

Culture



A Review of Traditional Environmental Knowledge: An Interdisciplinary Canadian Perspective

Richard G. Kuhn and Frank Duerden

Volume 16, Number 1, 1996

URI: <https://id.erudit.org/iderudit/1084104ar>

DOI: <https://doi.org/10.7202/1084104ar>

[See table of contents](#)

Publisher(s)

Canadian Anthropology Society / Société Canadienne d'Anthropologie (CASCA), formerly/anciennement Canadian Ethnology Society / Société Canadienne d'Ethnologie

ISSN

0229-009X (print)

2563-710X (digital)

[Explore this journal](#)

Cite this article

G. Kuhn, R. & Duerden, F. (1996). A Review of Traditional Environmental Knowledge: An Interdisciplinary Canadian Perspective. *Culture*, 16(1), 71–84. <https://doi.org/10.7202/1084104ar>

Article abstract

Over the past fifteen years there has been increasing interest in the nature and application of Traditional Environmental Knowledge (TEK) in Canada. This has coincided with the settlement of land claims, the emergence of comanagement regimes, and the ascendancy of First Nation power and influence in formal decision making processes. Discourses on actual and potential applications of TEK in land and resource management are the focus of this paper. TEK is the outcome of complex interactions between a culture and the natural environment. Although there are different cosmologies and adaptations, common themes emerge in the way knowledge is acquired and communicated. There is also a great deal of value in its application. However, a number of issues remain to be resolved such as the compatibility between Western scientific knowledge and TEK, and the acquisition and application of TEK by "outsiders." As knowledge is taken from its immediate context it is "abstracted" to conform with the needs of the user and to the scale at which it is being applied. Two subsequent issues emerge. First, TEK is transformed as it is removed from its original context, and second, it may be co-opted in the name of resource and land management decisions that do not necessarily serve First Nations' interests.

Tous droits réservés © Canadian Anthropology Society / Société Canadienne d'Anthropologie (CASCA), formerly/anciennement Canadian Ethnology Society / Société Canadienne d'Ethnologie, 1996

This document is protected by copyright law. Use of the services of Érudit (including reproduction) is subject to its terms and conditions, which can be viewed online.

<https://apropos.erudit.org/en/users/policy-on-use/>

Érudit

This article is disseminated and preserved by Érudit.

Érudit is a non-profit inter-university consortium of the Université de Montréal, Université Laval, and the Université du Québec à Montréal. Its mission is to promote and disseminate research.

<https://www.erudit.org/en/>

A Review of Traditional Environmental Knowledge: An Interdisciplinary Canadian Perspective¹

Richard G. Kuhn* and Frank Duerden**

Au cours des quinze dernières années, il y a eu un intérêt croissant envers les "Connaissances traditionnelles de l'environnement" (Traditional Environmental Knowledge ou TEK) et l'usage qui en est fait. Cette augmentation coïncide avec le règlement de revendications territoriales, l'émergence des régimes de co-gestion, et l'ascendance du pouvoir et de l'influence des premières nations lors des prises de décisions. Cet article étudie les discours portant sur l'application actuelle et potentielle du TEK.

TEK est le résultat d'interactions complexes entre une culture et l'environnement naturel. Bien qu'il existe des cosmologies et utilisations différentes, certains thèmes communs, portant sur l'acquisition et la transmission de la connaissance, émergent. L'application de cette connaissance est bénéfique. Cependant, il reste à résoudre certains problèmes tels la compatibilité entre le savoir scientifique occidental et le TEK ainsi que l'acquisition et l'application du TEK par des "étrangers." Quand les connaissances sont extirpées de leur contexte immédiat, elles sont transformées pour convenir à l'utilisateur et à l'échelle à laquelle elles sont utilisées. Deux problèmes surviennent: en premier lieu, le TEK subit des changements en étant pris hors son contexte original; en deuxième lieu, il peut être "arraisonné" lors de la prise de décisions sur la gestion des ressources et des terres d'une manière qui ne sert pas automatiquement les intérêts des peuples des premières nations.

Over the past fifteen years there has been increasing interest in the nature and application of Traditional Environmental Knowledge (TEK) in Canada. This has coincided with the settlement of land claims, the emergence of co-management regimes, and the ascendancy of First Nation power and influence in formal decision making processes. Discourses on actual and potential applications of TEK in land and resource management are the focus of this paper.

TEK is the outcome of complex interactions between a culture and the natural environment. Although there are different cosmologies and adaptations, common themes emerge in the way knowledge is acquired and communicated. There is also a great deal of value in its application. However, a number of issues remain to be resolved such as the compatibility between Western scientific knowledge and TEK, and the acquisition and application of TEK by "outsiders." As knowledge is taken from its immediate context it is "abstracted" to conform with the needs of the user and to the scale at which it is being applied. Two subsequent issues emerge. First, TEK is transformed as it is removed from its original context, and second, it may be co-opted in the name of resource and land management decisions that do not necessarily serve First Nations' interests.

* Department of Geography, University of Guelph, Guelph, Ontario N1G 2W1

** School of Applied Geography, Ryerson Polytechnic University

Growing interest in alternative perspectives on environment, the emergence of co-management regimes, and the perceived alignment between Indigenous notions of resource management and contemporary environmental philosophy have spawned a great number of studies dealing with Indigenous environmental knowledge and its applications. In approaching the question of applying Traditional Environmental Knowledge (TEK)² for a recent project, the authors of this paper were struck by the range and variety of works on the topic, and believed an attempt to capture major themes in literature in this area would be useful. A literature review was undertaken to determine the essential characteristics and applications of Traditional Environmental Knowledge, particularly as it applies to land and resource management issues.

There has been a long history of anthropological investigation of local or traditional knowledge, and the relationship between cultural and environment. Durkheim (1968) argued that totemism was essentially a classificatory system articulating nature and culture. Malinowski (1954) argued that science, consisting of empirical observation, was as much a part of preindustrial societies as religion and magic. Levi-Strauss (1966), focusing on what he referred to as the "science of the concrete," emphasized the tremendous knowledge that preindustrial peoples possessed regarding flora and fauna; knowledge that was codified in elaborate and sophisticated local taxonomies.

Also relevant to TEK are the theoretical perspectives in anthropology known as ethnohistory and cultural ecology. Ethnohistory (see Taylor, 1969) attempted to capture the cognitive maps of people in order to tap "meaning" in a highly formal and rigorous manner. Cultural ecology has been, and remains, a central approach in anthropology. Within this perspective, the reciprocal links between culture and environment are emphasized. Initially, the emphasis was placed on objective conditions such as soil type and level of technology (see Rappaport, 1967; Stewart, 1955). A more sophisticated application of the cultural ecology framework was achieved by Bennett (1969) in his research in western Canada. Bennett focused primarily on the subjective factors, showing how people's values, assumptions and local knowledge shaped the adaptive process of culture to nature.

