28 Implementing Traditional Ecological Knowledge in Conservation Efforts

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Abstract

Many different fields are involved in the complex practice of biodiversity conservation. To be successful, ecologists and other natural scientists must collaborate with experts from disparate fields such as economics, politics, engineering, and anthropology. However, one of the most recently recognized contributors to a successful conservation effort are the community stakeholders who are intertwined with the local ecology. The people who live on the land that is to be restored or protected hold a crucial role in effective conservation efforts. They can provide scientists and conservation biologists with invaluable information known as traditional ecological knowledge (TEK), which can include how the land is and was used, how species composition has changed over time, and what forces they perceive to be affecting the land and its biota, among other observations. Such knowledge can help create an effective, well-rounded conservation plan. Locals are also key enactors of a conservation plan. The success of a biodiversity conservation project hinges upon the cooperation and enthusiasm of local community members, for without the support from local stakeholders, conservation efforts are neither practical nor sustainable. We will explore these concepts through case studies, showing examples of successes and failures, collaborations and disharmony. We will also address the nuances involved in discussing traditional ecological knowledge, including the associated misconceptions and stereotypes, and how these assumptions can affect the understanding and implementation of TEK.

28.1 Introduction

Within the past 400 years, hundreds of plant species have gone extinct and approximately 20–25 species of birds and mammals are lost every 100 years, a rate far greater than the estimated average through geological time (CBD, 2001). In addition, traditional cultures across the globe are also going extinct at an alarming rate (Davis, 2007; Davis, 2009). These traditional cultures are important from an anthropological perspective as they teach us different ways of being and knowing. Conscientiously incorporating these diverse belief systems and lifestyles into our approach may be crucial for us to survive our current conservation crisis (Linehan and Gross, 1998). Simply eliminating or marginalizing these differences will do us no good; we must find ways to respectfully integrate them into our scientific understanding and conservation policies (Fenstad *et al*., 2002). A successful conservation effort is an interdisciplinary one. Individuals from many different fields must collaborate to create and enact a plan that is comprehensive in its ecological understanding, respectful of the locals' lifestyles, and sustainable in the long term (Usher, 2000; Nadasdy, 2003; Padilla and Kofinas, 2014). Involving traditional ecological knowledge (TEK) in the planning and management processes can help ensure all three factors. Community stakeholders are intertwined with their local ecology, and their intimate knowledge of their home environment can

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enrich biological research as well as improve the functionality of management plans. In this chapter, we will explore this integration using case studies, discuss the methods and complexities of co-management, and suggest trajectories for the future role of TEK in biodiversity conservation.

28.2 Defining TEK

28.2.1 Definitions

Traditional ecological knowledge (TEK) as a term has not been consistently defined within the scientific community (Berkes, 1993; Berkes, 1999). Many studies include their own definitions of TEK, which vary slightly depending on how flexibly the term is used. For example, Huntington (2000) describes TEK as 'the knowledge and insights acquired through extensive observation of an area or species'. Charnley *et al.* (2007, 2008) describe'a cumulative body of knowledge about the relationships living things (including people) have with each other and with their environment, that is handed down across generations through cultural transmission'. In addition, TEK is often considered a holistic way of 'knowing', as opposed to the compartmentalized method of scientific study. It fuses fields labelled as distinct, such as science with economics and religion (Anderson, 2011). A similar term, 'local ecological knowledge'(or LEK), has also been used to describe the knowledge of people who do not necessarily have a long-term relationship with a particular environment, but nevertheless have expertise and practices adapted to the local ecosystem (Ballard and Huntsinger, 2006).

