Hum Ecol (2006) 34: 495–513
DOI 10.1007/s10745-006-9042-0

Coming to Understanding: Developing Conservation through Incremental Learning in the Pacific Northwest

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Published online: 20 July 2006

Abstract Lessons in conservation are often seen as resulting from cycles of overexploitation and subsequent depletion of resources, followed by catastrophic consequences of shortage and starvation, and finally, development of various strategies, including privatization of the commons, to conserve remaining resource stocks. While such scenarios have undoubtedly occurred on many occasions, we suggest that they are not the only means by which people develop conservation practices and concepts. There are other pathways leading to ecological understanding and conservation, which act at a range of scales and levels of complexity. These include: lessons from the past and from other places, perpetuated and strengthened through oral history and discourse; lessons from animals, learned through observation of migration and population cycles, predator effects, and social dynamics; monitoring resources and human effects on resources (positive and negative), building on experiences and expectations; observing changes in ecosystem cycles and natural disturbance events; trial and error experimentation and incremental modification of habitats and populations. Humans, we believe, are capable of building a sophisticated conservation ethic that transcends individual species and resources. A combination of conservation knowledge, practices, and beliefs can lead to increasingly greater sophistication of ecological understanding and the continued encoding of such knowledge in social institutions and worldview.

Key words Traditional ecological knowledge · conservation · indigenous peoples · ethnoecology.

An earlier version of this paper was presented at the IASCP Conference in Oaxaca, Mexico (August 2004) for a panel organized by Berkes and Turner, "How does resource management knowledge develop?"

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Introduction

Resource conserving practices of indigenous and local peoples drawn from their traditional knowledge systems have been described for many parts of the world and for many different cultures and environments (Blackburn and Anderson, 1993; Balée, 1994; Berkes, 1999; Berkes *et al*., 2000; Minnis and Elisens, 2000; Turner *et al*., 2000; Alcorn *et al*., 2003; Hunn *et al*., 2003). A wide variety of conservation strategies have been documented, ranging from cultural teachings against harvesting specific resources or harvesting at specific times or places, to selective or limited harvesting, to sanctions against waste (Berkes, 1999). In fact, traditional ecological knowledge systems are infused with practices and concepts, and modes of teaching and learning that can be related directly and indirectly to resource stewardship and conservation at various scales. However, despite considerable attention directed towards documentation of these systems and approaches to conservation, we still have a limited understanding about their development, evolution, and transmission over time and space.

It is sometimes assumed that the development of community-based conservation strategies, ethics, and teachings is a result of some realization or recognition of a catastrophic resource depletion situation (e.g., Johannes, 1998, 2002). Many authors have questioned whether such resource management systems can be considered to represent "conservation" at all, and, by extension, whether traditional resource managers can be effective conservationists. In part, the argument goes, a "real" conservationist both acts to prevent or mitigate resource depletion and has the *intention* to conserve (Smith and Wishnie, 2000). We do not wish to enter here into the debate on "conservation" and whether indigenous conservation is likely or even possible (Hunn *et al*., 2003). However, we refute the hypothesis that conservation is only authentic if it results from the intention to conserve, as have Wilson *et al*. (1994) and some others. The conservation biology or evolutionary ecology critique of indigenous conservation has its own logic, based on the notion that evolutionary theory more easily accounts for short-term and self-centered behaviors (Tucker, 2003). We find the assumptions behind the evolutionary ecology critique to be too limiting and western-centric; they are not supported by the realities of the indigenous groups that we deal with in this paper. However, we certainly make no claim for a universal conservationist bent in all indigenous or traditional cultures! The ethnohistorical and archaeological record provides evidence of situations in which people failed to conserve their resources, sometimes with dire consequences (Diamond, 1997; Krech, 1999; Redman, 1999).

Our focus is on learning and knowledge accumulation. Despite the undeniable existence of human-caused resource depletion, it seems unlikely that conservation arising from direct experiences with depletion and the resulting crisis is the *only* way that humans have learned to manage and conserve their resources. Indeed, the pervasiveness of conservation strategies, philosophies, and teachings that result in regulated resource use, or outright care for and conservation of non-resource species, indicates that people are capable of developing and enacting de facto conservation through other means. As Heiltsuk cultural specialist Pauline Waterfall noted (personal communication to NT, May 2004), "We had a form of regulated use based on the understanding that conservation would result if we regulated our use in a mindful and respectful way." For purposes of discussion, we have developed two models for learning conservation: the *depletion crisis model* and the *ecological understanding model*. In this paper, we explore the latter: what are the mechanisms and circumstances, beyond direct response to resource depletion, by which people can come to an understanding of the need to care for their resources and develop ways of promoting conservation?

Based mainly (but not exclusively) on the indigenous peoples of the North American Pacific Northwest, and using a general schematic for describing the diverse components of traditional ecological knowledge (Turner *et al*., 2000), we consider the development of conservation techniques and prescriptions based on the various components of traditional ecological knowledge systems. We then identify some possible mechanisms for building ecological understanding. We use the Saanich Reefnet fishery as an example of a complex conservation and resource management strategy, combining various elements of traditional ecological knowledge. We conclude by discussing the importance of philosophy and worldview in mediating and directing conservation activities. Given that conventional "western" efforts have generally not been successful in meeting conservation goals and objectives, it is crucial to consider possibilities for integration of indigenous and western perspectives in developing strategies for conservation.