The focus of this paper is on the applications of Traditional Environmental Knowledge to identify not only its value as a legitimate and increasingly accepted source of knowledge by non-Indigenous groups, but how it has been, and could be, applied in formal decision making processes. In other words, the task is to uncover how TEK is variously conceptualized and applied. For anthropologists, the fact that alternative knowledge systems exist and are valuable is obvious. For many practitioners and scientists, however, Indigenous knowledge about the environment provides "new" information that can (or must) be incorporated into the decision making process. The actual implementation is problematical for a variety of reasons. Formal approaches to resource management, economic analysis, wildlife studies and environmental analysis revolve around the "scientific" paradigm, a structured and ideally (but rarely) value-free framework which has the formalization of data, hypothesis testing and replicability of experience at its core. This approach leads to regarding resource management as a form of technical rationality hinged on reductionism and objectivity, and dependent on the collection and interpretation of selected information (data) deemed relevant within the scientific paradigm. Resource management decisions such as land use plans or environmental impact assessment constitute the action or result. A major constraint to this approach is the inability or reticence of the resource manager to give credence to other knowledge systems, that by the strictures of the scientific paradigm, have no validity. This situation may be changing, albeit slowly, as evidenced in formal arrangements between First Nations and governments such as land claim settlements and co-management agreements which contain specific requirements to include TEK in land use planning and resource management initiatives.

There has been a long history in North American society of the incorporation of aspects of Indigenous culture into mainstream culture as a means of creating a public impression of "consultation" and "respect" while in reality deflecting serious challenges to the status quo of aboriginal-state relations. Thus, the increased "visibility" of TEK in mainstream literature or in government programs must not necessarily be taken as evidence of increased empowerment or legitimacy. Rather, its recognition and use by non-aboriginals represents a stage in the on-going evolution of social relations between Indigenous populations

and the dominant groups. What is certain, however, is that there has been increasing interest in the nature and application of traditional environmental knowledge of physical environments, land use patterns, and land management practices held by native peoples in Canada.

The majority of papers consulted for this paper focus on recent Canadian applications and interpretations. Most authors provide a formal definition of TEK and focus on resource management. The geographical scale of the studies varied from detailed local to more general global and philosophical statements. On the basis of the review, three major areas of TEK were identified (Fig. 1).

These are discussions of characteristics of TEK, descriptions of the way in which a body of TEK evolves, and discourses on its actual or potential application. The ensuing review is organized around this categorization. A concluding section focuses opportunities identified in the literature to increase the use and understanding of TEK in land and resource management practices.

CHARACTERISTICS

Traditional Environmental Knowledge, folk ecology, ethnoecology, traditional ecological knowledge, Indigenous knowledge, customary

Acquisition	Characteristics	Application
<ul style="list-style-type: none"> • experience on the land -hunting, trapping, etc. • accumulated by individuals • systematic accumulation of detailed observations • knowledge systems intertwined with the belief and value systems that underlie the culture • traditional knowledge becomes personal knowledge through training and observation • oral tradition: -stories, legends, songs -social interaction -cultural norms • handed down through generations 	<ul style="list-style-type: none"> • experiential "to know is to experience" • qualitative • intuitive and descriptive • holistic • internalization of information about seasonal changes, mineral resources, plant and animal life cycles • rooted in the past • cumulative and dynamic • empathy with all forms of life • obligation to maintain ecological integrity • unique to a given culture or society • rooted in social context • provides unwritten rules and social norms • part of all-encompassing behavioural influences 	<ul style="list-style-type: none"> • subsistence/traditional pursuits • basis for local decision-making • cultural preservation • resource management: -agriculture, fisheries, wildlife, nonrenewable resource, etc. • land use planning • development assessment • environmental assessment • conservation • co-management • ecological consciousness • role model in global environmental debate

Fig.1. Major Attributes of Traditional Environmental Knowledge Recognized in the Literature

law, and knowledge of the land (Johnson, 1992a) are terms used interchangeably in the literature. TEK is variously described as a paradigm, as a view of the world, and as an avenue to "truth" that is fundamentally different from that which is held by those whose knowledge is based on European philosophies (Davis, 1993; Department of Culture and Communications, 1991; Freeman, 1985; Warren, 1989; 1991; Wheeler, 1988) and as operating from a different epistemological basis than Western scientific thought (Freeman, 1991). Scientific knowledge is based on objectivism, reductionism, and positivism whereas TEK is characterised as subjective, holistic, and existential (Gunn et al., 1988; Johannes, 1989; Warren, 1989; Wolfe et al., 1992). Until recently, Western scientists paid little regard to TEK, describing it as anecdotal, non-quantitative, without method, and unscientific (Cruikshank, 1984; Hobson, 1992). Freeman (1985) describes TEK as eschewing reductionism and placing little emphasis on the study of small, isolated parts of the ecological system.

A common characteristic of TEK found throughout the literature is that it is based on experience and is therefore local knowledge. A number of authors, for example, maintain that TEK is most insightful and potentially useful in resource management applications at the local scale. Local knowledge is described as that which is gained from astute observation of local environments (Pawluk et al., 1992) and the internalization of detailed information about local topography, climate, resources, biotic and abiotic characteristics, animal and plant life cycles and other environmental features. Themes often include reference to a particular local attribute such as the beluga whale (Adam et al., 1992; Harwood and Adams, 1991; Pike et al., 1991), bowhead whales (Freeman et al., 1992), fish resources (Berkes, 1977; Morell, 1989; Pinkerton, 1989; Wheeler, 1988), polar bear (Gunn et al. 1988; Lloyd, 1986), eider ducks (McDonald and Fleming, 1991; Nakashima, 1990), muskox and caribou (Freeman, 1985), agriculture (Pawluk et al., 1992; Warren, 1989) and reindeer (Bjorklund, 1988). An outstanding attribute of local knowledge is that it comprises an understanding of the complex relationships between these individual environmental components and the dynamics of local ecosystems (Berkes, 1977; Okrainetz, 1992). This knowledge extends beyond specific attributes of nature to the general characteristics of a given region like those of a rainforest, of arid or semi-arid lands or of mountainous areas (Davis, 1993).