28.2.2 Stereotypes

Many stereotypes and Western biases accompany the concept of TEK (Whyte, 2013). The word 'traditional' in TEK may seem to indicate knowledge of the past, a form which has already been developed and is unchanging. However, viewing TEK as a romantic, static and archaic way of knowing is a false stereotype, which does not provide space for development and adaptive change (Usher, 2000). Like other living systems and bodies of knowledge, TEK has the ability to evolve (and continue to evolve) over time. TEK holders are not a homogeneous group, but diverse in their practices and beliefs (Nadasdy, 1999; Turner *et al.*, 2000). They face the challenge of maintaining their unique ancestral practices while adapting to changes of the present and future (Turner *et al.*, 2000; Padilla and Kofinas, 2014), including the pressure to conform to scientific methods of conservation and land management. Scientists often subject TEK to a process of validation and, although challenging to knowledge holders, this may ultimately prove to be a useful tool for encouraging governments and outside sources to trust the knowledge (Gratani *et al.*, 2011). Governments and agencies are now paying closer attention to TEK and touting the benefits of incorporating it and other interdisciplinary dialogue into global biodiversity conservation work (CBD, 2005; UNESCO, 2005; CEAA, 2012; IPBES, 2014). The 2005 United Nations Convention on Biological Diversity states in Article 8(j):

> Each contracting Party shall, as far as possible and as appropriate: Subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices.
>
> (CBD, 2005)

This step forward in prioritizing the use of traditional knowledge should not be ignored. However, while governments and agencies may express a clear desire to incorporate TEK into conservation efforts, there are often no clear expectations of how to do so. At this scale, TEK is in jeopardy of being transformed from a broad and ever-changing body of knowledge into a 'bureaucratic object' (Anderson, 2011). Such an oversimplification makes it easy for governing agencies to further isolate and ignore the knowledge and the people who possess it (Nadasdy, 1999). Additionally, some scientists have been slow to include TEK in their work because there is a 'general resistance to change', specifically the change required by using it (Huntington, 2000). Suspicions may arise about the validity of observation-based TEK in a scientific study. Some researchers view TEK as unsubstantiated (Johannes, 1993), even to the extent of accusing it of being 'simply a political ploy invented by aboriginal people to wrest control of wildlife from "qualified" scientific managers' (Nadasdy, 1999). Any potential distrust can go both ways, as TEK holders may be suspicious of others' motives for wanting to use TEK, believing that ‘others will not use it responsibly or in a manner that benefits the knowledge holders’ (Charnley *et al*. 2007). TEK holders wishing to aid conservation efforts may find great difficulty in conforming to the methods of outside researchers, while finding little opportunity to speak with any sort of decision-making power. Finally, TEK is not limited to aboriginal/indigenous peoples (Berkes 1999; Usher, 2000), but may include anyone using adaptive instincts and skills to navigate an ecosystem, whether urban or rural (Wavey, 1993; Ballard and Huntsinger, 2006; Bethel *et al*., 2014).

28.3 Potential Roles in Conservation

There are numerous ways in which TEK can contribute to conservation efforts. From informing research to enacting management plans, TEK can inform all stages of conservation. TEK experts have an understanding of ecology that has been passed down for generations, making them knowledgeable about the past and present of the environment as well as invested in its future. Their knowledge of the ecosystem is a part of life, for making one’s living off the land successfully requires an intimate understanding of growing seasons, migrations, and species–habitat relations (Ballard and Huntsinger, 2006; Emery and Barron, 2010; Turner and Turner, 2008). And when one of those crucial details changes – a harvest occurs sooner, a population declines, or species composition changes – a TEK expert is likely to notice (Wavey, 1993; Turner, 2003). On the other hand, scientists are often limited in their observations by time and by geography. Likewise, land managers cannot be everywhere at once. In these situations, TEK provide information to scientists and conservationists about the ecological, social, and historical aspects that science may not capture (Uprety *et al*., 2012).

TEK can improve the quality of research by filling in gaps between limited scientific data. Locals can provide invaluable observational knowledge that may not be available to scientists, including how the land is and was used, how species composition has changed over time, and what forces they perceive to be affecting the land (Bethel *et al*., 2014). With the collective memory of elders and the oral record, a community can account for a history of the land that far precedes modern scientific records. They also have a more complete understanding of the land that is not restricted by the limited spatial reach or small time window of scientific surveys (Nadasdy, 2003). As Jackson and Hobbs (2009) note: ‘Systematic monitoring of ecosystems, whether deeply degraded or nearly pristine, rarely spans more than the past few decades’. This limitation can pose problems when attempting to set restoration targets for a landscape. While paleoecology and other natural records can provide insight to a site’s ecological history (Jackson and Hobbs, 2009), a people’s lived experience may provide a deeper understanding of this history as well as a clearer reflection of what the future may hold.