We define traditional ecological knowledge as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes, 1999, p. 8). In keeping with the teachings of the indigenous peoples of the Pacific Northwest, we define conservation here as keeping something, especially an important environmental or cultural resource, or an entire habitat, from harm, loss, or change, using a resource sparingly so as not to exhaust supplies, and/or using specific measures to maintain and enhance a resource, a suite of resources or entire habitats (for example, as in landscape burning; Boyd, 1999; Peacock and Turner, 2000). Note that conservation in indigenous thought and practice does not preclude use, as it does in some western conservation traditions (Berkes, 1999). Resource depletion refers to a reduction in the abundance or productivity of plants, animals or substances used or required by humans.

Traditional Ecological Knowledge Systems and Learning of Conservation

In the framework presented here, *ecological understanding* is the term we use to refer to a suite of attributes embodied within traditional ecological knowledge systems, including:

- Incremental learning of individuals and groups and elaboration of environmental knowledge as a result of detailed observation and experience of variations in nature and leading to a sophisticated understanding of the ecosystem in which they dwell;
- Development of concomitant belief systems that help avert serious resource depletion and promote conserving approaches;
- Creating and perpetuating ways of encoding, communicating and disseminating both the practical aspects of such incremental learning and adaptive response and the ideologies and belief systems associated it; and
- Development of institutions that consolidate environmental knowledge and practice, or development of rules by which members of a society deal with their environment and resources.

Incremental Learning from Observation and Experience

We contend that humans living in close proximity to their environments are capable of observing, identifying, monitoring, and reacting to variations in resource availability, ecological relationships, and biological responses to particular circumstances. Such

knowledge can be acquired in the same ways as other important knowledge for survival, such as of food and medicine. Learning about new foods and medicines, and how to prepare and process them safely and effectively, for example, has been in large part incremental and cumulative (Johns, 1996). There would have been calamitous experiences and tragedies along the way, but more often, judicious tasting, sampling, experimentation, and evaluation would have guided the learning experience. Just feeling sick from eating a small amount of a plant, or detecting a bitter taste or some temporary hallucinogenic effect, would have been sufficiently remarkable to engender further experimentation or trial or to ward off more intensive use. This type of experience, Johns maintains, is the very mechanism whereby people learned to differentiate between food and medicine. Furthermore, observations leading to ecological understanding can be positive, just as tasting and learning about certain foods can be a positive experience (imagine a first taste of wild strawberry for someone testing for new foods!). For example, a natural burn attracting browsing deer and increased berry production in subsequent years would provide an incentive for clearing and development of anthropogenic burning (e.g., Boyd, 1999). Pauline Waterfall, Heiltsuk cultural specialist and teacher, writes (personal communication to NT, May 2004), "My grandfather taught me that observing how animals behaved and used certain natural resources was normal process of basis for experimenting, modifying, learning. For example, he told me that he came across many trees that had old scars with dried sap mixed with many varieties of animal fur. Upon observing, he discovered that animals came along and rubbed themselves against the sap and that these animals had injuries."

Plant resource management and conservation practices that could have developed incrementally include burning and clearing, pruning, coppicing, tilling, replanting and transplanting, partial harvesting of individual trees and shrubs, selective harvesting for size and life cycle stage, and rotational harvesting through annual or multiyear cycles, as well as genetic selection for maximum productivity or other desirable traits (Williams and Baines, 1988; Blackburn and Anderson, 1993; Minnis and Elisens, 2000; Deur and Turner, 2005).

For animal populations, including shellfish, fish, terrestrial and marine mammals, birds and bird eggs, and other resources check, there are parallel strategies and specific practices applied to maintaining numbers and representative age categories. Many examples exist of conservation practices including harvest selection by age, sex, size, and reproductive stage and season for various species (Moller *et al*., 2004), as well as the preparing and maintaining of productive habitats and foods for certain key resource species through the use of fire and other means (Brookfield and Paddoch, 1994; Colfer, 1992; Young *et al*., 1991).

Pauline Waterfall (personal communication to NT May 2004) described another conservation practice used by Heiltsuk hunters, namely to rotate areas where one hunted. "For example," she said, "If lots of deer were caught at a specific area, that area was left alone for a couple of years and other areas were used." Such rotation of harvesting areas indicates that hunters have an understanding of natural renewal cycles and the length of time that a population would need to replenish itself. Another example is from Daisy Sewid-Smith (personal communication to NT, October 1994), when asked about responses to scarcity:

> It was not the idea of harvesting too much... sometimes something would happen where a certain plant won't grow as much as it did last year. And they [her elders] said it's a cycle that happens—fish will disappear and there won't be very much fish—and yes, they did have people monitoring this. And, when they could see that there was

> going to be scarcity, then they were not allowed to go to that particular area. They were told to go to another area, and let that area build up. And yes, they did have people within the clan or tribal groups that monitored these changes...

There is evidence that some indigenous groups can manage ecological cycles at multiple scales. For example, Cree hunters of James Bay seem to be managing simultaneously beaver populations on a 4- to 6-year cycle, fish on a 5- to 10-year cycle and caribou on a 80- to 100-year cycle (Berkes *et al*., 2000). Such management systems can work well only if there are systems of proprietorship in place for these resources; otherwise one group's long-term conservation and management practices could be thwarted by another group's unregulated use (cf. Turner *et al*., 2005).