In contemporary literature local knowledge is frequently linked with the concept of the sustainable use of local resources (Wolfe et al., 1992). Indigenous people are seen to implement the principles of sustainability for their survival and local knowledge accumulates as a culture strives to meet goals of survival in a particular ecological setting (Pawluk et al., 1992). The resulting dependence on the health of the local environment, wildlife and other resources, have promoted consideration of the complex interactions between human and biological systems (Arranutainaq and Fleming, 1991). Local knowledge often describes symbiotic relationships between people and animals and the ability to make life-sustaining decisions about how to relate to the environment (Brody, 1981; Martin 1977; Ridington, 1992).

This concern with sustainability parallels the contemporary global debate on the same issue and the apparent philosophical alignment between the environmental movement and Indigenous perspectives on resource management (Doubleday, 1991; Knudtson and Suzuki, 1992). A re-occurring theme is that sustainability, cultural survival and TEK are intractably related through social organization, human interaction, institutional arrangements, values, and moral codes of conduct. TEK both directs the relationship of Indigenous people with the natural environment and is enhanced by this relationship through traditional practices. The sustainable use of resources is not only directed through culture but determines and preserves culture; "if we destroy then we ourselves are destroyed" (Kassi, 1991). This view that TEK, culture, and the natural environment are inseparable is manifest in the belief held by many Indigenous people that they were put on this earth to take care of the land and "taking care of country" is of central concern (Jull, 1991).

Traditional Environmental Knowledge has been described as the knowledge that governs the interactions between people (Johnson, 1992b) and as an accumulation of knowledge and an understanding of the place of human beings in relation to the world in both an ecological and spiritual sense (Hobson, 1992). The interactions between people is not separated from interaction with the natural world. Knowledge is the producer of life-sustaining relationships between people and animals within the overall environment (Ridington, 1992) and a change in one is thought to result in a change in the other. This is evident for the Inuit of

Narrow River, Northwest Territories. The interactions between people have been greatly affected by a diminishment in the use of environmental knowledge for traditional patterns of living and hunting. The old ways of communal sharing of food, property, and child-raising are threatened by non-traditional activities (Ryan, 1992).

Because of its critical role in cultural sustainability TEK is more than empirical local observations of land and landscape. As Gunn et al. (1988) observe, traditional knowledge includes a system to organize observations and initiate action. Johnson (1992a) has also noted that TEK includes systems of classification and systems of self-management and thus is like any other knowledge system, inseparable from a cultural and philosophical basis. Numerous facets of TEK are discussed in the literature which illustrate this richness and complexity. Davis (1993), for example, describes the close attachment to the land and the environment in a philosophical and cosmological sense as something that is shared by numerous geographically disparate and culturally diverse people throughout the world. Resultant common themes are that land is not regarded as a market commodity; trees, plants, animals and fish that cohabit the land are not regarded as "natural resources" which produce profits or rents (Davis, 1993) and human life is not seen as superior to other animate and inanimate elements (Department of Culture and Communications, 1991; Knudtson and Suzuki, 1992). Traditional Environmental Knowledge encompasses spiritual relationships with the natural environment and the understanding that the elements of matter have a life force (Department of Culture and Communications, 1991; Ridington, 1982). The land is viewed as a living body with spirit and power containing tribal genealogies (Booth and Jacobs, 1990). The spiritual link to the land often comes to individuals in the form of mystical experiences such as vision quests (Ridington, 1992).

ACQUISITION

The roots of Traditional Environmental Knowledge are firmly based in the past (Department of Culture and Communications, 1991), in the landscape (Beilawski, 1992), and are intertwined with the belief and value systems that underlie culture (Jull, 1991; Young, 1992). Knowledge is developed through everyday experience in activities of such as harvesting, travelling,

searching and hunting (Brody, 1981; Osherenko, 1988; Usher, 1987) and through individual observation and training (Ridington, 1992). It is consolidated and communicated through historical sharing of stories, song and dance (Okrainetz, 1992; Osherenko, 1988; Ridington, 1982). In this way, information and knowledge is passed on from generation to generation, and the critical role of elders in First Nation societies in maintaining and communicating TEK is a recurrent theme (Johnson, 1992a). The body of knowledge is reflective of where people go on the land and the subsequent sharing of information within the community to provide a synthesis describing the environment. Over time knowledge encoded in various forms is communicated from generation to generation and is augmented with new, contemporary, information. This results in detailed images of "land," descriptions of changes in the environment over time, and explanation of such changes (Gunn et al., 1988).

APPLICATIONS OF TRADITIONAL ENVIRONMENTAL KNOWLEDGE

There are several actual and potential applications for TEK apparent from the literature. TEK is most often considered in the context of natural resources management, particularly wildlife management (Adam et al., 1992; Myers, 1990; Osherenko, 1988; Usher, 1987) and agriculture (Cizek, 1993; Furbee, 1989). Other applications of TEK have been related to international economic development (Davis, 1993; Warren, 1991), local economic development (Arragutainaq and Fleming, 1991), cumulative impact assessment (Okrainetz, 1992), global climatic change (Department of Indian and Northern Affairs, 1993), ecological consciousness (Booth and Jacobs, 1990; Knudtson and Suzuki, 1992), technological hazards (Ridington, 1992) and Indigenous cultural preservation (Department of Culture and Communications, 1991; Jull, 1991; Ridington, 1982; Ryan, 1992; Stokes, 1992; Weber, 1989).

An initial application is the survival of culture, a theme already discussed in this paper. Ridington (1992) suggests that TEK can be identified as the means of production for Indigenous societies and that it is the extent of knowledge, not the use of tools, that determines survival for hunter-gatherer groups. A better understanding of

the culture is gained through the study of the knowledge base than can be obtained by simply looking at artifacts and tools.

Many native organizations hold the view that TEK should be incorporated into all institutions, laws, policies and services that affect native people (Department of Culture and Communications, 1991; Jull, 1991). It is felt by some that social problems should be handled within communities, with the assistance of elders, and that justice and educational systems would better serve with native input (Department of Culture and Communications, 1991). TEK is seen as having an important role in political process and public policy issues (Jull, 1991). In New Zealand it was found that with increased participation in land claims negotiations Maori people became more intimate with their own culture. Maori cultural knowledge and language is now formally taught at various educational levels in New Zealand (Stokes, 1992).

The integration of TEK and Western knowledge in formal resource management decision-making structures is seen as important by many authors (e.g. Colorado, 1988; Heber, 1989; Johnson, 1992a; Nakashima, 1990; Reed, 1990; Wolfe et al. 1992) and the emergence of co-management agreements associated with Land Claim settlements has stimulated a number of papers examining the application of TEK to such regimes (Berkes et al., 1991; Doubleday, 1989; East, 1986; Myers, 1990; Pinkerton, 1989; 1992; Richardson and Green, 1989; Usher, 1987; Waquan, 1986).

