

# Chapter 5

## North America

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**Abstract** The colonial history of North America presents a contrast between Mexico and the two predominantly English-speaking countries, the United States and Canada. In Mexico, indigenous and other local communities own considerable forested lands, a consequence of the Mexican Revolution of the early twentieth century. In the United States, forest land is now primarily in private or federal hands, while in Canada forest land is primarily managed by the provinces. In all three countries, traditional knowledge had little effect upon forestry until the end of the twentieth century. In Mexico and the United States, the central government retained control over forested lands ostensibly held by communities. Policy changes in those two countries have

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decentralized control to indigenous peoples, and their ideas have started to affect forestry. In Canada, although traditional management of lands in remote regions persisted until the middle of the twentieth century, provincial policies have generally been displacing indigenous control; First Nations knowledge, which has survived well in some areas, is only recently being applied to forest management, and in only a few examples.

**Keywords** Canada • Cultural diversity • Forest history • Ejidos • Forest management • Forestry education • Indigenous peoples • Mexico • Traditional knowledge • United States

## 5.1 Introduction

The chapter begins with a brief survey of ecological and cultural diversity in North America and Mexico before proceeding to a summary of the history of aboriginal people since the arrival of European settlers. The rest of the chapter addresses the contribution of traditional forest-related knowledge to modern forest management, and to good practices in the utilization of traditional knowledge for management and research. A number of boxes provide specific examples from North America.

## 5.2 Context and History

### 5.2.1 *Regional Overview of Cultural and Ecological Diversity*

This section provides a general overview of the great cultural diversity of three countries of North America: the United States, Canada, and Mexico (Fig. 5.1). The view that the North American continent was pristine and untouched prior to settlement by Europeans has been discarded. Forest researchers and managers now recognize that widespread epidemics of communicable diseases greatly reduced the population of indigenous peoples, creating a ‘widowed land.’ European settlement was aided in many regions as a result of fields that had already been cleared and forests that had been managed to produce products useful to humans.

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**Fig. 5.1** Forest and woodland cover in North America (Source: Adapted from FAO (2001)). Key: *Dark green* closed forest, *light green* open or fragmented forest, *pale green* other wooded land, *yellow* other land

In the east of what became the United States, the indigenous peoples of the northern hardwood forest had a territorial system that included agriculture. The Haudonosaunee, Huron, and neighbouring tribes, for instance, were organized in villages and towns that moved from place to place within the forest, based on a system of shifting agriculture having long fallow periods for the forests to grow back (Fenton 1998; Trigger 1969). A town would clear the forest and establish agriculture based on the corn-bean-squash complex and managed by women, who held title to the farmed land. Fire was used to clear the forest for agriculture, and also used within the forest to favour particular plants and wildlife. Confinement of these peoples to reservations in the United States and Canada has removed that system of forest management.

In the Southeast, the Cherokee, prior to relocation by the U.S. government, also had agriculture and used fire to enhance the productivity of forested lands (Chapman et al. 1989; Delcourt and Delcourt 1997, 2004). In New England, the landscape changed after contact and the displacement of indigenous peoples as European settlers established farms using plants and animals new to America (Cronon 1983).

In Canada, the Algonquin peoples of the boreal forest followed a semi-nomadic lifestyle with distinctive family or clan territories. In these regions, land ownership was by territory, with overall authority for access and management of the territory held by an elder, steward, titleholder, or chief (Feit 1992). For purposes of this discussion, we will refer to them as stewards. The steward was expected to know his or her area well, and to pass along the knowledge to successors. The territories were not the personal property of the steward; the use of the land belonged to a group, always some kind of kinship-defined association. The stewards also had systems of relationships among each other, which served as higher level governing structures (Feit and Beaulieu 2001; Feit 2010; Scott 2001; Tanner 1988).

Similar but more elaborate territorial systems occurred among the peoples of the west coast from Alaska to northern California (Kroeber 1939). For instance, titleholders in and near the west coast held periodic feasts to recognize each other's authority and profiled efficient stewardship through sharing goods (Mills 1994, 2005). Knowledge of how to use plants was widespread (Deur and Turner 2005).

Complex resource management systems were reinforced by highly developed socio-political and religious organizational structures. Tribal clans or village families with chiefs or headmen often regulated access and use of terrestrial and aquatic flora, fauna, fungi, and geologic properties (see references in Suttles (1990b)). Tribal groups of different linguistic and ethnic origins intermarried and maintained socioeconomic trade relations. Along the Northwest coast, from Southeast Alaska to northern Oregon, many tribal village systems existed. In the southern coastal range from central Oregon to northwestern California, a more decentralized, village-family headman structure regulated commerce and management of natural resources (Trosper 2009).