Belief Systems that Promote Conservation

Eugene Anderson (1996) suggests that the complex belief systems that comprise human religions and that are reflected in our social institutions, narratives, ceremonies and day-to-day activities are engendered from an ethic of conservation and responsibility to the environment. The question is: *how* do such complex belief systems develop, particularly in relation to conservation of other lifeforms? We know that attitudes are socially mediated and directed, and that attitudes guide and determine our actions. The notion of "respect" predominates in many traditional belief systems (Callicott, 1994; Turner and Atleo, 1998). As Chief Umeek (Richard Atleo) articulates for the Nuu-Chah-Nulth (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound, 1995, p. 15):

> *The Creator made all things one.*
> *All things are related and interconnected.*
> *All things are sacred.*
> *All things are therefore to be respected.*

Pauline Waterfall reiterated the same perspective for the Heiltsuk (personal communication to NT May 2004): "All living things have a spirit life. We acknowledged and still do that every life is worthy of being respected."

Related sentiment expressed in indigenous societies is appreciation and thanks. As Tewa elder Vickie Downie explains (Wall, 1993):

> You give thanks before you even receive your gifts from the Creator. When you ask, you give thanks. Your prayers are thanksgivings for everything—the sun, the moon, the snow, the water, the fire, the rocks. You see them as being alive, having a life of their own. A tree has its own life...

Another key concept in indigenous belief systems, arising from the first two, is that waste is deplorable: "Take only what you need; never waste anything!" is an instruction heard over and over again in traditional teachings (Turner and Atleo, 1998; Turner *et al*., 2000); avoiding waste might not always ensure conservation, but it would certainly help remind people of the limits they must impose on their actions. However, there may be a gap between the ideal and the actual practice. Some authors have also argued that the belief in some indigenous cultures in the unlimited renewability of resources could lead to overexploitation. For example, Brightman (1993 p. 280) uses ethnohistorial evidence that the northern Manitoba Cree conceived animals such as caribou as "infinitely renewable resources whose numbers could neither be reduced by overkilling nor managed by selective

hunting." But such potential overexploitation would be reined in by the application of rules of respect.

To what extent do attitudes of "respect," "appreciation" and "taking only what you need" within a belief system promote conservation without the experience of serious resource depletion? It may well be that resource depletion—or a series of resource depletions—somewhere at some time in the past did prompt the development of such belief systems (Berkes, 1999; see also, Berkes and Turner, this volume). However, on a broad scale, and over a long time frame, a belief system, in turn, helps prevent overharvesting or wanton destruction of other lifeforms, whether conservation per se is the intended result or not (Minnis and Elisens, 2000).

One of the major social mechanisms by which societies remember and build upon traditions of resource conservation is the use of stories and myths. Many of the traditional narratives of First Nations that reflect lessons of respect, appreciation, and conservation, describe a time of profound lack of resources, when people, sometimes with animal personas, were deprived of even the basic requirements for life: sun, moon, tides, winds, water, fire, and proper food. The stories do not necessarily depict human negligence or overharvesting as the cause of this deprivation. Consider, for example the Saanich story of the Origin of Salmon:

> Once there were no seals and the people were starving; they lived on elk and whatever other game they could kill. Two brave youths said to each other, "Let us go and see if we can find any salmon." They embarked in their canoe and headed out to sea.... They journeyed for three and a half months. Then they came to a strange country. When they reached the shore a man came out and welcomed them....
>
> The youths stayed in the place about a month. Their hosts then said to them, "You must go home tomorrow. Everything is arranged for you. The salmon that you were looking for will muster at your home and start off on their journey. You must follow them." So the two youths followed the salmon; for three and a half months they travelled, day and night, with the fish. Every night they took ***qexmin*** (Indian celery, *Lomatium nudicaule* (Pursh) Coult. & Rose) and burned it that the salmon might feed on its smoke and sustain themselves. Finally they reached Discovery Island (***Ktces***), where they burned ***qexmin*** all along the beach; for their hosts had said to them, "Burn ***qexmin*** along the beach when you reach land, to feed the salmon that travel with you. Then, if you treat the salmon well, you will always have them in abundance."
>
> ...Because their journey took them three and a half months, salmon are now absent on the coast for that period. The coho said to the other salmon, "You can go ahead of us [on the ocean journey], for we have not yet got what we wanted from the lakes." That is why the coho is always the last of the salmon.

The story continues, relating how the Salmon people taught the young men how and when to make and use reef nets and how to honor the first salmon with a ceremony and prayer "...that [the salmon] may always be plentiful" (Jenness, 1930).

There are many other stories, such as the Ditidaht story of the origin of the winds, tides, seasons, fire, fish, sun, moon, and daylight (Touchie, 1977), in which the resources that people rely on were provided as gifts from the Creator, or from the powers and generosity of individuals like Raven and other supernatural beings and cultural heroes. Some convey imperatives for conservation directly, but most impart a general sense of the need for

appreciating and not wasting these valuable gifts. The end result, however, would be a conserving philosophy.

Perceived kinship with other lifeforms, even trees and other plants, leads to a different way of treating these beings (Salmón, 2000; Turner, 2005). For example, Northwest Coast people had the technology and perhaps even a practical reason to kill cedar trees when they were removing the bark for clothing, mats or baskets. Yet everywhere teachings directed harvesters to be careful and only remove one or two straps from each tree, so as to keep the tree alive (Deur and Turner, 2005). Franz Boas (1921, pp. 616–617) explains this practice for the Kwakwaka'wakw:

> Even when the young cedar-tree is quite smooth, they do not take all of the cedar-bark, for the people of the olden times said that if they should peel off all the cedar-bark... the young cedar would die, and then another cedar-tree near by would curse the bark-peeler so that he would also die. Therefore, the bark-peelers never take all of the bark off a young tree.

