*Perspectives*

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# A biologists' perspective on amalgamating traditional environmental knowledge and resource management

**Alex W.L. Hawley[1], Erin E. Sherry[2], and Chris J. Johnson[3]**

## Abstract

Recent transitions in resource management and recognition of the role of First Nations in resource management have heightened the need for conciliation of these two different views of the world and the place of people in it (world view). Efforts to amalgamate these diverse perspectives in resource management are impeded by a legacy of cultural imperialism and difficulties in understanding and accommodating differences in world views, including the place of resource management in society, the meanings and implications of incongruent language, the management of people and resources, and the characteristics of information and knowledge. We examine the consequences of each of these to the establishment of a unified management system that emphasizes points of commonality and is based on respect and communication.

KEYWORDS: *Aboriginal, co-management, First Nation, natural resource management, traditional environmental knowledge, wildlife, world view.*

### Contact Information

1 Associate Professor*, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N 4Z9. E-mail: alex.hawley@unbc.ca

2 Manager, Northern Aboriginal Research and Development Alliance, Northern Land Use Institute, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N 4Z9. E-mail: sherry0@unbc.ca

3 Assistant Professor, Ecosystem Science and Management Program, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N 4Z9. E-mail: johnsoch@unbc.ca

* At the time of writing, Alex Hawley was also Director of the Northern Land Use Institute.

 

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## Introduction

The latter part of the 20th century saw a transition in resource management in Canada and the United States from a focus on specific uses of selectively valued products (resource-based management) to a focus on ecosystem-based management, in which the maintenance of fully functional ecosystems is the priority (Kessler *et al.* 1992). This transition arose from growing recognition of the depth and pervasiveness of ecosystem processes, and that industrialization, and the approaches to resource management associated with it, had a number of unpredicted and disturbing ecological consequences. The role of science in ecosystem-based management remained paramount, since it is science that reveals the components and principles of ecosystem functioning, and thereby provides the knowledge platform and predictive capacity on which ecosystem-based management is based (Walters and Holling 1990).

The perception of the role of First Nations in resource management also changed during this time, with the recognition that Aboriginal people, as descendants of the First Peoples of North America, hold rights and title to land and resources. This translated into a number of practical applications such as a judicial requirement in some jurisdictions (e.g., British Columbia, Quebec, Yukon) to include First Nations in resource management decisions (Berkes 1989; Robinson and Binder 1991; Royal Commission on Aboriginal Peoples 1996; Asch 1997). Traditional Aboriginal cultures were also recognized as interwoven with resource-bearing environments in ways that most non-Aboriginal cultures were not. This was accompanied by a shift in interest in the environmental ethos of First Nations from objects of anthropological study to sources of insight and guidance in the design of new environmental management approaches (Berkes 1987; Johnson 1992; Wolfe *et al.* 1992). This has been part of an international shift in the perception and role of traditional knowledge of indigenous and local peoples (Mauro and Hardison 2000). The result of these changes was an effort to include First Nations' perspectives in resource management.

A number of approaches have been taken to include First Nations' perspectives in resource management including co-management systems in which First Nation and government representatives participate in decision making (Pinkerton 1989; Berkes *et al.* 1991). Co-management and related efforts often meet with only limited success from the standpoint of both First Nations (Notzke 1994; Beckley 1998; Treseder *et al.* 1999) and other resource managers (Urquhart 1996). Efforts to improve success include increasing community participation, training, and education in resource management, and providing operational resources (Noble 2000). However, our work in resource management and with Aboriginal people has led us to believe that these valuable and important efforts fail to address the underlying cause of difficulty, which we consider to be differences between the science-based world view of resource managers and a traditional Aboriginal world view. The purpose of this paper is to share our perspectives on two approaches to resource management and the world views that underlie them in the hope of facilitating their amalgamation into comprehensive, ecosystem-based management strategies.

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## Our Perspective

The science-based world view, which underlies resource management, and a traditional Aboriginal world view are different (Brockman 1991). We can speak with familiarity about the science-based world view of trained biologists in which we are fully indoctrinated. Conversely, we do not purport to speak for First Nations in our expression of a traditional Aboriginal world view. Rather, we describe what we see, hear, feel, and have been taught about that world view. This may transgress unwritten political or cultural boundaries, but we believe such open communication is necessary to achieve the fundamental changes in perspective that are required to unite world views. Our orientation derives from our Canadian experience, but we feel that the principles considered herein are widely applicable. In a quest for broad relevance and to initiate communication at a very fundamental level, we consider generalities at the expense of specifics. However, we must emphasize the diversity among First Nations and the need to understand the specific culture, language, spiritual connections, beliefs, social structures, institutions, and history of a particular people.

We face, in this effort, a large hurdle imposed by language. Using English to discuss other than our

science-based world view is terribly constraining for two reasons. First, it is difficult to express or convey certain concepts and values using English as opposed to an Indigenous language. Second, people of both world views use English and assume congruence in meaning, when there are really some very important underlying differences. Indeed, words such as "resource" and "management" may be inappropriate in a traditional Aboriginal world view. We have undertaken this challenge nonetheless and will consider language, among other things, as a specific hurdle to bridging understanding across world views.

## Two World Views, Two Approaches

### Science-Based Resource Management

The notion of resource management has changed markedly over the last century. Management implies the manipulation of organisms and their communities or ecosystems to achieve a predetermined goal. Using wildlife management as an example, so-called "game management" was philosophically similar to other land-cropping activities such as agriculture, and was defined as "the art of making land produce sustained annual crops of wild game for recreational use" (Leopold 1933:3). More modern definitions vary from the general such as, ". . . the management of wildlife populations" (Caughley and Sinclair 1994:1), to the specific such as, ". . . the application of ecological knowledge to populations of vertebrate animals and their plant and animal associates in a manner that strikes a balance between the needs of those populations and the needs of people" (Robinson and Bolen 1989:2). The term "wildlife" now refers to more than mammals and upland game birds hunted for consumptive purposes (i.e., game species), and includes potentially all non-domesticated animals (Shaw 1985). This reflects the changing definition of resource from something of economic or consumptive value to include recreational, spiritual, existence, and inherent values. As a result, resource managers are adopting new values and approaches to understanding the natural and social environment (Wagner 1989; Decker *et al.* 1992; Kellert 1995; Kessler 1995; Lancia *et al.* 1996; Czech 2001). There is also strong consensus that resource management must be science-based and operate at an ecosystem level (Murphy and Noon 1991; Nudds and Morrison 1991; Sinclair 1991; Drew 1994; Williams 1997). Thus, we define "science-based resource management" (SBRM) as the application of the scientific method to address issues involving a wide range of species and environmental features, their ecosystems, the underlying ecological processes, and the workings of humans.