Common among all nations, tribes, and bands were individuals' inherited rights and responsibilities to own, access, manage, and use resources or perform ceremonial practices that were reinforced by transmission of intellectual and spiritual properties. Diverse and productive coastal marine and riverine resources of mammals, birds, fish, and shellfish enabled larger and more stable tribal populations. Coastal to interior forests and grasslands were influenced by cultural burning practices (Boyd 1999). Vegetable, berry, nuts/seeds, and plants used for basketry were enhanced and benefited from periodic burns (Anderson 2005; Boyd 1999; Lewis 1993). Indigenous terrestrial, aquatic, and marine management systems accentuated existing geologic and ecological diversity and adapted to influences of ecological processes such as volcanism, earthquakes, floods, fires, and landslides (Suttles 1990a). The temperate rainforests of the coastal regions contain significantly high biodiversity with climax forests of western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*) from the sea water edges to the steep mountain subalpine mix of spruces and firs. Crossing the mountainous terrain into the interior basin plateaus, the forest transitions from Douglas-fir (*Pseudotsuga menziesii*) into ponderosa pine slopes edged with oak (*Quercus garryana*) at lower latitudes.

Interior forests and grasslands—primarily composed of Douglas-fir, pines, and oaks—were systematically burned by tribal groups to improve access to and quality of food plants; to enhance range forage quality; to aid hunting; to promote growth

structure of plants used for basketry, implements, or cordage; to reduce pests; to lessen fuel loads and threats of catastrophic fires; to increase water yield at springs; and to facilitate travel (Anderson 2005; Boyd 1999). Along the Cascades and Rocky Mountain regions, fire was used primarily to maintain camas meadows, to open understory pine/fir forests for hunting, to maintain huckleberry and other berry fields, and to improve quality of forage or medicinal plants (Boyd 1999; Turner and Peacock 2005). Tribal groups in California's interior valleys, foothills, and mountains used fire primarily to enhance acorn productions, root-bulb crops, basketry plants; to reduce seed and parasite pests; and to maintain ecological diversity of various habitats for access and use of plants, animals, and minerals (Anderson 2005; Lewis 1993).

In the southwestern region of the United States and northern Mexico, mountains and mesas converge with alluvial desert flood plains where cycles of drought, fire, and water inundation transform the landscape and plant communities. Southwest forests contain the largest contiguous ponderosa pine forest in the world. The intense elevation gradients from desert to alpine tundra enable exceptional diversity and support the greatest numbers of endemic species in North America. For thousands of years, indigenous cultural groups tended careful use of forest resources and practised agriculture in seasonal rounds between valley deserts and mountain forests with reciprocal exchange of disturbance and restoration at sites based on fire ecology and water characteristics. The White Mountain Apache tribal stories describe stewardship practices and often do not differentiate between crops and cultivated wild plants (Long et al. 2003; Wilkinson 2005).

In Mexico, indigenous communities have been using and managing forest resources since pre-Columbian times (Barrera et al. 1977; Gómez-Pompa 1987; Peters 2000). For several thousand years, both temperate and tropical forests throughout the country have been periodically cleared and burned as part of the 'milpa' cycle, a traditional system of growing corn, beans, and squash that is a fundamental part of Mexican culture (Coe 1984; Harrison and Turner 1978). A milpa produces food, but perhaps more importantly, it also represents an essential link between the community, the land, the plants, and the universe (Hernandez Xolocotizi 1985). Cutting and burning the forest to plant corn has, as a result, traditionally been somewhat of a divine obligation for Mexican farmers. In most regions, the milpa is not abandoned after 2 or 3 years, but is enriched with an assortment of fruit trees, construction materials, and economic plants in sophisticated managed-fallow, agroforestry systems (Alcorn 1984, 1990). This practice is especially well-developed among Mayan communities who plant, spare, graft, or coppice dozens of useful tree species in their managed fallows (Gómez-Pompa and Kaus 1987; Harrison and Turner 1978). Totonac communities in northern Veracruz add allspice trees and vanilla after the last maize crop (Medellín Morales 1986); farmers in more arid regions frequently plant agave for making mescal, *Opuntia* cactus for their fruits, and assorted leguminous trees for improving soil quality (Messer 1975).

Managed fallows are either cycled back into milpas after a decade or two, or maintained and gradually converted into managed forests. The latter form of land-use is one of the most invisible, poorly understood, and potentially valuable forms

of resource management in Mexico. Managed forests, which look identical to “undisturbed” forests, contain several hundred species of useful trees, shrubs, and herbs, many of which are shade tolerant, native plants adapted for growth and regeneration under a closed canopy (Alcorn 1983; Gómez-Pompa et al. 1987). When abandoned, these forests maintain themselves, with much of the original species composition introduced by the traditional farmers who created them. Nowhere is the imprint of indigenous forest management more visible than in the structure and composition of the forests of Mexico (Lundell 1937).