The ultimate motivation for this practice was evidently to avoid needless killing of another lifeform, rather than conservation per se in the western sense. Pauline Waterfall (personal communication to NT May 2004) explained: "Needless killing is a teaching that is passed along to impress upon us that if we don't respect another lifeform, it won't return or will die out, thereby depriving us of future access and use. This is an explicit teaching of conservation." In any case, the practice of avoiding needless loss of life reflects a widespread belief system, at once respectful and utilitarian, that would engender conservation. Gitga'at elder Helen Clifton (personal communication to NT 2002) said that they were always taught as children that all creatures—mice, wolves, birds—had their own families and their own lives, parallel to and as important as those of people. Children were warned not to harm or needlessly disturb them. Mountains, too, were regarded as living beings, with their own stories and their own families, and requiring of respect. For example, there are certain mountains that one should never point to, or they will cause hard luck at some time in the future, especially bad weather (Roger William, Tsilhqot'in, personal communication to NT 2003; Elsie Claxton, Saanich, personal communication to NT 1998). Children were taught not to pick certain flowers or it might cause rain, or fog, or lightning storms (Turner *et al*., 1983; Turner, 2004).

There is a well-known narrative theme, recurring in several language communities on the North Coast of British Columbia and coastal Alaska (Haida, Haisla, Tsimshian, Tlingit), about the consequences of harming frogs. In the Haida version, centering in the village of Cumshewa, young boys on a fishing outing were playing with a frog, and threw it into the fire. The frog's mother, a supernatural being named *Jilaa quns*, or Creek Woman, was so distraught by this cruelty that she predicted the death of the boys, one after another, and finally, the destruction of their entire village (Turner, 2005). How closely is such a story based on an actual event, and, if it is, where and when did the event take place? It would have been many hundreds or thousands of ago, yet it still serves to teach one generation after the next about the dangers of willfully harming other species—in this case, a species that is not eaten by humans. The Nisga'a stories of the lava flows that destroyed several villages, said to be caused by the cruel and disrespectful treatment of salmon by a boy in one of the villages, is similar in the power of its lessons, perhaps even more so because of the obvious presence of the lava beds in the area (BC Parks, 2000). This story, and the lessons it embodies, seems to have its origins not in resource depletion but in disrespectful behavior—in lack of an environmental ethic.

Communication and Dissemination of Conservation Actions and Ethics

Stories and teachings are one example of the ways in which understandings of conservation and environmental ethics can be disseminated over time and space. Just as in learning about edible, poisonous, and medicinal plants without continuous episodes of fatality, it is not necessary for lessons in conservation to be learned by major catastrophic episodes of resource depletion. Rather, observations and experiences and guiding principles can be taught and acquired over generations, and spread through stories, ceremonies, and discourse from one community to another (Turner *et al*. 2000). Children are often taught by parents and elders about their responsibilities to their family, clan, and the other lifeforms. Community gatherings, such as potlatches and feasts, are occasions for reinforcing these values (George, 2003).

Social relationships, such as the roles and responsibilities of the hereditary chiefs and leaders in relation to their people, resources and territories, would also be reiterated at such times (Turner *et al*., 2005). Individuals and groups within a community would hold specialized knowledge to be imparted at appropriate times and circumstances (Turner, 2003). Some knowledge, especially relating to specific places, might be held privately, as part of an individual's or family's proprietory rights. Individual words and phrases, as well as stories, and lessons conveyed in art, music, and ceremony, are all part of this knowledge system leading to dissemination of environmental understanding. Children, too, participate on a daily basis in activities that foster conservation.

Secwepemc elder, Dr. Mary Thomas (personal communication to NT 2002), for example, learned lessons about conservation from her two grandmothers. As a child, she watched and helped while her grandmother carefully moved the carcasses of the salmon after they had spawned, from the banks of the Salmon River back into the water. Her grandmother explained that the salmon would nourish the baby fish to come. She also observed her grandmother remove and replant the smaller glacier lily (*Erythronium grandiflorum* Pursh) and chocolate lily (*Fritillaria lanceolata* Pursh) bulbs that Mary and her siblings had selected from the overturned turf and put into baskets when they were out harvesting roots with her. Her grandmother told them that they should only take the biggest roots and leave the small ones to grow for the future. In these demonstrations, and in Mary's participation, her grandmother was reinforcing the values of respect for other lifeforms and the practices required to sustain resources, imparting lessons that have endured over the many decades of Mary's life.

Creating and perpetuating ways of encoding, communicating and disseminating both the practical aspects of such incremental learning and adaptive responses and the ideologies and belief systems associated with them is as important today as in the past. In many cases, the opportunities for children to spend time with and learn from parents, grandparents, and others knowledgeable about conservation practices and beliefs, have been diminished, as have their opportunities for direct interaction with habitats and resources. This is a serious issue that needs to be addressed if traditional knowledge is not to be lost. This kind of knowledge cannot be mastered from books.

Institutions for Conservation Practice and Behavior

We have argued that environmental knowledge may be elaborated incrementally, leading to the development of belief systems and ways of transmitting this knowledge, both temporally (to other generations) and geographically (to other groups; cf. Turner *et al*., 2003). Another component of developing and consolidating conservation is the emergence

of institutions that foster the perpetuation of values and knowledge. By institutions, we mean the set of rules actually used or rules-in-use (Ostrom, 1990). Such institutions are socially constructed, with normative and cognitive dimensions, thus they embed values (Jentoft *et al*., 1998).

