the development of wildfire plans as well as on the ground management practices (92). As is noted by both Norgaard (2014) and Whyte (2017), this recognition is extremely important for tribes' political sovereignty and can work towards effective, non-exploitative, cross-cultural collaboration that legitimizes all aspects of traditional ecological knowledge. Due to the ever-increasing need for sustainable conservation and management strategies, it does not seem unreasonable to take seriously Norgaard's suggestion as one feasible step towards bridging the divide between Western scientific knowledge and traditional ecological knowledge.

To conclude, then, my analysis suggests that there is cause to be hopeful regarding the design and implementation of more collaborative practices between Indigenous holders of traditional ecological knowledge and practitioners of Western science. It is clear that TEK does not stand in opposition to Western science, nor is less effective than Western science. Western science and TEK are not only compatible, but also quite complementary. If I am right, then successful collaboration between TEK and Western science might help us address the looming ecological crisis in a way that promises to be both just and effective.

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