### Traditional Environmental Knowledge and Management Systems

We consider Traditional Environmental Knowledge and Management Systems (TEKMS) to be based on contemporary First Nations' perceptions of their place in the world. These perceptions are cumulative and evolving, so that new knowledge and experience is constantly integrated with ancient foundations (Berkes 1999). The knowledge and culture that Aboriginal people developed over thousands of years has been described as folk ecology, ethno-ecology, customary law, knowledge of the land, traditional ecological knowledge, and, most recently, Indigenous people's knowledge and traditional environmental knowledge and management systems (Johnson 1992). Non-Aboriginal people coined many of these terms in an effort to describe phenomena outside their culture. Much disagreement and misunderstanding exists about what the terms actually mean. To avoid connotations of inferiority, simplicity, primitiveness, and cultural stagnation, some prefer the use of "Indigenous ecological knowledge" or "Indigenous people's knowledge" (Agrawal 1996; Grenier 1998). We recognize that the concept of management as understood within SBRM may not fit well into Aboriginal people's thinking, but chose to use "TEKMS" because it is currently in use by some of the First Nations with whom we have been working, it recognizes the ancestral roots of the concept, and it better reflects the full integration of knowledge and practice.

No single knowledge base can be identified as TEKMS (Klee 1980). Each TEKM system is an integration of the knowledge, practices, and beliefs of an individual First Nation. Each is "traditional" because it, "has roots based firmly in the . . . landscape and a land-based life experience of thousands of years" (Brockman 1991:11). Each includes information on the biological characteristics and ecological relationships of plants and animals, but this information is integrated into an inseparable blend of songs, stories, dances, legends, local language, values, beliefs, rituals, community laws, land use, and technology (Grenier 1998). The cultural breadth of TEKMS was underscored by the Working Group on Traditional Knowledge (Brockman 1991:1), who described it as, "…the accumulated knowledge and understanding of the human place in relation to the universe." The congruence between culture and TEKMS means that TEKM systems are not static, but are adaptable and change continually.

## The Issue Of Aboriginal Title

First Nations people place enormous priority on their occupancy and the geographic delineation of traditional territory. What non-Aboriginal society might refer to as "jurisdiction" is incorporated in the First Nations' view of "Aboriginal Title." Aboriginal title is not just a matter of jurisdiction, but is a broad concept that focuses on people's relationships with each other and the land, and encompasses such notions as self-governance, autonomy, occupation of land, and how that land is used. This is reflected in a growing recognition of the rights of Aboriginal people with respect to land and resources. In Canada, this has resulted in precedent-setting court rulings such as *Calder* in 1973, *Sparrow* in 1990, and *Delgamuukw* in 1997 (Asch 1997). In particular, the *Sparrow* and *Delgamuukw* cases confirmed that Aboriginal title is protected as a constitutional right of First Nations. Further, *Delgamuukw* dictates that the Crown must consult with First Nations in a meaningful way and, in some instances, seek their consent (Sherry and Johnston 1999). Two landmark rulings of the British Columbia Court of Appeal—the Haida Nation *v.* B.C. and Weyerhaeuser [2002] and the Taku River Tlingit *v.* Ringstad *et al.* [2002]—held that the provincial government and third parties (i.e., business) have an enforceable legal and equitable duty to consult First Nations before proceeding with development on potential treaty settlement land and to seek accommodation of Aboriginal rights. The court further said First Nations do not have to prove their title to the land in the courts or by treaty settlement before this consultation takes place. Negotiation of Agreements-in-Principle, Umbrella Final Agreements, and Final Agreements with First Nations of the Northwest Territories, Yukon, and British Columbia (e.g., Inuvialuit, Gwich'in, Sahtu, Vuntut Gwitchin, Champagne/Ashihik, Inuit, Nisga'a) occurred in the 1980s and 1990s. One of the principal elements of these comprehensive agreements was control over, and access to, natural resources (Notzke 1995). As a consequence, resource management in a First Nation's traditional territory *will* involve that Nation. Some divestment of responsibility for management of natural resources to First Nations people is integral to land claim settlements and self-governance agreements.

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## Resource Co-Management

Aboriginal people seek not only equitable access to resources, but full participation in decisions that affect resources. As a consequence, co-management agreements concerning land and resources, also known as joint management or joint stewardship, have proliferated in Canada since the 1980s (Usher 1987; Osherenko 1988a; Pinkerton 1989). These arrangements cover a specific geographic area where local users and government agree to a system of reciprocal rights and obligations with procedures for collective decision making. Several such arrangements have been established in northern Canada (e.g., Smith [no date]; Usher 1987; Osherenko 1988b; Freeman *et al.* 1992; Richard and Pike 1993). Co-management agreements attempt to balance values among individual resource users, user groups, and government (Pinkerton and Weinstein 1995). The earliest co-management arrangements focused on wildlife resources and arose from a combination of Aboriginal dissatisfaction with government management systems, concern over economic and industrial pressures on the environment, and perceived wildlife population crises (Notzke 1994, 1995; Kofinas 1998). However, co-management is not limited to First Nation–government interactions and can involve non-Aboriginal local resource users, non-governmental organizations, and industry. Examples include the West Coast salmon fishery (Dale 1989) and Saskatchewan forestry (Beckley 1998).

Co-management arrangements have been viewed as mechanisms to achieve full participation of Aboriginal people in resource management, but they have met with only limited success (Feit 1988; Osherenko 1988a; Morgan 1993; Berkes *et al.* 1991; Notzke 1994). We think this limitation arises from a failure to recognize and accommodate differences in world views. The sense among First Nations that their world views are discounted, or are being marginalized, inhibits their full commitment to joint endeavours. Conversely, skepticism among some resource managers over the ecological consciousness of Aboriginal world views, even before European contact, inhibits their full commitment to joint endeavours with First Nations (Usher 1986; Krech 1999; Sherry and Myers 2002). In the following section, we consider some of the main hurdles posed to joint resource management, which we feel arise from differences in world views.