Rule sets that define access rights and specify appropriate behaviors are often known as tenure systems. There is a well-developed literature on land and marine tenure systems in the Pacific Northwest (e.g., Williams and Hunn, 1982; Turner *et al*., 2005) and we need not repeat them here. It is useful, however, to investigate some apparently simple plant use systems to illustrate how such institutions work. The harvesting of devil's club (*Oplopanax horridum* (Sm.) Torr. and A. Gray ex. Miq.) for medicine is a case in point (Lantz, 2001; Lantz and Antos, 2002). In general, only those who are considered medicine specialists are sanctioned to harvest and administer devil's club medicine. Even then, there are protocols to follow. It is usual to seek devil's club for harvesting in a remote place, removed from human settlement or intrusion. A harvester is taught to be conserving in terms of the way the medicine is harvested and in the quantities taken. Generally, only the branches are taken, not the main "mother" stalk (Captain Gold, Haida, personal communication to NT, 1996, among others). A practice of the Gitga'at (Tsimshian) is for the harvester to take no more than four stalks at any one time (Helen Clifton, Gitga'at, personal communication to NT, 2004). The harvester offers a prayer or words of thanks to the plant, and generally leaves a small gift of tobacco or a coin in the place where the plant was harvested. Some harvesters make a practice of replanting stem sections in the ground whenever they remove part of the plant (Arvid Charlie, personal communication to NT and T. Lantz 2000; Lantz *et al*., 2004). The "rules" around devil's club harvesting are embedded in a belief system in which devil's club is a living being with a spirit and the capacity to help or harm humans, depending upon how it is approached (Turner, 2004).

Another example is the harvesting and use of highbush cranberries (*Viburnum edule* (Michx.) Raf.). These berries are considered a valuable food, but the bushes can be quite sporadic. In many places, highbush cranberry patches are specifically owned. The owner, usually a chief or matriarch, may delegate others to pick the berries or may organize and lead a picking expedition of community members, but is always given a portion of the harvest. Then, in turn, the owner of the patch is expected to host a feast at which these berries are served. The patches are carefully monitored, both to determine when the berries are ripe and to ensure that outsiders do not encroach on the harvest. People have been known to transplant highbush cranberries to closer localities, and often these and other berry patches are cared for like orchards (Turner, 2005; Turner and Peacock, 2005; Turner *et al*., 2005). It is doubtful that such management developed as a result of catastrophic depletion.

Just as there are rules about the appropriate ways to harvest resources, there are also rules about how people make new environmental observations and how these observations eventually become part of the accepted knowledge of that group. Working with the Anishinaabe (Ojibwa) people of northwestern Ontario, Davidson-Hunt and Berkes (2003) argue that such learning requires maintaining a web of relationships of people and places. People literally learn as they travel over the landscape. This knowledge is remembered through social memory (McIntosh, 2000, p. 24) for long-term communal understanding of environmental change and the transmission of pertinent experience. Social memory describes how an individual thought or observation emerging out of a specific experience can become a part of the collective knowledge of a group. But how does individual creativity, emerging in response to a change in the environment, lead to change in social memory?

The rules that govern the evolution of knowledge in a particular group may be called "institutions of knowledge," defined as framing the process of creativity, learning, and remembering (Davidson-Hunt and Berkes, 2003). Institutions of knowledge, in the Anishinaabe case, comprise rules and values about how the process of learning can occur, the culturally correct way in which knowledge can be transmitted, how individual competency develops, and how observations of a specific experience may become part of the accepted, authoritative knowledge of the group.

Learning is a life-long process and legitimate knowledge requires establishing competency over a period of time. Not all observations are equally relevant or equally important. There is a filtering process of learning, within the bounds or frame set by the socially accepted rules that govern the establishment of accepted knowledge. Elders play a key role in this process. Among the Anishinaabe, elder is a social role and designation. Not all old people are elders; conversely some middle-aged people who have developed their competencies relatively quickly may be considered as elders. Institutions of knowledge allow authoritative and legitimate knowledge to be built through experience; this is by and large an incremental process. Understandings of the environment, embedded firmly within belief systems and informing resource use practices, can enable people to live within the constraints of their environment without the necessity of a major resource depletion crisis to force catastrophic learning.

Mechanisms for Building Ecological Understanding

The ability or capacity to learn from small and incremental lessons and from the experiences of others potentially enables people to develop sustainable practices and ecological understandings without always having to respond to and learn from crisis situations. Not only an event itself, but any inferences, extrapolations, or interpretations people draw from it can be enfolded into an enriched, elaborated system of knowledge and practice. Over time, even within one lifetime, experiences of others blend with personal knowledge and observations, compounding and accumulating to bring enhanced knowledge and wisdom. Table I summarizes some of the pathways by which lessons in land and resource management and knowledge of the importance of conservation may have been accrued, using examples from northwestern North American Indigenous peoples.

In reality, the knowledge acquisition and learning leading to an environmental ethic, and ultimately conservation of resources and biological diversity, is highly complex; it is impossible to trace and identify the countless diverse, tangled, and interwoven threads that comprise traditional knowledge systems and their origin and development. Under these circumstances, it is difficult, if not impossible, to identify *intention to conserve* as separate from a belief system that values and recognizes as kin all lifeforms, from frogs to wolves to cedar trees. Nevertheless, this system, within its cultural contexts, seems to have worked well for people in maintaining their resources over a long period of time. Resource depletion, natural and human-mediated, is a part of the story, but not the whole story.