Several examples of successful integration of Western science and TEK are documented in different wildlife management scenarios (Adam et al., 1992; Akhtar, 1992). Proposals to protect Bowhead Whales in Isabella Bay (Freeman, 1989; Myers, 1990), Beluga Whale research, monitoring and conservation (Adam et al., 1990), Musk-oxen research initiatives at Grise Fiord (Freeman, 1985), and caribou management strategies in northern Canada (Freeman, 1985) are all examples of successful integration of TEK into wildlife management systems (see also Flemming, 1992; Nakashima, 1990; Pinkerton, 1989; Reed, 1990).

The literature on fisheries management reveals studies conducted to evaluate the abilities of Indigenous people to manage subsistence fisheries (Berkes, 1977; Wheeler, 1981). The respective methods of the Fort George, James Bay Cree and the Alaskan Lower Koyukon Athapaskans, for

example, were deemed the most appropriate strategies for managing subsistence fisheries. In the field of agriculture, evaluation of TEK based approaches has been used to identify appropriate management, with examples ranging from the management and sustainability of wild rice resources in Mud Lake, Ontario (Cizek, 1993) to the terracing of fields of Peru so that effective conservation methods used by the Indigenous populations of the area can be transferred to parallel agricultural situations where good conservation is not taking place (Furbee, 1989), to the effective management of domestic animal populations and associated land resources as in the case of the reindeer populations of Norway (Bjorklund, 1988). Beyond wildlife, fisheries and agriculture, possibilities in the resource sector for TEK applications for management are identified including forest fire management, wolf predation, mining activities (Cole, 1992) and park development (Caulfield, 1988). Cruikshank (1984) noted that Indigenous knowledge has been applied to historical climatic research, geophysical research, and paleontological studies. Spink (1969) demonstrated the value of traditional knowledge in corroborating evidence for isostatic rebound.

The literature is replete with potential applications of TEK. These include economic development at both the global and local scales (Arragutainaq and Fleming, 1991; Davis, 1993; Warren, 1991), cumulative impact assessment (Okrainetz, 1992), environmental impact assessment (Cole, 1992; Everitt, 1986; Everitt et al. 1990; Shapcott, 1989), land claim settlements (Young, 1992), as a means to ensure the maintenance of native culture (Colorado, 1988; Mulvihill and Jacobs, 1991) in health, the design of human settlements (Akhtar, 1992) and to deal with justice and social problems (Bielawski, 1992).

Much of the literature refers to the potential application of TEK in the context of community-based management systems or co-management of resources between Western scientists, managers and Indigenous people (Berkes et al., 1991; Freeman, 1981; Myers, 1990; Usher, 1987). It is recognized that Traditional Environmental Knowledge has the potential to improve the management of resources because of conservation measures (Osherenko, 1988) and the sustainable use of resources that are inherent to the knowledge base and the level of expertise that is provided through TEK with regard to local resource characteristics

(Feit, 1988; Riewe and Gamble, 1988). It can serve to fill in gaps of knowledge found in state-managed systems and to enhance decisions made with regard to resources (Freeman, 1981).

Economic planners have argued that Indigenous knowledge can facilitate the development process in cost-effective, participatory and sustainable ways (Blaikie and Brookfield, 1987; Warren, 1991). Development initiatives around the world have failed because of poor design, for example, and many technology transfers to enhance food production in West Africa have had very disappointing results (Richards, 1985). Attempts to improve rural conditions can benefit from input from Indigenous groups, and perhaps effective Indigenous technologies can help other societies facing similar problems in different parts of the world (Warren, 1991).

The incorporation of Indigenous knowledge into global conservation and biodiversity projects or its analysis to yield better understanding of local fragile and harsh environments is a recurring theme (Davis, 1993). Arragutainaq and Fleming (1991) contend that the inclusion of Inuit knowledge in environmental impact assessment associated with James Bay Projects would make for better

assessment and understanding of the impacts of this kind of development. The contribution that native groups can make to environmental impact assessment and to cumulative impacts assessment may be tremendous. Okrainetz (1992) has identified the potential in the generational passing of information that native groups use as a means of documenting global change and of monitoring the cumulative anthropogenic effects and global pollution. The possibility of monitoring global change in this way has also been recognized by the Department of Indian Affairs and Northern Development (1993a). Some observers have argued that TEK can be viewed as broadly prescriptive for dealing with contemporary environmental problems. Booth and Jacobs (1990), among others, argue that given the state of the environment, Western culture could stand to gain from native ecological thought.

The application of Traditional Environmental Knowledge can be summarized under five categories, namely: 1) Cultural preservation where knowledge and images from the past keep a culture alive and reinforce a sense of place and the notion of "home." 2) Land claim processes where Indigenous geographies are used as a basis for land selection and for developing systematic