## Hurdles

### Cultural Imperialism

Aboriginal social and cultural systems are threatened by the destabilizing effects of modern technology, competition, globalization, population growth, declining community health, and resource depletion (Feit 1988; Dyer and McGoodwin 1994; Hawkes 1995). Many Aboriginal people view resource exploitation in North America as inseparable from the intentional subjugation of First Nations people and the cultural imperialism and enforced assimilation to which Aboriginal people have been subjected (Kalland 1993; Peterson 1993; Ris 1993). First Nations people associate years of subservience and token (or inequitable) power sharing, by government agencies with government reticence to adopt innovative and inclusive management approaches (Berkes *et al.* 1991).

#### *Consequences*

First Nations people and resource managers do not fully trust, embrace, or understand one another. As a consequence, both First Nations people and resource managers often enter into resource management discussions with distrust and cynicism. The fundamental features of SBRM are chronicled in text within a vast written record and held in repositories of academic institutions and an integrated group of active practitioners. This makes the tenets of SBRM relatively resistant to cultural upheaval. In contrast, the oral tradition of First Nations means that the features of TEKMS reside within living Aboriginal people and their non-written cultural expressions. Thus, the integrity of TEKMS has been threatened by the destabilization of Aboriginal cultures. Continued erosion of First Nations cultures may result in the loss of TEKMS to all people. The sceptre of this loss causes great concern to Aboriginal people and makes them cautious, distrustful, and cynical in circumstances involving the expropriation of TEKMS.

### The Cultural Shadowland

The amalgamation of TEKMS with SBRM is not independent of the re-invigoration and revitalization of communities. This revitalization is important for Aboriginal people who have grown up under varying amounts of influence from Aboriginal and non-Aboriginal cultures and, therefore, exist outside of traditional Aboriginal culture, but not fully within non-Aboriginal culture. Some people within non-Aboriginal cultures do not appear to be comfortable with any of the world views encapsulated within the cultural mosaic. We consider these people, Aboriginal and non-Aboriginal alike, to exist in what we refer to as a "cultural shadowland" in which cultural mores are indistinct and there is no clear blueprint for living.

#### *Consequences*

Both Aboriginal and non-Aboriginal cultures must deal with people who do not embrace either SBRM or TEKMS. This exacerbates a unification of systems in several ways. First, conclusions that are drawn about SBRM and TEKMS may be misleading if experiences are predominated by interactions with individuals who do not live within the context of the world view with which they are rightly or wrongly associated. This interferes with attempts to understand and communicate alternative world views. Second, people exist in both Aboriginal and non-Aboriginal cultures whose orientation towards the environment may not be conducive to either SBRM or TEKMS. In both cases, the challenges of dealing with people who occupy a cultural shadowland place a burden on all societies and impede progress towards an amalgamation of TEKMS with SBRM.

### The Place of SBRM and TEKMS in Society

Science-based resource management practitioners are trained specialists with specific roles and a prescribed, formal education that is a major determinant of their professional activities (Adelman *et al.* 1994). Knowledge about resource management is perceived by society as more meritorious coming from this subset of individuals. Non-professionals can hold information about resources, but they are not considered to have the scientific foundation of modern resource management, and should therefore not be charged with the responsibility or authority to manage resources. Instead, resource managers are empowered with the responsibility to manage resources on behalf of society, which includes identifying goals that society at large holds for resources such as wildlife. These goals may be modified by resource managers on the basis of their superior knowledge, experience, or education (e.g., prioritizing the maintenance of ecological integrity over some other societal goals).

In contrast, TEKM systems do not represent separate sets of knowledge and responsibilities held by a distinct group within society. Certain individuals within the community may be considered more knowledgeable about certain aspects of life (e.g., in Carrier culture, men defer to women regarding knowledge about fishing;

in many Aboriginal cultures, different families are considered to know more than others about their respective territories). However, the knowledge of all members collectively comprises the TEKMS of the community—no specialized group within the community is a recognized authority on TEKMS, nor is there a separate set of knowledge that comprises TEKMS. All aspects of traditional Aboriginal life are integrated, such that specific information about resources is only one component of TEKMS and is not separable from all other aspects of life. Thus, TEKM systems are not a *part* of traditional Aboriginal culture, they *are* traditional Aboriginal culture.

***Consequences***

Differences in the perceived cultural importance of resource management lead to misunderstanding. Both groups fail to recognize the framework and constraints within which each group attempts to manage resources. Issues of apparently less importance on a provincial scale to resource managers in distant locations may be hugely important to local First Nations (e.g., limits on hunting or fishing that affect both locals and visitors alike). This can lead to perceptions of insensitivity and disrespect. Similarly, First Nations may not recognize the social and cultural constraints within which resource managers in SBRM must function. This fundamental misunderstanding is exacerbated by the inclusivity of TEKMS, which produces an inherent paradox: all members of Aboriginal society are, in the traditional sense, potential holders of TEKMS, but not all Aboriginal people today are equal participants in TEKMS (e.g., Francis 1992; Usher 2000).

## Characteristics of Information and Knowledge

The terms "information" and "knowledge" are sometimes used interchangeably, but two distinctions may be drawn that are especially relevant to discussions regarding SBRM and TEKMS. The first is that information can refer to isolated items of fact, truth, or observation, while knowledge usually involves an assemblage of that which is known, thought, or observed, and how elements of that assemblage relate. The second is that information has elements of independent empiricism; that is, information can be acquired and recorded independently of other pieces of information. In contrast, knowledge has a clear element of understanding that involves comprehension of the context in which information exists, not just awareness or possession of the information itself. Although SBRM and TEKMS have similar views of what information and knowledge are, they have very different views of how they are generated, acquired, and evaluated.

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Science-based resource management is based largely on reductionism, objectivism, and positivism (Sinclair 1991). Resource managers acquire and use "sound" biological information, which suggests that "unsound" information exists (Romesburg 1981), a distinction that is related to methods of information acquisition and validation. Science involves a systematic approach to the revelation of the laws of nature. The knowledge thereby revealed is used in SBRM to achieve defined goals by manipulating the environment. Information is generated through targeted investigations of defined scope and added to a larger knowledge pool about the environment. Information acquired through the objective empiricism of scientific investigation has greater value for resource management than subjective information or conjecture. This is consistent with the formal education considered within SBRM to be necessary to apply scientific methodology.