The locals of a conservation area can also be key enactors of a management plan (Johannes, 1993; Huntington, 2000). The most successful conservation plans engage local knowledge holders as key participants. Charnley *et al.* (2007) describes several formats through which TEK experts can be involved in conservation: collaborative species-specific management; co-management projects; integrated scientific panels; formal institutional liaisons; and ecological modelling. Collaborative species-specific management occurs when locals collaborate with scientists to create a management plan for a particular species of concern. This allows for scientists to learn about historic management methods, while locals learn about new technology and research that could enhance or inform these methods. Co-management projects are similar, but do not have a species focus. Here, TEK experts and conservation biologists collaborate to create a management plan to restore an entire landscape. Integrated scientific panels, such as the Intergovernmental Platform on Biodiversity and Ecosystem Services, may be used during this process to facilitate discussion and knowledge sharing among all parties – from governments and nonprofits to scientists and local peoples (IPBES.net). However, longer-term relationships, such as formal institutional liaisons, may be formed to enact a management plan. These groups, such as the Indigenous Peoples Restoration Network, work with the community as well as conservationists to encourage the incorporation of TEK in conservation efforts (SER, 2014). Ecological modelling allows for TEK experts and scientists to share their knowledge of a resource, landscape or species and discuss their hopes for the future. Examples of many of these formats are explored in the case studies section of this chapter. TEK experts can also contribute to co-management through data gathering, decision making, resource protection, regulation enforcement and plan creation (Pinkerton, 1989).

It is crucial that locals are willingly involved and invested in conservation efforts, for it is their home and their future. When communication is weak and understanding is lacking, it is unlikely that rules will be enforced within the community (Padilla and Kofinas, 2014). On the other hand, if locals are enthusiastically invested in the management plan – because it aligns with their beliefs, hopes, and lifestyle – they will likely be more eager to work with scientists and follow new regulations or guidelines.

28.4 Challenges

Few studies discuss conservation and management efforts that have failed to properly utilize TEK. This does not signify an absence of challenges or failure, but rather that these are rarely described within the scientific community. It is difficult to learn from others' mistakes if they are not honestly addressed. In this section, we will explore several potential challenges of incorporating TEK into conservation efforts.

While studies of integrating conservation biology and TEK are often focused on the technical aspects of the collaboration, political aspects are often ignored (Nadasdy, 1999). The political frameworks in which co-management efforts take place illuminate underlying struggles for power. In most conservation efforts, traditional peoples must conform to the scientific way of defining and understanding 'knowledge' in order to contribute. This ultimately concentrates power in administrative centres instead of with the local stakeholders (Nadasdy, 1999). It is now often politically imperative for scientists, governments and resource managers to include TEK in some form or another into conservation projects (CBD, 2005; UNESCO, 2005; CEAA, 2012.). Ironically, guidelines for how to utilize TEK lack consistency, resulting in an often miniscule use of TEK, which may not ultimately assist these local groups in any way (Usher, 2000). As a result, locals may develop an underlying sense of distrust of the term 'traditional ecological knowledge', the motives for utilizing it, and the odds of a truly successful outcome.

Another challenge inherent to biodiversity conservation is defining what is 'natural' to conserve. Conservationists can no longer ignore the profound influence humans have had on the environment (Kareiva and Marvier, 2012). The concept of 'natural' is understood by some traditional peoples as the integrated and interconnected world we live in, and includes 'active human manipulation' as a necessary component of the ecology of a landscape (Charnley *et al*., 2007). Conservation biologists are becoming increasingly aware of this notion of 'natural' as inclusive of human activity (Jackson and Hobbs, 2009). This creates a predicament for ecologists and conservation biologists who are tasked to 'save' nature, which is neither 'natural' nor wild (Anderson, 2011). Therefore, ecologists must find effective ways to assess and evaluate ecosystems in varying states of alteration, which will maximize benefits to both people and biodiversity (Jackson and Hobbs, 2009; Kareiva and Marvier, 2012).