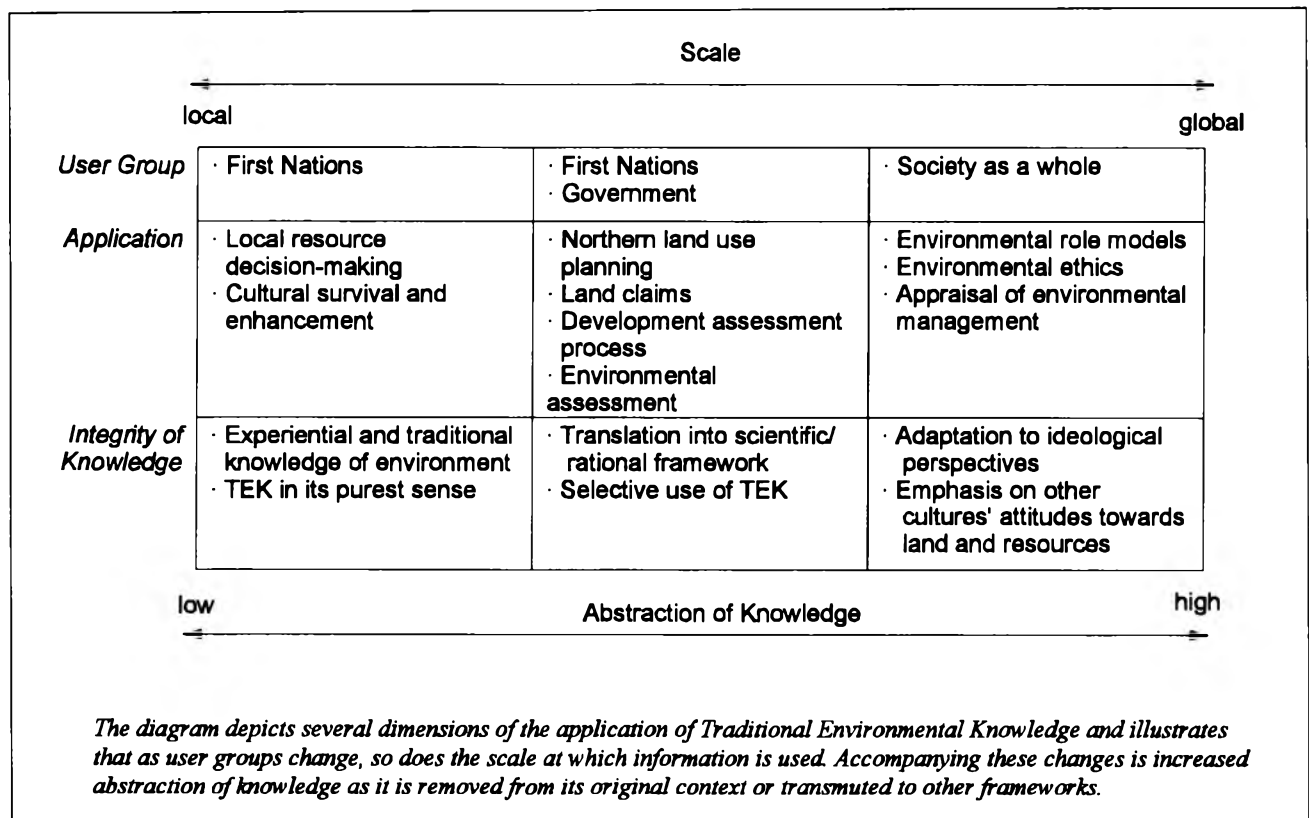


Fig. 2 Characteristics of Traditional Environmental Knowledge

approaches to the maintenance of native control of the land. 3) Resource management practices incorporating a wide array of knowledge concerning species habits and habitats basic to wildlife management. Some authors suggest that management practices fundamental to TEK and First Nations could provide role models for addressing contemporary environmental problems. 4) Land use regulation where TEK is used in locally based planning or environmental assessment processes to take into account local and regional perspectives of those most affected by development and planning initiatives. 5) Environmental monitoring to depict and record changes relating to the well-being of a people and their land over time. Oral histories describing isostatic rebound, flooding, or the structure of local ecosystems are well documented.

The way TEK is used to convey values and information depends on the nature of the user group and the focus of the application. In Figure 2, the described approaches are matched with applications and a typology emerges. The diagram depicts the manner in which TEK is transmuted as the nature and scale of applications change. Users range from native groups to the broader population, and the scale concomitantly changes from local to global. As the user and scale change, so does the nature of knowledge and its application. As the knowledge is taken from its immediate context it is "abstracted." Some information is rejected while selected information is retained and often reduced to numeric form. At each juncture the information becomes more abstract as it is further moved from its original context and manipulated so that it is congruent with application.

At the local level, knowledge is immediate information about local environments encoded in a manner that assists in local (and often informal) resource management decision making. This Traditional Knowledge in its purest form is characterized by Freeman (1992) as being a holistic and highly integrated perspective on all aspects of life, integrating all knowledge as the basis for regional decision making and survival. Crudely, it could be expressed as "being at one with the environment," accumulated through generational experience, providing the means or ability to deal with local environmental fluctuations on various temporal scales, and communicating such knowledge through stories and oral histories. This Traditional Knowledge can only be truly conveyed within the cultural group.

The second approach involves placing TEK in conventional cartographic form or using it to build what may be termed economic or management models of specific communities or regions. Numerous native groups have taken this approach to depict their land use interests in a manner Euro-Americans can understand. Although TEK is encoded in a much different manner than contemporary Euro-American environmental knowledge, information from stories and oral histories can be abstracted to elicit some information that can be conventionally mapped or quantified (DIAND, 1993b; Duerden and Keller, 1992; Duerden and Johnson, 1993). This represents a major cultural compromise because by changing the medium, vital environmental information (the message) may be lost. At this juncture, TEK is often transmuted to numeric form and is often placed in a "scientific" framework to assist in regional land use decision.

The final role of Traditional Knowledge is as an ethical model or standard for urban based societies. At critical junctures in the past, Indigenous populations have served as role models for Euro-Americans (Booth and Jacobs, 1990). Symbolism is very important in any social movement. For example, the mantra "sustainable development" has a pervasive value in raising environmental consciousness that may outmatch the practical utility of the term (Duerden, 1992). The idea that Indigenous peoples have developed viable common property resource management practices (Berkes and Feeney, 1990), or that they may have harmonized their land use practices with local ecosystems (Clad, 1985; Knudtson and Suzuki, 1992), serves as a philosophical underpinning for some groups or segments in society. Here it is not knowledge per se that is important but the philosophical alignment it is perceived to have with contemporary notions of environmentalism. At the global scale, it is not the knowledge itself but its symbolic value that becomes important.

DISCUSSION

The essence of Traditional Environmental Knowledge is, by its very nature, difficult to describe and define. It is the outcome of complex interactions between a culture and the natural environment of Indigenous populations. Although there are a wide range of cosmologies and cultural adaptations to environment, there are common

themes regarding the way knowledge is acquired and communicated and in attitudes towards landscape and living things. Much of the work reviewed documents successful applications of TEK or argues that it contributes positively to management strategies. The potential for incorporating TEK into various management strategies at regional and global as well as local levels is a reoccurring theme. The need for a "pragmatic turn" in the use of TEK for resource and land management is expressed by numerous observers. As noted by Johnson (1992a:5), there is a:

[s]hift away from theoretical studies to more applied research. Recent emphasis has been on understanding the ecologically sound practices that contribute to sustainable resource use among Indigenous peoples and the ways that this knowledge can be successfully integrated with the scientific resource management of the West.

A range of initiatives to integrate traditional knowledge into current regulatory processes is evident, however a major problem is that of identifying appropriate frameworks for its use. Generally, the relationship between First Nation and Western knowledge has been asymmetrical, corresponding to power relationships between governments and Indigenous communities. Thus, in most regions of Canada where the two cultures have met, the Western scientific approach to planning and resource management has dominated (Berkes et al., 1991). There is increasing evidence that this may be changing. A range of co-management regimes, land use planning, and environmental impact assessment processes have been identified, for example, in recent land claim agreements (e.g. Yukon Umbrella Agreement; Inuvialuit Final Agreement; Eastern Arctic Final Agreement; James Bay). However, analyses of the various comprehensive agreements indicates that while participatory structures for land use regulation abound, statements regarding the manner in which TEK will be utilised are dilute. Recent work in the Yukon found that some government agencies only see value of TEK if it is rendered into quantifiable form (Kuhn et al., 1994). Considerable confusion exists in government agencies about the way in which it should be integrated into land management processes, with many agencies viewing Indigenous participation on management boards as constituting adequate use of Indigenous knowledge.