In contrast, TEKM systems are holistic rather than reduc-tionist, subjective rather than objective, and experiential rather than positivistic (Wolfe *et al.* 1992). Traditional environmental knowledge is accumulated through trial and error and purposeful observation (Grenier 1998). Personal experience is the primary source of new information, but revelation and spiritual insight are also recognized sources. The integrity of information and knowledge is derived from the personage of the holder of that information and knowledge, rather than from adherence to a suite of protocols and procedures employed, as in experimentation, to obtain that information. There is no separate educational stream for TEKMS because TEKM systems fully integrate all aspects of culture (Sherry and Myers 2002). As a consequence, no hierarchy of information or knowledge exists and all members of the community contribute to TEKMS. Elders are considered to have greater wisdom and perhaps greater knowledge, but not necessarily more or better information. Greatest credibility is given to the observations and views

of individuals who are considered by the community to have the greatest knowledge and understanding of the item under consideration.

***Consequences***

Resource managers often view TEKMS as anecdotal, non-quantitative, lacking in rigorous methods, irrational, or unsubstantial (Wolfe *et al.* 1992). Some elements of TEKMS are rejected because they do not correspond well to science-based concepts of "truth" (Nakashima 1991). The amalgamation of SBRM with TEKMS in co-management systems is often not amalgamation at all, but rather a regulated inclusion of selected information about plants and animals from TEKMS into SBRM (Stevenson 1998). This conscription of information from TEKMS into SBRM ignores the context within which such information exists and casts doubt on the validity or applicability of this world view. The expropriation of selected information, while ignoring other aspects of TEKMS, implies that resource managers value only that which can be verified using scientific methods. Under these circumstances, the context for management decisions is only that provided by SBRM, thereby preventing any management system, which is ostensibly based on the two world views, from departing substantively from SBRM. The result is a mutual rejection of world views and alienation between Aboriginal and non-Aboriginal groups. This impedes, rather than enhances, integration of the two systems (Huntington 2000).

## Language

First Nations use the vocabulary of modern resource management to refer to "land claims," "rights," "resources," and "management," but these terms have been adopted by First Nations people in response to external cultural pressures and the realities of negotiation processes. In fact, the words have very different connotations for the practitioners of TEKMS and SBRM. Within SBRM, the term "land" is primarily used to refer to the geographic extent of an environment. It is the place where people live (or don't live) and includes the biotic and abiotic features of that environment, plus the ecosystem processes linking them. Resources are features yielded or supported by that environment and that have value. These values can be intrinsic, but are defined primarily by the values held by society for the features. In industrialized societies, land itself can be a resource. It can be owned by individuals, and therefore bought and sold, as can rights of access to, and use of, other resources. Some resources, such as game species and Crown land, are considered to be owned publicly rather than individually. Public resources are managed by resource managers to yield values to society at large.

In both SBRM and TEKMS, humans are recognized as being part of ecosystems in an operational sense, but in TEKMS a spiritual connection is also present. Spiritual connection to the land is not unique to Aboriginal people, but it is at the heart of TEKMS, while it is neither predominant nor pervasive in SBRM. Within TEKMS, land is not a place where people live as much as it is something that is part of people and that people are part of. Land to Aboriginal people is a source of self-identification, distinctiveness, rights, and culture. It is seen more as friend and family, rather than as a detached entity (Berger 1977). This view of the land has important implications for the notions of resources and their management. In the traditional Aboriginal view, "resources" do not exist. Traditional environmental knowledge and management systems emphasize the spiritual qualities of materials in the environment, as opposed to the physical, chemical, and utilitarian properties normally emphasized in SBRM (Blackstock 2001). Within TEKMS, it is natural for all things to have spirit (e.g., Byers 1999). Animals are viewed more as co-inhabitants and kin, entities that are afforded the same or greater status, rights, and privileges as held by humans and that are to be honoured and respected as opposed to exploited.

***Consequences***

Decisions regarding how people interact with their environment are made in different contexts in SBRM and TEKMS. It is extremely difficult to understand and overcome these differences when the language used to describe them appears to have congruent meanings for participants, but really has important underlying differences. Decisions in SBRM are based predominantly on operational connections. Resource-based activities occur at both a physical and metaphorical distance from the rest of society. Decisions regarding land in TEKMS are based on predominantly spiritual connections. Actions are both spatially and spiritually intimate—doing things to the land and the things that are part of it amounts to doing things to the people themselves. Dishonouring or inappropriately disrupting the lives of the entities that are part of the land is, therefore, hurtful and offensive. This results in differences between TEKMS and SBRM in terms of evaluating what can and should be done on the land. For example, the term "resource" might have physical and operational inferences for one group, and metaphysical and spiritual inferences for another. The resulting differ-

ences in valuation and management decisions are dramatic. The cause of these differences often remains unknown to participants, leaving their resolution compromised or even improbable.

## Rights and Management of the Environment

Practitioners of SBRM have both a right and a responsibility to be good stewards of the environment. They feel a deep-seated affinity towards, and a sense of responsibility for, the land and the resources it holds. This responsibility is predicated on a system of human authority. The notion of "rights" within SBRM implies an authority that is held by individuals or groups. If this power is not inherent, but is granted by some higher bureaucratic authority, then it is a privilege. Within SBRM, access to resources involves a combination of rights and privileges. For example, all citizens may have the right to be eligible to hunt, but hunting is a privilege controlled by regulation. In this view, therefore, what happens in the environment is controlled at some level by the actions of people; therefore, SBRM has the responsibility of ensuring those actions are appropriate by basing decisions on sound scientific knowledge.

In TEKMS, people are viewed as participants in the cyclic unfolding of natural events, rather than as designators and creators of management outcomes. The role of people in nature is not determined by people, but by some higher authority, just as it is for other organisms (Salmón 2000). Environmental conditions can be manipulated to achieve specific ends (e.g., fish harvesting systems, burning range to enhance berry production), but such manipulations are viewed as part of the role of people in nature, rather than human control imposed on natural processes. People may hold desired outcomes for resources (e.g., maintenance of a viable population of animals), but are not considered to have the authority to predicate those outcomes.

Consumptive use of animals and plants by people is at the will of the animals and plants themselves, and not because people have the power to exploit them. For instance, hunting is neither a right nor a privilege in TEKMS, but rather a role and a responsibility determined not by people, but by some higher authority. Thus, there is no management in the SBRM sense of the word, only responsibility. People cannot legitimately take responsibility away and people cannot legitimately grant it. It is, therefore, especially distressing to First Nations that non-Aboriginal society views itself as conferring rights on First Nation people with respect to their occupancy of land and their activities thereon.