28.5 Case Studies

There are many ways by which traditional ecological knowledge can be collected and integrated into conservation policy. The methods differ based on the research team, the locale and its residents, and the aim of the research (Huntington, 2000; Usher, 2000; Carlsson and Berkes, 2005; Charnley *et al*., 2007; Charnley *et al*., 2008). The following case studies display a few ways in which TEK has been investigated and used, both successfully and unsuccessfully. The three examples of successes are data collection studies for future implementation in policy making while the failures are reflective studies examining two cases of unsuccessful attempts to incorporate TEK into policy or science. These, plus three more case studies not discussed here, can be found in Table 28.1, which compares the purposes, methods and outcomes of studies conducted around the globe. It is important to note that this is in no way a comprehensive list of studies on TEK, but merely a selection of examples we found illustrative of a particular method or issue.

Information from the data collection studies featured here can be consulted for future conservation efforts or management plans for their studied regions. But it is valuable to acknowledge that positive collaborations are already happening in forms such as the Maidu Land Stewardship project in the Sierra Nevada mountains (which brings the Feather River Land Trust in partnership with the Maidu community; FRLT.org) and land management groups such as the Iisaak Forest Resources (which produces timber in Clayquot Sound, British Columbia, while being deeply invested in the well-being of the surrounding community; Iisaak.com).

Table 28.1. Comparison of eight case studies of TEK in conservation.

Authors	Topic	Location	Participants	Aim of study	Methods	Conclusions
Ballard and Huntsinger, 2006	Salal harvesting	Washington state, USA	20 immigrant harvesters	Data collection: to inform land management policies	Interviews, site visits	The harvesters know how to harvest sustainably but do not have the proper access to the land to allow them to put this knowledge to full use.
Bethel *et al.*, 2014	Louisiana coastline	Louisiana bayou, USA	13 local resource users	Data collection: to inform future restoration efforts	Interviews, site visits, maps	Combining TEK with GIS mapping technology can help visually identify sites for future restoration, as well as areas of consensus and conflicts between local stakeholders and policymakers.
Emery and Barron, 2010	Morel harvesting	Mid-Atlantic, USA	41 local harvesters	Data collection: to investigate morel decline, learn about morel ecology	Interviews, site visits	TEK could guide future research on the taxonomy of *Morchella* species, as well as suggest that future research should focus on changes in forest composition and land use.
Nasady, 2003	Dall sheep	Yukon Territory, Canada	Ruby Range Sheep Steering Committee	Review: attempted co-management to address decline in sheep population	Observational, reflective	This effort failed due to lack of trust between scientists and First Nation people, as well as political involvement of hunting outfitters.
Padilla and Kofinas, 2014	Caribou leaders	Yukon Territory, Canada	29 First Nation hunters and elders	Review: attempted reduction of highway hunting of caribou population	Interviews, archival review	This effort failed due to lack of understanding of the differences in tribal TEK and the need for rule enforcement within the tribes.
Gómez-Baggethun *et al.*,2012	Environmental extremes	Doñana region, Spain	33 interviews and 3 village focus groups, involving 13 villages	Review: community responses to changes in climate and resource availability	Interviews, focus groups, archival review	TEK helps facilitate a community-wide response to crisis and keeps social–ecological systems alive across generations.
Gratani *et al.*, 2011	Fish poisons	Queensland, Australia	2 Malanbarra Yidinji elders with groups of non-indigenous scientists	Experiment: validating TEK through scientific laboratory testing	Experiments, interviews	Scientific validation of TEK can provide legitimacy in the eyes of scientists and government environmental agencies.
Cardoso and Ladio, 2011	Local forestry practices	Patagonia region, Argentina	28 Mapuche residents	Data collection: analysing local forestry practices for better forestry management	Interviews	The influence of external agricultural agents has created a hybrid system of slow-growing native woods, as well as less sustainable exotic species.