Developing Conservation: The Reefnet Fishery Example

In reality, people probably combine the lessons and understandings gained from all of the pathways, including experiences of resource depletion, to build up their knowledge, practices, and beliefs into complex systems of land and resource management. These systems

Table I Potential Pathways for Accruing Land and Resource Management and Conservation Lessons with Examples from Indigenous Societies of Northwestern North America

Mechanisms	Explanation	References
Lessons from the past	Stories of positive and negative experiences, remembered by individuals, recounted within families and communities, or embedded in art, place names and ceremonies	George, 2003; Teit, 1912; BC Parks, 2000
Language	Terms that embody conservation concepts, understandings and teachings, e.g., the Heiltsuk word *mnaqels*, which refers to "selectively collecting things outside," and *miaisila*, which refers to someone whose responsibility it is to be a guardian of certain fish-bearing rivers, or the Nuu-chah-nulth word *7uh-mowa-shitl*, "to keep some and not take all"	Pauline Waterfall, personal communication May 2004; Earl Maquinna George, personal communication to NT 1998
Metaphorical sayings and narratives	Symbolic and metaphorical stories also teach lessons about conservation (e.g., Nlaka'pamux story of Old One and the Creation of the Earth; Haida *Jila quuns* story)	Swanton, 1905; Teit, 1912
Lessons from other places	Technologies, products, names, and ideas relating to conservation and environmental stewardship (e.g., use of fire for clearing; digging and propagation techniques; first foods ceremonies) passed from one community to the next through intermarriage, potlatches, trade	Turner and Loewen, 1998; Turner *et al*., 2003
Learning from animals	Observations of animal foraging strategies, populations, browsing and predation, behaviors that might engender understandings of kinship and reciprocity (e.g., grizzlies foraging for edible roots; birds' egg-laying habits; pack and leadership relationships in wolves; bears "pruning" berry bushes)	Loewen, 1998; Hunn *et al*., 2003; Blackfoot Gallery Committee, 2001; Deur and Turner, 2005
Monitoring—building on experiences and expectations	Routine observation of seasonal changes, animal migrations, plant life cycles, and berry production brings recognition of expected patterns and ability to detect variation from the norm	Lantz and Turner, 2003; Davidson-Hunt and Berkes, 2003
Observing ecosystem cycles and disturbance events	Relative abundance and productivity of plants and animals in particular circumstances, both temporal and spatial, can guide peoples' land and resource management strategies (e.g., successional stages following fire; effects of flooding on salmon migration patterns; relation between moisture and berry productivity)	Boyd, 1999; George, 2003; Thornton, 1999

Table I continued

Mechanisms	Explanation	References
Trial and error experimentation and incremental modification	Observing the results—positive and negative, intentional or incidental, short- and long-term—of people's own activities, such as selective harvesting (e.g., harvesting cedar bark and planks), or of emulating natural disturbance (e.g., use of fire to clear patches)	Garrick, 1998; Boyd, 1999
Learning by association, extension, and extrapolation	If a practice works in one place at one time, it might work in another place at another time; conversely, if a practice or activity results in negative consequences in one circumstance, it might be avoided at another time or place (e.g., knowledge about harvesting or conserving one type of shellfish, berry or root might be extended to other, similar types)	Turner and Loewen, 1998
Elaborating and building sophistication	Combining the lessons and understandings gained from all of these pathways, and building up knowledge, practices and beliefs into complex systems of land and resource management (e.g., Heiltsuk berry gardens; Saanich reefnet fishery)	Cyril Carpenter and Pauline P. Waterfall, personal communication 2002; Turner, 2005; Deur and Turner, 2005

ingrain social structures, land and marine tenure systems, and opportunities for adaptation at different scales. For instance, as described by Daisy Sewid-Smith and Chief Adam Dick (personal communication to NT 1997), one time, shortly before Captain George Vancouver arrived on the Northwest Coast (1792), the salmon returning to spawn to the Nimpkish River on northeastern Vancouver Island were very scarce. The Chiefs of the villages situated along the river conversed and decided to place a moratorium on salmon fishing. They moved all the people out to the mouth of the river or to other villages, and they all lived on shellfish and other food until the salmon became more plentiful. (The salmon were described as having their own societies and practices that paralleled those of humans, and it was said that they had gone to attend a wedding of the daughter of the Chief of the Underwater World.) This story reflects some of the complexities around conservation, including social institutions and leadership, resource tenure, belief systems, and adaptive capacity of communities. Although resource depletion was experienced, there were already institutional mechanisms in place to respond to the situation. There are many other treatments of Aboriginal fishing systems and practices relating to fisheries conservation (cf. Swezey and Heizer, 1977; M'Gonigle *et al*., 1999).

The Saanich reefnet fishery (Claxton and Elliott, 1994; Earl Claxton Sr., personal communication to NT 2004) serves as a detailed example of how narratives, social rules, ecological knowledge, conservation practices, and technology come together. Reefnet (S*X*OLE) salmon fishing technology is ancient, and the Straits Salish peoples around Haro and Rosario Straits of southern Vancouver Island, the Gulf Islands, and the American San Juan Islands are well-known for this unique innovation. There are only certain localities where the reefnet can be used, places where the schools of migrating salmon are channeled

into a restricted passage, for example between an island and an adjacent reef. These locations fall under the hereditary ownership of individuals and cannot be used by anyone else without permission (Fig. 1).