### *Consequences*

The difference between steward or custodian on the one hand, and recipient or participant on the other, leads to fundamental misunderstandings. Science-based resource managers must address international commercial, sport, and non-renewable resource interests. Their responsibilities go far beyond local ecologies in terms of the factors considered in management. Mitigative and protective resource management is required because the scope and impacts of industrialization, technological development, and population growth on ecosystems are immense. It is difficult within TEKMS to envision possessing or wielding such power over the environment and the managerial responsibility that such power evokes. Traditional Aboriginal world views based on local ecologies, which change on ecological or geological time scales, do not accommodate well the rapid and unprecedented global changes currently being wrought.

As a consequence of these misunderstandings, people of all perspectives often fail to recognize the depth of commitment of others to the land and its resources. Aboriginal groups often view SBRM as rooted in an ethos of dominion over nature, resource management as misguided, and resource managers as disrespectful of the environment (Johnson 1992; Byers 1999). Conversely, it is difficult for science-based resource managers to understand why the seemingly obvious (to them) choices of responsibility and action required by SBRM are not wholeheartedly embraced by First Nations, if values within TEKMS are indeed consistent with the goals of conservation and environmental integrity.

## Management of People

Both SBRM and TEKMS recognize that some regulation of peoples' activities is necessary to achieve conservation goals. Thus, both systems establish rules of conduct for people. However, these systems differ in how the values underlying those rules are identified and how the rules are implemented. Science-based resource management exists as a distinct element in democratic societies in which individual values are respected, but the majority rules. Rules governing the interactions of people with resources are established by a small group of specialists, enshrined in legislation, and applied to all people through enforcement and judicial processes enacted by another small group of specialists. As a consequence, "human dimensions" have become prevalent themes in

resource management and SBRM strives for "partnerships with the public" and greater involvement of all sectors in the management process (Decker *et al.* 1992). Managers must craft regulations to guide public behaviour and to govern those members of society who do not act in a manner commensurate with resource management goals. The primary mechanisms for influencing behaviour are education and enforcement, with penalties identified and levied by people against transgressors.

In contrast, TEKM systems require that people conduct themselves in a manner that is respectful of, and reciprocal towards, their natural and spiritual environment, accepting what the environment does as the other side of the reciprocal relationship. Traditional environmental knowledge and management systems reside within the community as a whole; therefore, the public-at-large is not separated from those who might legitimately comment on rules of conduct regarding the environment. The entire community engages in dialogue that reveals collective perceptions of people and their environment. People then have individual responsibility to interact with the environment in a manner consistent with their personal, and possibly the collective, perspective. Unwritten rules or social norms govern resource use, and the establishment of guidelines for behaviour involves all community members rather than a delineation of guidelines by an external authority (Osherenko 1988a). Community disapproval, sanction, public shame, and efforts at re-education are the primary societal mechanisms for influencing behaviour. However, people view the conscious forces of nature as potent motivators. Individuals who contravene the etiquette of the relationship with their environment may suffer by the loss of beneficence from nature through such things as poor hunting success or illness (Sherry and Myers 2002). This is viewed as a far greater sanction than could be imposed by people themselves.

#### *Consequences*

Procedures of governance that work well within SBRM for establishing and ensuring acceptable behaviour have not been broadly useful within TEKMS, and *vice versa*. Predominant mechanisms of determining environmental values and of achieving compliance and enforcement surrounding those values are not culturally compatible between TEKMS and SBRM. Misunderstanding is construed as disrespect when individuals fail to recognize the roles, responsibilities, and authority of others. Management problems are exacerbated by racially based legislation that attempts to deal with culturally based issues. For example, different hunting and fishing regulations for Aboriginal and non-Aboriginal people may be predicated on the legal association of an individual with a recognized group. However, the intent of the regulations may be directed at the world view and cultural way of life of the individual, which is not necessarily the same as the individual's legal association.

## Towards A New System

Efforts to combine SBRM and TEKMS through enhancing community capacity by providing operational resources, training, and education, may be effective in incorporating TEKMS into SBRM while falling short of a reciprocal amalgamation of the two. We believe that co-operative and effective resource management systems require accommodation of the two underlying world views. To that end, we identify below six areas for emphasis in the pursuit of amalgamated management systems.

### Respect

#### *World View*

For resource management, the most important and fundamental difference between SBRM and TEKMS involves the place that people occupy in the environment. World views are primarily cultural, rather than racial, phenomena, so it is incorrect and misleading to make ethnically based assumptions about world views. It is equally incorrect to assume that different people cannot embrace or appreciate different world views. It is not necessary to live by the tenets of another world view, but it is essential to acknowledge the value of that other world view and to accept and respect the goals, values, and orientations that are held because of it. McGregor (2002), Parsons and Prest (2003), and others have emphasized the need for mutual recognition of the individual strengths and complementarities of SBRM and TEKMS. Respecting people means respecting their world views.

*We believe that co-operative and effective resource management systems require accommodation of the two underlying world views.*

***Knowledge***

The mutual respect that must be afforded between SBRM and TEKMS includes the absence of chauvinism about knowledge. The credibility and continuity of knowledge within an oral-based culture (such as TEKMS) are questioned within an information-based culture built on the written word (such as that of SBRM). Selective appropriation of information, dismissal of values as unimportant or unrealistic, and rejection of approaches as misguided, all deny the context within which views are formulated and held. Knowledge bases can be made compatible between SBRM and TEKMS. The Taku River Tlingit First Nation Conservation Area Design (Heinemeyer *et al.* 2003), the Northern Contaminants Program (Bocking 2000), the Arctic Borderlands Ecological Knowledge Society (Berkes *et al.* 2001), and the Inuit Observations of Climate Change Project (Berkes and Jolly 2000), all provide examples of projects involving mutual respect and sharing of knowledge.

## Communication

Communication is the most fundamental aspect of knowledge sharing. However, cultural differences impede communication between SBRM and TEKMS. It is difficult to transmit specific features of TEKMS to SBRM because those features exist in an oral tradition and cultural context (Johnson 1992). Communication is further impeded by absence of a common lexicon and false assumptions based on cultural differences (Pedersen 1994). Terms such as "land," "resources," and "management" are poorly or wrongly transmitted between TEKMS and SBRM. It is essential, therefore, that all participants strive to understand the cultural context of their dialogue. Sherry (2002) provides recommendations for procedures to ensure successful and effective communication.