These are just two of many conservation collaborations that are happening now (see SER.org for more examples), and they provide hope that successful co-management is possible.

28.5.1 Successes

28.5.1.1 Input for future restoration

In response to a 2012 Coastal Master Plan developed for the Louisiana coast, Bethel *et al.* (2014) conducted a survey of local resource users to get their perspectives on areas of concern and potential restoration approaches. The Master Plan sought to incorporate stakeholder input, but as the authors noted, the public forums used to solicit this input were either too technical for the public or not representative of their ideas. As a result, public engagement with the Master Plan process was limited. Therefore, Bethel and colleagues sought to fill in the gaps and find out what the people who know this area intimately from living on the land and using the resources have to say about the restoration needs. The research team chose their participants carefully, based on multiple iterations of peer referral. Finally, 13 of the most-referred people – fishers, trappers, and hunters – agreed to participate in the study. Each participant took the researchers on a site visit, or data-collection trip, to explore the areas they were most concerned about. The researchers transcribed and coded the interviews conducted during these trips and later reviewed the transcriptions with the participants to confirm that they were accurate. Four dominant themes emerged from the interviews: 1) methods of coastal restoration; 2) issues of freshwater salinity; 3) land loss; and 4) resource use and change (Bethel *et al*., 2014). The researchers asked their participants about potential responses to each issue, discussing priority areas, restoration tactics and possible conflicts with local interests. These discussions revealed that TEK experts possessed a deep understanding of the local ecological processes and a thoughtfulness that revealed a true concern for the future of the coastal region.

While the researchers' methods were more representative of statistics and biological research than ethnography, their concern with accuracy ensured that they chose well-respected, knowledgeable TEK experts and that their participants agreed with the interpretations of the data. What made this TEK collection unique was their effective use of maps. GPS coordinates were collected throughout the data-collection trips, and the data from each visit were compiled into one map to compare the routes. They also asked each participant to mark on a map which areas they saw as a priority for restoration, as well as the restoration method they believed would be most effective. These maps were also combined to show TEK expert consensus for restoration sites. By sharing the data in a visual map form, policy makers can quickly and easily understand which areas are priorities for local stakeholders. The maps combined with the interview data can help inform policy makers and scientists as they carry out the Coastal Master Plan and determine sites for restoration, considering areas of consensus and conflict and better understanding locals' values and concerns.

28.5.1.2 Insight for better land management

Land is often managed by people far removed from the actual property; as a result, policies, while made with good intentions, often are impractical for those using the land on a daily basis. Ballard and Huntsinger's (2006) study sought to find out what people who rely on the land know about the local ecology with the hopes of integrating this knowledge into future land management. While their study did not directly contribute to a management plan, their research revealed several important points. A defining feature of this study was the participant population. They interviewed 20 harvesters of salal (*Gaultheria shallon*; Ericaceae) in the Olympic Peninsula of Washington state; most of the harvesters (17) were recent immigrants to the United States. This defies the popular notion that TEK is only held by Native peoples. Regardless of their ethnicity, these harvesters derived their livelihood from the land and relied on their intimate understanding of the ecology for a successful harvest. The interviews also revealed, as may be suspected, that the harvesters with more experience (eight or more years) had 'distinctly more detailed answers' and a more nuanced perspective on the ecology of the forests they worked in (Ballard and Huntsinger, 2006). Their experience had taught them that harvesting at a low intensity and allowing an area to lie unharvested for a year to recover, or a 'rest-rotation system,' is the ideal approach. However, their temporary access to the land does not allow them to utilize the sustainable practices they would prefer. Instead, a permit allowed a person to harvest only one species or category of species (i.e. 'floral greens'). Many harvesters expressed a desire to stay in one area while harvesting numerous species. But their permits did not guarantee that a 'rest-rotation system' will protect the plants from illegal harvesting by others (Ballard and Huntsinger, 2006). This study shows that the people using the land may possess a better understanding of what works than forest managers and scientists may assume. If these harvesters were allowed more long-term access to a parcel of forest, they could securely practise the sustainable harvesting methods they know from years of experience are best for the plant and the forest as a whole. If policy makers were to collaborate with the people using the land, a more sustainable management plan could be developed, satisfying both human and ecological needs.