Reefnet fishing usually lasts around a month, starting when the oceanspray (*Holodiscus discolor* (Pursh) Maxim.) starts to bloom and the first berries start to ripen in late June. The reefnet is made of willowbark (*Salix lasiandra* Benth. and other *Salix* spp.) and other plant materials and is suspended into the water between two canoes, with a leading edge, or "floor," anchored in place and extending towards the direction from where the salmon are coming (Fig. 2). Sometimes a channel is cleared in an offshore kelp bed leading to the reefnet to help direct the salmon. The leading edge is positioned so that it forms a false bottom sloping downwards to give the approaching salmon the impression that they are swimming into deeper water. Strands of American dunegrass (*Elymus mollis* Trin.) tied onto the "floor" help in this deception, making the approach resemble the oceanbottom (Earl Claxton Sr., personal communication to NT 2000). The crews in the two canoes wait until there is evidence that the salmon are approaching—either sighting them underwater, or seeing the advancing fish jumping out of the water. Sometimes, if visibility is poor, they induce the fish to jump by raising some of the floor lines to make the approach more uneven; the lead salmon will jump out of the water to see what the conditions are like (Earl Claxton Sr., personal communication to NT 2000). The fishers know just how long it will take the salmon to swim into the main part of the net between the canoes. Then, when enough fish are in position, the crew brings the vessels together, pulling up the net at the same time and capturing the fish in the canoes. For conservation purposes, a sizable willow hoop is constructed at head of the net. This is to ensure that a few fish—regarded as all

Fig. 1 Saanich Elder, Earl Claxton, Sr., one of the last of the Saanich elders who has participated in reefnet fishing, showing the different reefnet sites on a map of the Gulf and San Juan Islands of Haro and Rosario Straits

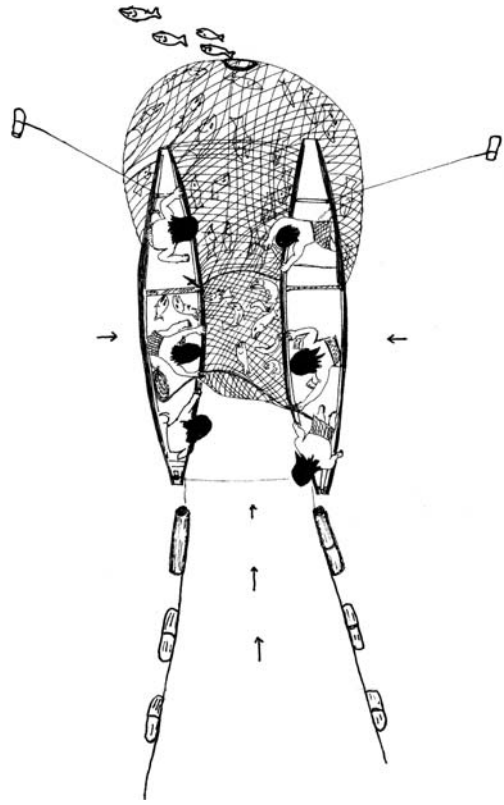

Fig. 2 Diagram of the Saanich Reefnet Fishery, showing the arrangement of the canoes and net (drawing courtesy of John Elliott, Saanich cultural specialist)

members of the same family—will invariably escape and be able to continue on to their home river to spawn. Earl Claxton Sr. (personal communication to NT 2004) explained that the salmon, like humans, travel in family groups, and it is very important, just as for human families, that some members of the family be allowed to carry on their lineage. Any of the salmon can be caught in the reefnet device, but sockeye and springs are the two most generally sought. The first salmon of the season to be caught is thanked and celebrated through a special ritual. The salmon caught after this are divided up in twos amongst the participating fishers; any odd fish left is replaced in the ocean.

Learning how to use the reefnet technology, and regulating its use effectively, required tremendous attention and practice for all those participating and special administrative skills on the part of the owner. Ironically, the Canadian government banned the use of reefnets in the mid 1900s, and only a few members of the Saanich Nation who had an opportunity to fish across the border in the San Juan Islands were able to retain the knowledge and practice of this sustainable fishing method (Claxton and Elliott, 1994; Earl Claxton Sr., personal communication to NT 2004).

The reefnet system, said to be taught to the Saanich people by the Salmon people themselves and by the Creator, XALS, at the same time when the Salmon first offered themselves to the Saanich (as in the story told earlier), represents technological and social knowledge and skills, conserving and respectful attitudes embodied in traditional Saanich philosophies, and mechanisms for perpetuating these practices, technologies, and beliefs from generation to generation (Table II).

Table II The Saanich Reefnet Fishery as a Complex Conservation and Resource Management Strategy [Based on Claxton and Elliott, 1994; and Interview with Earl Claxton Sr. (personal communication to NT and Nicholas Claxton, September, 2004)]