The difficulty in merging traditional knowledge with Western scientific knowledge is reflected in the literature. Approximately half of the papers consulted for this review focus on the potential use of TEK rather than on actual applications. This underscores the fact that the perception of TEK as a valid and legitimate form of knowledge by those in formal decision making structures is relatively recent. When actual uses of TEK are documented, the vast majority focus on the local, as opposed to the regional or global, scale. For many authors, this is where TEK is seen to have its greatest utility; in providing detailed local knowledge of the complex interactions of biotic and abiotic elements of the environment coupled with an implicit or explicit management strategy to preserve the material and cultural integrity of local inhabitants. The latter was a prime goal of the now defunct Northern Land Use Planning Programme (DIAND, 1981).

Knowledge and information are power. The increased attention given to TEK by non-Indigenous scholars and government departments must also be seen in this perspective. As First Nations in Canada struggle to gain self-government and control over traditional territories, interest in TEK has also increased. For First Nations, this interest works two ways. In one sense, it reaffirms their culture and role in managing their affairs and their land. In another sense, however, there is a legitimate fear that their knowledge of the land, and hence their culture, is being co-opted in the name of "better" or "holistic" resource and land management decisions. In many instances there is understandable reticence on the part of First Nations to share their knowledge with "outsiders." The historical role of First Nations in Canada has been one of subservience to the dominant Western group, both culturally and economically.

CONCLUSION

What is required is to intensify the focus on successful applications of TEK in formal management regimes and to investigate the mechanisms and outcomes of endeavours where TEK and scientific management frameworks have been used. Applications could then be suggested for larger scale initiatives. Alternatively, what may emerge as a result of Land Claim settlements and increased First Nation autonomy will be the increased application of TEK as the prime provider

of information and context for decision-making. Western scientific information would then be used to supplement rather than guide decision-making.

Recognition of the utility of TEK and the ascendancy of First Nation power and influence has led to a renewed attempt to understand the practices that have contributed to the sustainable use of resources amongst Indigenous peoples. The use of "environmental expertise of local people" was called for by the World Commission on Environment and Development (1987). This document stressed the need to develop a science based on the priorities of local people and the creation of a technological base that blends both traditional and modern approaches to problem solving (Johnson and Ruttan, 1993). As is demonstrated in this review, local knowledge and resource practices constitute the essence of TEK.

Notes

- 1 The authors gratefully acknowledge the comments made on drafts of this paper by Stanley Barrett and two anonymous referees. Financial support for this research was provided by the Social Sciences and Humanities Research Council of Canada.
- 2 For consistency the authors use the term Traditional Environmental Knowledge (TEK) to describe Indigenous perspectives on environment, but acknowledge the use and validity of other nomenclature.

References

- ADAM, M., K.J. FROST and L.A. HARWOOD
1992 Alaska and Inuvialuit Beluga Whale Committee (AIBWC) – An Initiative in "At Home Management," *Arctic*, 46(2): 134-137.
- AKHTAR, S.
1992 *Traditional Ecological Knowledge: A Resource to Manage and Share*, International Development Research Centre, Ottawa: Canada.
- ARRAGUTAINAQ, L. and B. FLEMING
1991 Community-based Observations on Sustainable Development in Southern Hudson Bay, *Alternatives*, 18(2): 9-11.
- BENNETT, J.W.
1969 *Northern Plainsmen*, Chicago: Aldine Publishing Company.
- BERKES, F.
1977 Fishery Resource Use in a Subarctic Indian Community, *Human Ecology*, 5(4): 289-307.
- BERKES, F. and D. FEENEY
1990 Paradigms Lost: Changing Views on the Use of Common Property Resources, *Alternatives*, 17(2): 48-55.
- 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(2): 13-17.
- BIELAWSKI, E.
1992 Inuit Indigenous Knowledge and Science in the Arctic, *Northern Perspectives*, 20(1): 5-8.
- BJORKLUND, I.
1988 Sami Reindeer Pastoralism as an Indigenous Resource Management System in Northern Norway: A Contribution to the Common Property Debate, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M.M.R. Freeman and L.N. Carbyn (eds.), Edmonton: Boreal Institute for Northern Studies, Occasional Publication No. 23: 49-53.
- BLAIKIE, P. and H. BROOKFIELD
1987 *Land Degradation and Society*, London: Methuen.
- BOOTH, A. and H. M. JACOBS
1990 Ties That Bind: Native American Beliefs as a Foundation for Environmental Consciousness, *Environmental Ethics*, 12: 27-43.
- BRODY, H.
1981 *Maps and Dreams: Indians and the British Columbia Frontier*, Toronto: Douglas and McIntyre.
- CAULFIELD, R.A.
1988 The Role of Subsistence Resource Commissions in Managing Alaska's New National Parks, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M.M.R. Freeman and L.N. Carbyn (eds.), Edmonton: Boreal Institute for Northern Studies. Occasional Publication No. 23: 55-64.
- CIZEK, P.
1993 Guardians of Manomin: Aboriginal self-management of wild rice harvests, *Alternatives* 19(3): 29-32.