## Learning

Learning arising from good communication is essential for bridging the gaps in understanding between TEKMS and SBRM. First Nation representatives should learn about the science of resource management. Resource managers should learn about local knowledge, beliefs, and practices. It is especially important to understand the cultural aspects of SBRM and TEKMS so that issues, such as the identification and appreciation of values and the establishment and implementation of regulations, may be addressed. Thus, educational programs for resource professionals should continue to augment interpersonal skills in different cultural contexts (Adelman *et al.* 1994). Resource managers must accept that their methods and procedures are sometimes impractical or unacceptable to First Nations people, or are ineffective and prohibitively expensive in hinterlands (Osherenko 1988a; Berkes *et al.* 1991; Byers 1999). They must recognize that dialogue about resources and land management may have limited implications for non-Aboriginal society, but can affect the very fabric of traditional Aboriginal life. First Nations people must recognize the geographic extent and biological and cultural complexity of the resource issues with which resource managers must deal. They must recognize both the strengths and limitations of TEKMS as they relate to modern environmental issues, and be sensitive to the power of political, economic, and social forces acting on resource managers. Educational programs such as that developed between Oregon State University and the Confederated Tribes of Warm Springs (Wasco, Warm Springs, and Paiute First Nations) provide guidance for the establishment of successful programs (Vergun *et al.* 1996).

## Identifying Shared Goals

Emphasis should be placed on identifying and attaining common goals. To this end, SBRM and TEKM systems have many points of commonality that serve as starting points for identifying shared goals. Both have a sense of responsibility to people and to the environment. They share the common goals of conservation, sustainability, and ecological integrity. Both are interested in biological and ecological principles; both are concerned with more than just consumptive or recreational aspects of resources; and both recognize the importance of ecosystem-level processes to environmental integrity. The two world views are complementary in that both are founded on information and knowledge—scientific knowledge for SBRM and traditional knowledge for TEKMS (Pierotti and Wildcat 2000). Guidance on procedures for identifying common goals can be obtained from participatory action initiatives such as that involving Inuit of Hudson Bay or the Vuntut Gwitchin First Nation (McDonald 1997; Sherry and Vuntut Gwitchin First Nation 1999). A modified Delphi technique might be especially useful in this regard (Sherry 2002). Once shared goals are established, it is necessary to identify which features of TEKMS and SBRM best contribute towards the attainment of those goals. The two systems must be viewed as potentially making equal contributions.

### Helping the Disenfranchised

Both TEKMS and SBRM also have in common the disenfranchisement of people within their respective societies. These are people who do not understand, respect, or appreciate the importance of SBRM or TEKMS. Disenfranchisement from SBRM is an outgrowth of an agronomically supported urban culture that separates humans from their natural environment and fosters the view of biotic and abiotic features as merely exploitable resources. For TEKMS, the disenfranchised group arises from the erosion of Aboriginal cultures and deterioration of TEKMS. Resource managers and the holders of TEKMS should work together to face the common challenge of the distancing of people of all sorts from the natural environment. An amalgamation of world views can lead to a new vision of the place of people in their environment.

### How to Proceed

Mutual understanding, respect, honesty, trust, and shared goals are the foundations for overcoming barriers between SBRM and TEKMS. The people who are personally engaged in management processes will be essential in overcoming these barriers. Resource management professionals selected to work with First Nations people towards amalgamation of TEKMS and SBRM should be chosen on the basis of their ability to interact effectively, and not on the basis of authority, seniority, or technical experience. Similarly, First Nation representatives selected to work with resource managers should be open-minded and cognizant of the realities of resource management in an industrialized society.

It falls to resource managers to initiate the bridging of barriers between SBRM and TEKMS because SBRM is perceived by most Aboriginal and non-Aboriginal people to be in a position of operational authority over TEKMS. Resource managers should work through the community to establish and achieve a meaningful dialogue. Indigenous scholars such as Battiste (2000), Youngblood Henderson (Battiste and Youngblood Henderson 2000), and Simpson (2000) provide direction on community participatory processes. The entire community must be embraced because of the inclusiveness of TEKMS. Paradoxically, resource managers must seek out the holders of TEKMS because not all First Nations people embrace TEKMS. Input from the community, and especially Elders, is pivotal in this regard. Our experience has led us to conclude that Elders should be contacted through community representatives in a manner that reflects community protocols.

*Mutual understanding, respect, honesty, trust, and shared goals are the foundations for overcoming barriers between SBRM and TEKMS.*

Methods and procedures to approach and engage people for the sharing of information are very important. For example, hunters in three Arctic communities used a participatory group approach to share traditional knowledge that helped develop an understanding of caribou reactions to traffic, hunting, and snow machines on the Dempster Highway (Smith and Cooley 2003). Results were shared among scientists and government managers through quote-filled reports and plain language summaries. Participants determined this was a reasonable way to gather and present the understandings of expert hunters.

Specific action steps must be identified through dialogue with individual First Nations. Initial efforts should be focused on establishing open, honest, and respectful communication. This will require specific attention to the challenges of cross-cultural communication. We recommend that resource managers start by approaching the First Nation(s) with whom they wish to interact and ask how they would like to proceed. A discussion of the issues raised may serve as a suitable platform from which to initiate dialogue.

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## References


Adelman, I.R., D.J. Schmidly, and J. Cohen. 1994. Educational needs of fisheries and wildlife professionals: Results of a survey. Fisheries 19:17–25.

Agrawal, A. 1996. Indigenous and scientific knowledge: Some critical comments. Indigenous Knowledge and Development Monitor 3:1–6.

Asch, M. 1997. Aboriginal and treaty rights in Canada: Essays on law, equality, and respect for difference. University of British Columbia Press, Vancouver, B.C.

Battiste, M. 2000. Reclaiming indigenous voice and vison. University of British Columbia Press, Vancouver, B.C.

Battiste, M. and J.S. Youngblood Henderson. 2000. Protecting indigenous knowledge and heritage: A global challenge. Purich, Saskatoon, Sask.

Beckley, T.M. 1998. Moving towards consensus-based forest management: A comparison of industrial, co-managed, community, and small private forests in Canada. The Forestry Chronicle 74:736–744.

Berger, T.R. 1977. Northern frontier, northern homeland: The report of the Mackenzie Valley Pipeline Inquiry. James Lorimer and Co. Publishers, Toronto, Ont.

Berkes, F. 1987. Common property resource management and Cree Indian fisheries in subarctic Canada. *In* The question of the commons: The culture and ecology of communal resources. B.J. McCay and J. M. Acheson (editors). University of Arizona Press, Tuscon, Ariz. pp. 66–91.

_____. 1989. Co-management and the James Bay Agreement. *In* Co-operative management of local fisheries: New directions for improved management and community development. E. Pinkerton (editor). University of British Columbia Press, Vancouver, B.C. pp. 189–209.