Practical techniques	Inferred knowledge and understanding
Creation of a false ocean bottom leading to reefnet, held in place by anchor stones	Understanding salmon schooling habits and habitat preferences; technologies for constructing, placing and anchoring lines
Cutting swathes through kelp beds to create channels for the fish	Identifying key salmon habitat and preferences
Paired canoes positioned for pulling in the reefnet; moved by tides and currents	Understanding of western red-cedar (*Thuja plicata* Donn ex D. Don), woodworking and canoe making technologies; tides, weather, currents, seasonal changes
Construction of the nets from the inner bark of Pacific willow (*Salix lasiandra* Benth.) and other willows	Understanding of willow seasonality, prime habitat, coppicing, regeneration, harvesting and net making techniques
Distinguishing different Pacific salmon species [e.g., coho *(Oncorhynchus kisutch),* Chinook (*O. tshawytscha,* also known as spring) and sockeye *(O. nerka*)]	Each kind of salmon has its own season, habits, fat content, etc.; important for timing of fishing and processing methods; provides diversity and flexibility in fishery
Use of ecological indicators, like time of blooming of oceanspray (*Holodiscus discolor* (Pursh) Maxim.), berries ripening and summer thunderstorms, to judge the timing of the fishing activity	Familiarity of salmon lifecycles in context of overall ecosystem cycles and weather patterns (cf. Lantz and Turner, 2003); understanding of the dynamics of salmon runs
Belief system	Result in terms of Conservation
Salmon and other resources, as well as techniques for harvesting and processing them, as gifts of the Creator, XALS	Constraints against waste; take only as many as needed, and as many as can be properly processed
Salmon viewed as members of families and lineages, akin to human families	Need to always allow escapement of a portion of the catch (a built in “escape” hole at the end of the net), to perpetuate individual Salmon families
Humans as responsible to the Salmon and other resources	Respect and careful use
Attachment to territory and place, as in traditional tenure systems	Attention to specific places and changes over many generations
Communication and Dissemination of Practice and Belief	Perpetuating Knowledge and Beliefs
Original absence of salmon	Primary resource depletion, followed by the “gift” of salmon
Ritual and spiritual recognition of the gift of salmon	First Salmon ceremony (cf. Swezey and Heizer 1977)
Recognition of different kinds of salmon	Use of names; taxonomies for distinguishing different species and stocks
All the reefnet locations have names	Allows proprietory recognition and monitoring of specific sites; enhances communication
Stories, narratives, language and names about the reefnet fishery and the salmon	Reinforcing and communicating knowledge and beliefs

Table II continued

Practical techniques	Inferred knowledge and understanding
Institutions: the tenure system	Rules that govern access and fisher behavior
Social organization of fishers, families and leaders	Confirming, teaching and enforcing the cultural constraints against waste and disrespect
Fishing areas (and other resource harvesting sites) owned by the Saanich people, and often particular families	Proprietary rights to located resources, enables coordination of fishing effort and conservation efforts as well
Systematic sharing of catch amongst participating fishers and their families	Salmon catch from reefnet haul divided by twos; any "odd" fish remaining are returned to the water, another form of conservation
Reciprocal fishing access rights are granted to neighboring groups (e.g., Halkomelem weir fishing on the Cowichan River)	Builds resilience in the face of uncertainty; opportunities to access a wider range of resources
Hereditary rights of individuals and families to reefnet locations as well as to other, associated property, names, ceremonial dances, fresh water sources, and house sites	Allows learning and sustainable use of resources across multiple generations; links property, place, actions and beliefs with social organization

Conclusions

The resource harvesting and management systems discussed here, embodying belief systems, narratives, ceremonies, specialized vocabulary, and other means of communicating and acquiring knowledge, institutional structures for regulating resource use, and multifaceted arrangements such as the Saanich reefnet fishery, are too complex and culturally ingrained to have been developed solely in response to experiences of catastrophic resource depletion. Major depletion events may have at some point triggered some of these mechanisms, but they cannot explain or account for the whole range of cultural constructions that lead to sustainable resource use and conservation.

The circumstances for the development of the Saanich reefnet fishery are lost in the mists of time, but the Saanich maintain that they have always been careful not to deplete their stocks, and declare that it is only in the last century, since their reefnets were banned in Canada, that the stocks of sockeye, coho, and other salmon have declined, in some cases to the point of extinction.

The power and potential of such holistic traditional systems that combine harvesting with resource management and conservation is undeniable. It seems that modern industrial society has not been able to match the success of traditional conservation practices, whatever their origins, even with the knowledge of ongoing resource depletion (Pauly *et al*., 1998). We need something more to help us conserve effectively. Adaptive comanagement, incorporating elements of the complex knowledge system from which the Saanich reefnet was generated, may enable all of us to live more sustainably. Our worldviews and attitudes are critical components of conservation, and may be more important than any other factor in conserving ecological integrity.

Ackowledgments We are indebted to the many knowledgeable elders and cultural specialists who contributed to the development of this paper, especially: Cyril Carpenter (Heiltsuk), Arvid Charlie (Hul'qumin'um Coast Salish), Earl Claxton, Sr. (Saanich, Coast Salish), Chief Johnny and Helen Clifton

(Gitga'at, Tsimshian), Chief Adam Dick (Kwakwaka'wakw), John Elliott Jr. (Saanich, Coast Salish), Chief Earl Maquinna George (Nuu-Chah-Nulth), Captain Gold (Haida), Dr. Daisy Sewid-Smith (Kwakwaka'wakw), Kim Recalma-Clutesi (Kwakwaka'wakw), Dr. Mary Thomas (Secwepemc), Pauline Waterfall (Heiltsuk), Chief Roger William (Tsilhqot'in). A special *Giaxsixa* to Pauline Waterfall for her careful reading of this article and her contributions and to Nicholas Claxton for his interest in the Saanich Reefnet fishery. We also thank our colleagues, Dr. Iain Davidson-Hunt, Dr. Eugene Hunn, Dr. Eugene Anderson, and Nigel Haggan for their insights. We also acknowledge with appreciation the contributions of the three anonymous reviewers of this paper. Research was funded in part by Coasts Under Stress major collaborative research initiative (Dr. Rosemary Ommer, P.I.) and through a grant from Social Sciences and Humanities Research Council of Canada (General research grant #410-2000-1166 to NT). Berkes' work was supported by the Social Sciences and Humanities Research Council (SSHRC) and the Canada Research Chairs program.

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