- CLAD, J.C.
1985 Conservation and Indigenous Peoples: A Study of Convergent Interests, *Culture and Conservation: The Human Dimension in Environmental Planning*, J.A. McNeely and D. Pitt (eds.), London: Croom Helm: 45-62.
- COLE, D.
1992 *A Rapid Rural Appraisal (RRA) Method of Research: Traditional Ecological Knowledge (TEK) Use Among the Naskapi of Northeastern Quebec*, University School of Rural Planning and Development, University of Guelph. Prepared for The Canadian Environmental Assessment Research Council.
- COLORADO, P.
1988 Bridging Native and Western Science, *Convergence* 21(2/3): 49-68.
- CRUIKSHANK, J.
1984 Oral Tradition and Scientific Research: Approaches to Knowledge in the North, *Social Science in the North: Communicating Northern Values*, Ottawa: ACUNS Occasional Studies No. 9.
- DAVIS, S. H.
1993 *Indigenous Views of Land and the Environment*, World Bank Discussion Papers, Washington, D.C.
- DEPARTMENT OF CULTURE AND COMMUNICATIONS
1991 *Report of the Traditional Knowledge Working Group*, Yellowknife: Government of the Northwest Territories.
- DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT
1981 *Northern Land Use Planning: Discussion Paper*, Ottawa: Minister of Supply and Services.
1993a Growing Appreciation of Tradition Knowledge, *Circumpolar Notes*, 2(1): 2-3.
1993b *Community Resource Mapping*, Yellowknife: GIS and Special Projects Division.
- DOUBLEDAY, N. C.
1989 Co-management Provisions of the Inuvialuit Final Agreement, *Co-Operative Management of Local Fisheries*, E. Pinkerton (ed.), Vancouver: University of British Columbia Press: 209-227.
1990 The Inuit Regional Conservation Strategy: Sustainable Development in the Circumpolar Region, *Sustainable Development Through Northern Conservation Strategies*, E. Smith (ed.), Calgary: University of Calgary Press: 83-90.
1991 Competing Value Systems: Evolution of Norms, *State Control and Traditional Ecological Knowledge*, Paper presented at the IASCP Common Property Conference, September 1991, Winnipeg, Manitoba.
- DUERDEN, F.
1992 A Critical Look at Sustainable Development in the North, *Arctic*, 45(3): 219-225.
- DUERDEN, F. and V. A. JOHNSON
1993 GIS and Visualization of First Nations Land Selection, "Eyes on the Future" GIS '93, Vancouver: 727-729.
- DUERDEN, F. and C. P. KELLER
1992 Gis and Land Selection for Native Claims, *Operational Geographer*, 10(4): 11-13.
- DURKHEIM, E.
1968 *The Elementary Forms of the Religious Life*, London: George Allen and Unwin [1912].
- EAST, K.
1986 Resource Comanagement in Wood Buffalo National Park: The National Park's Perspective, *Native People and Renewable Resource Management*, The 1986 Symposium of the Alberta Society of Professional Biologists, Edmonton: Alberta Society of Professional Biologists: 86-95.
- EVERITT, R. R.
1986 Native Roles in Monitoring Energy Developments, *Native People and Renewable Resource Management*, The 1986 Symposium of the Alberta Society of Professional Biologists, Edmonton: Alberta Society of Professional Biologists: 44-48.
- EVERITT, R.R., D.A. BIRDSALL and D. STONE
1990 The Beaufort Environmental Monitoring Program, *Integrated Approaches to Resource Planning and Management*, R. Lang (ed.), Calgary: The University of Calgary Press: 251-266.
- FEIT, H.
1988 Self-management and State-management: Forms of Knowing and Managing Northern Wildlife, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M. M. R. Freeman and L. N. Carbyn (eds.), Edmonton: Boreal Institute for Northern Studies, Occasional Publication No. 23: 72-91.
- FLEMMING, M.
1992 Reindeer Management in Canada's Belcher Islands: Documenting and Using Traditional Environmental Knowledge, *Lore: Capturing Traditional Environmental Knowledge*, M. Johnson (ed.), Hay River: Dene Cultural Institute and International Development Research Centre: 69-87.

- FREEMAN, M. M. R.
 1985 Appeal to Tradition: Different Perspectives on Arctic Wildlife Management, *Native Power, the Quest for Autonomy and Nationhood of Indigenous People*, Jens Brosted et al (eds.) Oslo: Universitetsforlaget AS.: 265-281.
 1989 The Alaska Whaling Commission: Successful Co-management Under Extreme Conditions, *Co-Operative Management of Local Fisheries*, E. Pinkerton (ed.), Vancouver: University of British Columbia Press: 137-153.
 1992 The Nature And Utility of Traditional Ecological Knowledge, *Northern Perspectives*, 20(1): 9-12.
- FURBEE, L.
 1989 A Folk Expert System: Soils Classification in the Colca Valley, Peru, *Anthropological Quarterly*, 62(2): 83-102.
- GUNN, A., K. JINGFORS and P. EVALIK
 1986 The Kitikmeot Harvest Study as a Successful Example for the Collection of Wildlife Harvest Statistics in the Northwest Territories, *Native People and Renewable Resource Management*, The 1986 Symposium of the Alberta Society of Professional Biologists. Edmonton: Alberta Society of Professional Biologists: 249-259.
- GUNN, A., G. ARLOOKTOO and D. KAOMAYOK
 1988 The Contribution of Ecological Knowledge of Inuit to Wildlife Management in the Northwest Territories, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M. M. R. Freeman and L. N. Carbyn (eds.), Edmonton: Boreal Institute for Northern Studies, Occasional Publication No. 23: 22-30.
- HARWOOD, L. and M. ADAMS
 1991 Alaska and the Inuvialuit Beluga Whale Committee: A Case Study, Paper presented at the IASCP Common Property Conference, September 1991, Winnipeg, Manitoba.
- HEBER, W. R.
 1989 Indians as Ethnics: Chipewyan Ethno-Adaptations, *The Western Canadian Anthropologist* 6(1): 55-74.
- HOBSON, G.
 1992 Traditional Knowledge is Science, *Northern Perspectives*, 20(1): 2.
- JOHANNES, R. L.
 1989 *Traditional Ecological Knowledge: A Collection of Essays*, Gland, Switzerland: IUCN, The World Conservation.
- JOHNSON, M.
 1992a *Lore: Capturing Traditional Environmental Knowledge*, Hay River: Dene Cultural Institute and International Development Research Centre.
 1992b Dene Traditional Knowledge, *Northern Perspectives*, 20(1): 3-4.
- JOHNSON, M. and R. RUTTA
 1993 *Traditional Dene Environmental Knowledge: A Pilot Project Conducted in Ft. Good Hope and Colville Lake, NWT., 1989-1993*, Hay River, NWT: Dene Cultural Institute.
- JULL, P.
 1991 Indigenous Survivors in Canada and Australia, *Alternatives*, 18(2): 29-33.
- KASSI, N.
 1991 This Land Has Sustained Us, *Alternatives*, 18(2): 20-21.
- KNUDTSON, P. and D. SUZUKI
 1992 *Wisdom of the Elders*, Toronto: Stoddart.
- KUHN, R. G., F. DUERDEN and K. CLYDE
 1994 Government Agencies and the Utilisation of Indigenous Land Use Information in the Yukon, *Environments*, 22(3): 76-84.
- LÉVI-STRAUSS, C.
 1966 *The Savage Mind*, London: Weidenfall and Nicolson.
- LLOYD, K.
 1986 Cooperative Management of Polar Bears on Northeast Baffin Island, *Native People and Renewable Resource Management*, The 1986 Symposium of the Alberta Society of Professional Biologists. Edmonton: Alberta Society of Professional Biologists: 108-116.
- MALINOWSKI, B.
 1954 *Magic, Science and Religion*, New York: Anchor Books.
- MARTIN, C.
 1977 *Keepers of the Game: Indian animal Relationships and the Fur Trade*, Berkeley: University of California Press.
- MCDONALD, M. and B. FLEMMING
 1991 The Role of Traditional Knowledge in Community-Based Management of an Eiderdown Industry Developing in Northern Canada, Paper presented for the IASCP Common Property Conference, September 1991, Winnipeg, Manitoba.