28.5.1.3 Information about under-researched species

While scientific observation and research has been conducted for many years, limitations of time, geography and funding have resulted in gaps in scientific knowledge. Emery and Barron's (2010) study began at the request of the US National Park Service (NPS) with the hopes of filling in such gaps in information about morel mushrooms (*Morchella* spp.; Morchellaceae). The NPS had been receiving reports of a decline in morels in the US Mid-Atlantic region. Lacking sufficient scientific data on the mushroom, the NPS turned to local morel harvesters to ask for their perspective on the potential decline.

Emery and Barron (2010) conducted interviews and site visits with 41 participants, who had been harvesting morels for less than ten to more than 30 years. Morel harvesters must have a fairly detailed understanding of the genus if they want to harvest the correct species. The aspects they shared with the researchers included types, tree associations, disturbance relationships and seasonality. Because the genus is variable and its range extensive, there is little scientific information about morels, particularly in the region where this study was conducted. Therefore, the harvesters' insight is valuable to mycologists and ecologists who seek to learn more about the *Morchella* species throughout their range.

Regarding the reported decline of morels, the harvesters expressed some concern but also provided alternative explanations for the reduced sightings. Many participants noted that the ideal weather conditions for morel growth are becoming less frequent and the harvesting season has become earlier over several years. The participants agreed with mycologists that climate change and habitat destruction could be contributing to the decline; however, many of them also noted that social reasons could account for the perceived decline in harvests. Many harvesters had observed 'more people hunting morels today than in the past and several note that what they perceive as a decline in morels may actually be increased competition for them' (Emery and Barron 2010).

Clearly, determining the causes for morel decline – if there is indeed a decline – will require more careful study. This investigation into harvesters' TEK provided more insight into the species in the Mid-Atlantic region, and can guide the direction of future morel research. Harvesters' beliefs about the species decline also suggests that future studies will have to consider social as well as ecological factors. Their observations over time can also contribute to ecologists' understanding of the past and present of the morel population.

28.5.2 Failures

28.5.2.1 Misunderstanding TEK

Padilla and Kofinas (2014) analysed the case of a failed attempt to use TEK to guide hunting regulations in the Yukon Territory of Canada. After the opening of a highway through north-western Canada in 1979, First Nation hunters as well as government officials were concerned about the highway's impact on the local Porcupine caribou herd (*Rangifer tarandus granti*; Cervidae). The newly formed Dempster Highway committee of the Yukon Department of Renewable Resources created their first recommendation – a 16 km no-hunting corridor, later reduced to 2 km – without consulting any indigenous hunters. Then, in 1994, the local resource council recommended the government consult TEK as the basis for creating new hunting regulations. A group of First Nations people expressed concern that hunting along the highway would deflect the herd's migration. A new regulation was thus created, based on some First Nation elders' teachings of 'letting the leaders pass', which advised that hunters should not take the leaders of the herd in order to avoid spooking and diverting the others. However, as the Porcupine

Caribou Management Board would soon learn, this sort of TEK was very context-specific as well as tribe-specific. The new regulation created a week-long closure on highway hunting that began upon the arrival of the first caribou in the fall. This closure was based solely on TEK in light of the dearth of scientific studies on caribou herd leaders and the impacts of the highway on the herd. This new regulation was primarily weak because 'local perspectives on the number, sex, and ages of caribou leaders needed to let the leaders pass [...] was not well defined' (Padilla and Kofinas, 2014). A look into the context in which this teaching was shared reveals why it failed to be broadly applied. Until the mid-1900s, hunting was often a community-oriented, cooperative effort, consisting of a group travelling on foot directed by a chief. Here, hunters held each other accountable and followed the guidance of elders. But beginning in the mid-1900s, particularly with the advent of snowmobiles, hunting became more individualized. Rarely was there a leader to oversee the hunting practices. As a result, the hunters lacked an authority who could determine whether the caribou leaders had passed and an overseeing entity in the community to easily share this information with. This new social context, combined with inadequate definitions and a lack of communication, made the new hunting closure regulation confusing and difficult to enforce, and, consequently, it received mixed responses from the community. Finally, in 2007, a young hunter who had violated the closure contested his case in court. He testified that the new regulation did not reflect the teachings of Dawson First Nation elders. During Padilla and Kofina's interviews with nine hunters and elders in Dawson, three also asserted that the 'let the leaders pass' rule did not reflect their elders' teaching, and four others partially disagreed with the regulation. In response, the Yukon Territory Minister of Environment declared the closure voluntary until consensus had been reached.