_____. 1999. Sacred ecology: Traditional ecological knowledge and resource management. Taylor and Francis, Philadelphia, Penn.

Berkes, F. and D. Jolly. 2001. Adapting to climate change: Social-ecological resilience in a Canadian western Arctic community. Conservation Ecology 5:18. URL: *www.consecol.org/vol5/iss2/art18*

Berkes, F., J. Mathias, M. Kislalioglu, and H. Fast. 2001. The Canadian Arctic and the *Oceans Act*: The development of participatory environmental research and management. Ocean and Coastal Management 44:451–469.

Berkes, F., P. George, and R.J. Preston. 1991. Co-management: The evolution in theory and practice of the joint administration of living resources. Alternatives 18:12–18.

Blackstock, M. 2001. Water: A First Nations' spiritual and ecological perspective. BC Journal of Ecosystems and Management 1(1):54–66. URL: *www.forrex.org/jem/2000/vol1/no1/art7.pdf*

Bocking, S. 2000. Indicators of contaminants in the Arctic: Scieintific and indigenous perspectives on environmental risk. Department of Environment and Resources Studies, Trent University, Peterborough, Ont.

Brockman, A. 1991. Report of the traditional knowledge working group. A. Legat (editor). Department of Culture and Communications, Yellowknife, N.W.T.

Byers, T. 1999. Perspectives of aboriginal peoples on wildlife research. Wildlife Society Bulletin 27:671–675.

Caughley, G. and A.R.E. Sinclair. 1994. Wildlife ecology and management. Blackwell Scientific Publishing, Boston, Mass.

Czech, B. 2001. Incorporating nonhuman knowledge into the philosophy of science. Wildlife Society Bulletin 29:665–674.

Dale, N. 1989. Getting to co-management: Social learning in the redesign of fisheries management. *In* Co-operative management of local fisheries. E. Pinkerton (editor). University of British Columbia Press, Vancouver, B.C. pp. 103–124.

Decker, D.J., T.L. Brown, N.A. Connelly, J.W. Enck, G.A. Pomerantz, K.G. Purdy, and W.F. Siemer. 1992. Toward a comprehensive paradigm of wildlife management: Integrating the human and biological dimensions. *In* American fish and wildlife policy: The human dimension. W.R. Mangun (editor). Southern Illinois University Press, Carbondale, Ill. pp. 33–54.

Drew, G.S. 1994. The scientific method revisited. Conservation Biology 8:596–597.

Dyer, C.L. and J.R. McGoodwin. 1994. Folk management in the world's fisheries: Lessons for modern fisheries management. University Press of Colorado, Niwot, Colo.

Feit, H. 1988. Self-management and state-management: Forms of knowing and managing northern wildlife. *In* Traditional knowledge and renewable resource management in northern regions. M. Freeman and L. Carbyn (editors). University of Alberta Boreal Institute for Northern Studies, Edmonton, Alta. pp. 72–91.

Francis, D. 1992. The imaginary Indian: The image of the Indian in the Canadian culture. Arsenal Pulp Press, Vancouver, B.C.

Freeman, M.M.R., E.E. Wein, and D.E. Keith. 1992. Recovering rights: Bowhead whales and Inuvialuit subsistence in the western Canadian Arctic. University of Alberta Press, Edmonton, Alta.

Grenier, L. 1998. Working with indigenous knowledge: A guide for researchers. International Development and Research Centre, Ottawa, Ont.

Hawkes, S.L.E. 1995. Co-management and protected areas in Canada: The case of Gwaii Haanas. MSc thesis, Simon Fraser University, Burnaby, B.C.

Heinemeyer, K., T. Lind, and R. Tingey. 2003. A conservation area design for the territory of the Taku River Tlingit First Nation: Preliminary analyses and results. Round River Conservation Studies, Salt Lake City, Utah.

Huntington, H.P. 2000. Using traditional ecological knowledge in science: Methods and applications. Ecological Applications 10:1270–1274.

Johnson, M. 1992. LORE: Capturing traditional ecological knowledge. Dene Cultural Institute, Hay River, N.W.T.

Kalland, A. 1993. Management by totemization: Whale symbolism and the anti-whaling campaign. Arctic 46:124–133.

Kellert, S.R. 1995. Managing for biological and sociological diversity, or "*déjà vu*, all over again." Wildlife Society Bulletin 23:274–278.

Kessler, W.B. 1995. Wanted: A new generation of environmental problem-solvers. Wildlife Society Bulletin 23:594–599.

Kessler, W.B., H. Salwasser, C.W. Cartwright, and J.A. Caplan. 1992. New perspectives for sustainable natural resources management. Ecological Applications 2:221–225.

Klee, G. (editor). 1980. World systems of traditional resource management. Edward Arnold, London, U.K.

Kofinas, G. 1998. The costs of power sharing: Community involvement in Canadian Porcupine caribou management. PHD dissertation, University of British Columbia, Vancouver, B.C.

Krech, S. 1999. The ecological Indian: Myth and history. W.W. Norton and Co., New York, N.Y.

Lancia, R.A., C.E. Braun, M.W. Collopy, R.D. Dueser, J.G. Kie, C.J. Martinka, J.D. Nichols, T.D. Nudds, W.R. Porath, and N.G. Tilghman. 1996. ARM! for the future: Adaptive resource management in the wildlife profession. Wildlife Society Bulletin 24:436–442.

Leopold, A. 1933. Game management. Charles Scribner's Sons, New York, N.Y.

Mauro, F. and P.D. Hardison. 2000. Traditional knowledge of indigenous and local communities: International debate and policy initiatives. Ecological Applications 10:1263–1269.

McDonald, M.A. 1997. Voices from the bay: Traditional ecological knowledge of Inuit and Cree in the Hudson Bay bioregion. Canadian Arctic Resources Committee, Ottawa, Ont., and Environmental Committee of the Municipality of Sanikiluaq, Sanikiluaq, N.W.T.

McGregor, D. 2002. Indigenous knowledge in sustainable forest management: Community-based approaches achieve greater success. The Forestry Chronicle 78: 833–836.

Morgan, J.P. 1993. Co-operative management of wildlife in northern Canadian National Parks. MSc thesis, Faculty of Environmental Design, University of Calgary, Calgary, Alta.

Murphy, D.D. and B.D. Noon. 1992. Coping with uncertainty in wildlife biology. Journal of Wildlife Management 55:773–782.