- MORELL, M.
1989 The Struggle to Integrate Traditional Indian Systems and State Management in the Salmon Fisheries of the Skeena River, British Columbia, *Co-Operative Management of Local Fisheries*, E. Pinkerton (ed.), Vancouver: University of British Columbia Press, pp.231-248.
- MULVIHILL, P. R. and P. JACOBS
1991 Towards New South/North Development Strategies in Canada, *Alternatives*, 18(2): 34-39.
- MYERS, H.
1990 Community Conservation Planning in Action: Protecting the Bowhead Whales at Isabella Bay, *Information North*, 16(2): 1-7.
- NAKASHIMA, D.J.
1990 *Application of Native Knowledge in EIA: Inuit, Eiders and Hudson Bay Oil*, Ottawa: Canadian Environmental Assessment Research Council.
- OKRAINETZ, G.
1992 Towards a Sustainable Future in Hudson Bay, *Northern Perspectives*, 20(2): 12-16.
- OSHERENKO, G.
1988 Can Comanagement Save Arctic Wildlife?, *Environment*, 30(6): 7-33.
- PAWLUK, R. R., J. A. SANDOR and J. A. TABOR
1992 The Role of Indigenous Soil Knowledge in Agricultural Development, *Journal of Soil and Water Conservation*, 47(4): 298-302.
- PIKE, D., P. RICHARD and D. GOODMAN
1991 Eastern Canada Arctic Beluga And Narwhal Management: History, Status And Future Challenges, Paper presented for the IASCP Common Property Conference, September 1991, Winnipeg, Manitoba.
- PINKERTON, E.
1989 Introduction: Attaining Better Fisheries Management Through Co-management: Prospects, Problems and Propositions, *Co-Operative Management of Local Fisheries*, E. Pinkerton (ed.), Vancouver: University of British Columbia Press: 3-33.
1992 Translating Legal Rights Into Management Practice: Overcoming the Barriers to the Exercise of Co-management, *Human Organization*, 51(4): 330-341.
- RAPPAPORT, R.A
1967 *Pigs for the Ancestor: Ritual in the Ecology of a New Guinea People*, New Haven: Yale University Press.
- REED, M.
1990 *Environmental Assessment and Aboriginal Claims: Implementation of the Inuvialuit Final Agreement*, Ottawa: Canadian Environmental Assessment Research Council.
- RICHARDS, P., L. J. SLIKKERVEER and A.O. PHILLIPS
1989 *Indigenous Knowledge Systems for Agriculture and Rural Development*, The CIKARD Inaugural Lectures, Studies in Technology and Social Change, No. 13. Technology and Social Change Program, Iowa State University.
- RICHARDSON, M. and B. GREEN
1989 The Fisheries Co-management Initiative in Haida Gwaii, *Co-Operative Management of Local Fisheries*, E. Pinkerton (ed.) Vancouver: University of British Columbia Press: 249-261.
- RIDINGTON, R.
1982 Technology, World View, and Adaptive Strategy in a Northern Hunting Society, *Canadian Review of Sociology and Anthropology*, 19(4): 469-481.
1992 When Poison Gas Come Down Like a Fog: a Native Community's Response to Cultural Disaster, *Human Organization*, 41(1): 36-42.
- RIEWE, R. and L. GAMBLE
1988 The Inuit and Wildlife Management Today, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M. M. R. Freeman and L. N. Carbyn (eds.) Edmonton: Boreal Institute for Northern Studies, Occasional Publication No. 23: 31-37.
- RYAN, J.
1992 Eroding Innu Cultural Tradition: Individualization and Community, *Journal of Canadian Studies*, 26(4): 95-110.
- SHAPCOTT, C.
1989 Environmental impact assessment and resource management, a Haida case study: Implications for native people of the north, *The Canadian Journal of Native Studies*, 9(1): 55-83.
- SPINK, J.
1969 Historic Eskimo Awareness of Past Changes in Sea Level, *Musk-Ox*, 5: 37-40.
- STEWART, J.
1955 *Theory of Culture Change*, Urbana: University of Illinois Press.
- STOKES, E.
1992 The Treaty of Waitangi and the Waitangi Tribunal: Maori Claims in New Zealand, *Applied Geography*, 12: 176-191.

- TAYLOR, S. (ed.)
1969 *Cognitive Anthropology*, New York: Holt, Rinehart and Winston.
- USHER, P.
1987 Indigenous Management Systems and the Conservation of Wildlife in the Canadian North, *Alternatives*, 14(1): 3-9.
- WAQUAN, A.
1986 Resource Co-management in Wood Buffalo National Park: The Cree Band's Perspective, *Native People and Renewable Resource Management*, The 1986 Symposium of the Alberta Society of Professional Biologists. Edmonton: Alberta Society of Professional Biologists: 81-85.
- WARREN, D.M.
1989 Linking Scientific and Indigenous Agricultural Systems, *The Transformation of International Agricultural Research and Development*, J. L. Compton (ed), Colorado: Reinner Publishers: 153-170.
- WARREN, D.M.
1991 *Using Indigenous Knowledge in Agricultural Development*, World Bank Discussion Papers. Washington, D.C.
- WHEELER, P.
1988 State and Indigenous Fisheries Management: The Alaska Context, *Traditional Knowledge and Renewable Resource Management in Northern Regions*, M. M. R. Freeman and L. N. Carbyn (eds.), Edmonton: Boreal Institute for Northern Studies, Occasional Publication No. 23: 38-47.
- WOLFE, J., C. BECHARD, P. CIZEK and D. COLE
1992 *Indigenous and Western Knowledge and Resource Management Systems*, Guelph: University School of Rural Planning and Development, University of Guelph.
- WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT
1987 *Our Common Future*, Oxford: Oxford University Press.
- YOUNG, E. A.
1992 Aboriginal Land Rights in Australia: Expectations, Achievements And Implications, *Applied Geography*, 12: 146-161.
-