This case study demonstrates the complex, contextual nature of TEK. The ecological knowledge is intertwined with politics, social mores and spirituality. This complexity does not negate TEK's usefulness; it only means that it must be collected, considered and implemented while being mindful of the human component of the knowledge. This case also illustrates a common misconception: that all indigenous people have the same knowledge and culture. Policy makers had not considered that what an elder says in one First Nation tribe is not necessarily true in another tribe. Here again, the social context of the information must be considered. This implementation of TEK failed due to gaps in communication: disconnect between board members and tribal members; conflict between communities; and a divide between generations. The authors suggest that, in the future, co-managers must be cognizant of the difference between informal hunting customs and formal laws, confirm that all stakeholders fully support any recommendations made by a co-management board, engage elders in education efforts and oversight roles, and host community-wide discussions about the similarities and differences in their hunting traditions. These suggestions can be applied to any co-management situation involving local customs, and the principles of communication, context and complexity seen in this case are relevant to any TEK co-management situation.

28.5.2.2 Mistrusting TEK

A second case of a failed co-management efforts also occurred in the Yukon Territory. Nadasdy (2003) reviewed the struggle of the Ruby Range Sheep Steering Committee (RRSSC) as it sought to gather data about populations of Dall sheep (*Ovis dalli dalli*; Bovidae). The RRSSC was created in response to growing concern about a declining Dall sheep population, and its members included scientists, resource managers, hunting outfitters and First Nation people. Ostensibly, the members' mixed backgrounds would bring diverse perspectives to the table, enriching their collective understanding of the situation. However, collaboration was instead replaced with discord. According to Nasady (2003), 'virtually the only significant instance of knowledge-integration that occurred during the entire RRSSC process' was between scientists and hunting outfitters. Scientists, who distrusted the results of their 1996 annual aerial survey due to snowy conditions, consulted the results of a hunting outfitter's sheep count conducted a few months later. The outfitter's count included 100 more sheep than the aerial survey, yet the scientists and outfitter 'jointly concluded that the drop in the sheep count represented problems with the survey (e.g., different time of year, snow cover, and 100 moving sheep) rather than a drop in the actual number of sheep' (Nadasdy, 2003). However, the other parties of the RRSSC disagreed about the extent of, reasons for, and responses to the decline of the Dall sheep population, and each seemingly refused to consider the others' perspective. First Nation representatives argued that they have seen the population steadily declining since the 1960s, yet biologists were doubtful the decline was as severe or longstanding. Each considered the others' knowledge as invalid and unreliable; biologists wanted formal research and written reports, while First Nations people were dubious of studies so limited in time and geographic scope. Also at play in this situation was the political power of big game outfitters. With financial incentive for continuing hunting and the political sway of the Yukon Outfitters Association in the government, RRSSC recommendations could have been made irrelevant were they opposed by the outfitters. Ultimately, the RRSSC produced 24 recommendations: '12 dealt with the basically non-contentious issues of harassment, access, education, and predation. An additional six recommendations dealt specifically with how and when to conduct future scientific research. Five recommendations dealt with the contentious issues of hunting' (Nadasdy, 2003). These latter five recommendations were worded such that only First Nation peoples' hunting practices were ultimately affected.