Nakashima, D.J. 1991. The ecological knowledge of the Belcher Island Inuit: A traditional basis for contemporary wildlife co-management. PHD dissertation, Department of Geography, McGill University, Montreal, Que.

Noble, B.F. 2000. Institutional criteria for co-management. Marine Policy 24: 69–77.

Notzke, C. 1994. Aboriginal peoples and natural resources in Canada. Captus University Publications, North York, Ont.

_____. 1995. A new perspective in Aboriginal natural resource management: Co-management. Geoforum 26:187–209.

Nudds, T.D. and M.L. Morrison. 1991. Ten years after "reliable knowledge": Are we gaining? Journal of Wildlife Management 55:757–760.

Osherenko, G. 1988a. Wildlife management in the North American Arctic: The case for co-management. *In* Traditional knowledge and renewable resource

management in northern regions. M. Freeman and L. Carbyn (editors). University of Alberta Boreal Institute for Northern Studies, Edmonton, Alta. pp. 92–104.

_____. 1988b. Sharing power with native users: Co-management regimes for arctic wildlife. The Canadian Arctic Resources Committee, Ottawa, Ont.

Parsons, R. and G. Prest. 2003. Aboriginal forestry in Canada. The Forestry Chronicle 79: 779–784.

Pedersen, B. 1994. A handbook for developing multicultural awareness. Second edition. American Counseling Association, Alexandria, Va.

Peterson, J.H. 1993. Epilogue: Whales and elephants as cultural symbols. Arctic 46:172–174.

Pierotti, R. and D. Wildcat. 2000. Traditional ecological knowledge: The third alternative (commentary). Ecological Applications 10:1333–1340.

Pinkerton, E. 1989. Co-operative management of local fisheries. University of British Columbia Press, Vancouver, B.C.

Pinkerton, E. and M. Weinstein. 1995. Fisheries that work: Sustainability through community-based management. David Suzuki Foundation, Vancouver, B.C.

Richard, P.G. and D.G. Pike. 1993. Small whale co-management in the Eastern Canadian Arctic: A case history and analysis. Arctic 46:138–143.

Ris, M. 1993. Conflicting cultural values: Whale tourism in northern Norway. Arctic 46:156–163.

Robinson, M. and L. N. Binder, 1991. The Inuvialuit Final Agreement and resource use conflicts: Co-management in the western Arctic and final decisions in Ottawa. Canadian Institute of Resources Law, Calgary, Alta.

Robinson, W.L. and E.G. Bolen. 1989. Wildlife ecology and management. Macmillan Publishing Co., New York, N.Y.

Romesburg, H.C. 1981. Wildlife science: Gaining reliable knowledge. Journal of Wildlife Management 45:293–313.

Royal Commission on Aboriginal Peoples. 1996. Report of the Royal Commission on Aboriginal Peoples. Volume 2. Restructuring the relationship. Ministry of Supply and Services, Ottawa, Ont.

Salmón, E. 2000. Kincentric ecology: Indigenous perceptions of the human-nature relationship. Ecological Applications 10:1327–1332.

Shaw, J.H. 1985. Introduction to wildlife management. McGraw-Hill, Inc., New York, N.Y.

Sherry, E.E. 2002. Constructing partnership: A Delphi study of shared resource management in the north Yukon. PHD dissertation, Forestry Program, University of Northern British Columbia, Prince George, B.C.

Sherry, E.E. and C.J. Johnson. 1999. The forgotten forest: Revisiting the forestland allocation strategy. The Forestry Chronicle 75:919–927.

Sherry, E.E. and H.M. Myers. 2002. Traditional environmental knowledge in practice. Society and Natural Resources 15:345–358.

Sherry, E.E. and Vuntut Gwitchin First Nation. 1999. The land still speaks: Gwitchin words about life in Dempster country. Vuntut Gwitchin First Nation, Old Crow, Y.T.

Simpson, L.R. 2000. Aboriginal alternatives to integrating traditional ecological knowledge and western science: A personal reflection. *In* Aborignal health, identity and resources. J. Oakes, R. Riewe, W. Loolage, L. Simpson, and N. Schuster (editors). Native Studies Press, Winnipeg, Man. pp. 186–196.

Sinclair, A.R.E. 1991. Science and the practice of wildlife management. Journal of Wildlife Management 55: 767–774.

Smith, B. and D. Cooley. 2003. Through the eyes of hunters: How hunters see caribou reacting to hunters, traffic, and snow machines near the Dempster Highway, Yukon. Yukon Fish and Wildlife Branch, Department of Environment, Whitehorse, Y.T.

Smith, D. [no date]. Co-management regimes: An approach to the sustainable development of natural resources in the Arctic. Joint Secretariat, Inuvik, N.W.T.

Stevenson, M.G. 1998. Traditional knowledge in environmental management? From commodity to process. Sustainable Forest Management Network, University of Alberta, Edmonton, Alta.

Treseder, L., J. Honda-McNeil, M. Berkes, F. Berkes, J. Dragon, C. Notzke, T. Schramm, and R.J. Hudson. 1999. Northern Eden: Community-based wildlife management in Canada. Canadian Circumpolar Institute Press, University of Alberta, Edmonton, Alta.

Urquhart, D. 1996. Caribou co-management needs from research: Simple questions, tricky answers. Rangifer (Special Issue) 9:263–272.

Usher, P.J. 1986. The devolution of wildlife management and the prospects for wildlife conservation in the Northwest Territories. Canadian Arctic Resources Committee, Ottawa, Ont. Policy Paper No. 3.

_____. 1987. Indigenous management systems and the conservation of wildlife in the Canadian north. Alternatives 14:3–9.

_____. 2000. Traditional ecological knowledge in environmental assessment and management. Arctic 53:183–193.

Vergun, J.R., E.C. Jensen, P.S. Doescher, and R.R. Racine. 1996. A partnership between Northewest Indians and Oregon State University. Journal of Forestry (November):21–24.

Wagner, F.H. 1989. American wildlife management at the crossroads. Wildlife Society Bulletin 17:354–360.

Walters, C.J. and C.S. Holling. 1990. Large-scale management experiments and learning by doing. Ecology 71:2060–2068.

Williams, B.K. 1997. Logic and science in wildlife biology. Journal of Wildlife Management 61:1007–1015.

Wolfe, J., C. Bechard, P. Cizek, and D. Cole. 1992. Indigenous and western knowledge and resources management systems. University School of Rural Planning and Development, University of Guelph, Guelph, Ont.