The case of the Ruby Range Sheep Steering Committee demonstrates many concepts that may be overlooked when considering co-management. Successful co-management is more than having different stakeholders in the same room; there are social interactions, cultural differences and political influences at play that can cause conflict and make fruitful conversations scarce. Additionally, the context in which these conversations were taking place was troublesome. As Nadasdy (2003) notes: 'since the RRSSC process was created within the context of (and inserted into) existing systems of state resource management, biologists had no choice but to undervalue the artifacts of TEK vis-a-vis those of biology.' The bureaucracy which ultimately oversees the co-management body can limit the outcome of even the most collaborative co-management efforts. The biologists wanted numbers because they required numbers in order to make recommendations for legislation. TEK was undervalued, not only by the RRSSC, but also by the system within which the RRSSC functioned. If governments are going to integrate TEK with management (CEAA, 2012), then they must truly value TEK as a valid source of data. Otherwise, all of the diverse committees and discussions with indigenous people and local stakeholders are all for the sake of appearances, nothing more.

28.6 Discussion and Recommendations

In light of the information we have today regarding co-management practices, what steps can be taken to better integrate TEK into conservation efforts? First, the dynamics of management planning processes would surely be changed by giving TEK holders equal decision-making power: '"traditional knowledge" cannot truly be "incorporated" into the management process until native elders and hunters have achieved full decision-making authority in that realm' (Nadasdy, 1999). In addition, communities must have the scientific tools and technical support to control and refine their own management methods (Wavey, 1993). Co-management systems will be unable to reach their true potential as long as TEK holders are coerced to validate their lifestyles in the terms of external Western and scientific standards (Gratani *et al.*, 2011). Granted, our current political and management systems, in which power over TEK holders seems almost inherent, may make an idealistic balance seem unachievable. However, the outcome is in the hands of co-managers, who can choose to collaborate and optimize their use of TEK as well as scientific data.

Co-management can be difficult and complex, but Carlsson and Berkes (2005) provide some insight into the types and methods of co-management; they note that 'management processes can be improved by making them adaptable and flexible through the use of multiple perspectives and a broad range of ecological knowledge and understanding'. This recognizes the complexities of both human and ecological systems. If we see co-management as a network, we can acknowledge the many authorities with whom individuals interface throughout the conservation process, as well as the sometimes fragmentary nature of a community (Carlsson and Berkes, 2005). With these concepts in mind, one will be able to approach co-management situations with the understanding of the humanity of the situation. Biodiversity conservation is not solely about the threatened species; conservation plans affect human lives and require human knowledge. On this note, we recognize that many conservation biologists are not social scientists; however, it benefits all to have good ethnographic and anthropological skills (Johannes, 1993). By knowing the area and culture, conducting interviews in the interviewee's preferred language, and being open and honest with participants, a researcher creates an underlying foundation of respect. This goes a long way towards eliminating the inequalities in the dynamic between scientists and local knowledge holders.

28.7 Conclusion

TEK is an indispensable resource to biodiversity conservation efforts. However, Chief Wavey warned in his 1993 keynote address to the International Workshop on Indigenous Knowledge and Community-Based Resource Management: 'traditional ecological knowledge is not another frontier for science to discover' (Wavey, 1993). We must commit not to simply 'discover' and appropriate TEK from others, but to find ways of being active and engaged members of our shared ecological landscapes (Kimmerer, 2002). We should question what science can do to support TEK (such as by providing resources, technical support, supplies, education in methodology, etc.), so that we may cultivate a mutually beneficial relationship with TEK holders (Wavey, 1993). We must also recognize TEK as a way to better promote the value of interacting with and understanding our natural (and even urban) environments in a more holistic way. Because TEK is not transmitted in an institutionalized way like scientific knowledge, acquiring TEK requires participatory learning (Setalaphruk and Price, 2007). Thus, teaching children the skills needed to interact with nature is a way of activating our own type of local ecological knowledge (Kimmerer, 2002). By doing so, we may prevent the development of a cultural apathy for nature, and instead find that our local conservation efforts become enhanced by the participation of newly engaged citizens. Ultimately, integrating different ways of knowing and changing our mindsets could turn the tide on global conservation efforts. By fostering mutual well-being and respect at the core of our knowledge systems, we may allow better systems of co-management to evolve in the future.

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