Indigenous communities in Mexico also manage their forest commercially for the production of timber (Bray et al. 2003). Most of the communities managing tropical forests (*selva mediana subperrenifolia*, or medium sub-deciduous forest) for wood products are located in the states of Campeche and Quintana Roo (Bray et al. 2005); an even greater number of community forestry operations are located in the temperate pine and oak forests of the states of Chihuahua, Durango, Michoacán, Guerrero, Puebla, and Oaxaca. A few of the indigenous management programmes in Quintana Roo have been certified by the Forest Stewardship Council (FSC) for more than a decade and are some of the oldest certified tropical forests in the world. Taking temperate and tropical forests together, Mexico has more certified community forest operations than any other country in the world (Gerez-Fernández and Alatorre-Guzmán 2005).

### ***5.2.2 History of the Interaction of Traditional Societies and Modern Forest Management***

Although both Canada and the United States primarily use English legal systems, each country has a different history of the relationship between colonizers and indigenous peoples. Also, the timing of colonization and the development of modern forestry are also different. When settlers harvested trees on the eastern side of the continent, modern forestry had not yet been created. By the late nineteenth century, as modern forestry was established, indigenous people were in a period of political weakness and dispossession. Subsequently, as indigenous political strength has improved, so has their influence on contemporary forest management decisions. But even when indigenous power was low, the peoples had some effect on forest management (by encouraging uneven-aged management) or participated in forestry operations as workers.

In Mexico, colonization occurred much earlier. By the time industrial forestry began to be practised, in the aftermath of the Mexican Revolution, indigenous peoples had acquired title to much forested land. In spite of this, the federal government maintained the right to grant forest concessions on both *ejido* and indigenous community lands until the 1980s, when forestry laws were changed.

A common view, shared by many indigenous peoples, was the existence of reciprocal relationships among humans, plants, and animals. The land required respect, and humans had a responsibility to take care of the land so it could continue to provide

resources for their use. Other species were seen as having powers of their own that humans needed to recognize and consider in managing the relationships among different entities occupying the land. These peoples illustrated Bruno Latour's observation that indigenous people did not live 'in harmony with nature' because the separate idea of 'nature' did not exist (Latour 2004). The world was composed of humans and others interacting in ways that required humans to behave properly (McGregor 2004). Enrique Salmon describes the view as kincentric ecology, a viewpoint consistent with Gregory Cajete's description of native science (Cajete 1999; Salmón 2000).

European colonists introduced and later imposed a fundamentally different view of the forest. Since it was thought that forests were frightening places, 'much of the forest was an enemy to be eradicated as quickly as possible' (Lambert and Pross 1967). Later, forests began to take on a different, more utilitarian value and were exploited on an increasing scale. In the early years of colonization, this exploitation involved little in the way of management. Acquisition of land was an important policy objective of the colonial governments. Aboriginal people, like forests, were regarded as impediments to the path of colonial progress and subsequently were systematically removed through treaties, legislation, and policies (e.g., British North America Act, Indian Act) of the Dominion and later Canadian governments. (Alfred 1999; McGregor 2011). In the early colonial period, indigenous peoples had sufficient military and political power to insist on treaties that recognized their status as self-governing entities. These peace treaties were later replaced by treaties of cession. In this period, treaties seemed necessary as a way to remove people from the path of 'progress,' including settlements and other developments (Lambert and Pross 1967; RCAP 1996b).

In time, forests became valued for their timber, and management of the forests began to be seen as important. The dominant form of human interaction with the forest thus rapidly shifted from systems of aboriginal stewardship to 'management' as practised by Europeans and their entrepreneurial descendants. The territories upon which aboriginal people depended for their survival were wrested from their control without their consent, and in many cases, without their knowledge until facts on the ground revealed what had occurred.

### 5.2.2.1 United States

Control over indigenous forested lands by indigenous people occurred rarely in the United States in the early years of modern forestry. After the period of treaty-making ended in 1871, the United States moved to establish control on reservations. With pressure from states and economic interests, the federal government passed the General Allotment Act in 1887 (Dawes Act). The Act gave the Indian Office the authority to parcel out tribal land to individual Indians (usually 160 acres to the head of the family, with less to wives and children). Because the allotment policy emphasized agricultural lands, forested lands were not allotted to a great degree; the Quinault Reservation in western Washington state is a famous exception because its extensive rain forest was

divided into individual parcels, which made forest management difficult. Allotment similarly affected the Hoopa-Yurok Reservation in California.

The Allotment Act is one of the most devastating policies in the history of American Indians. The act resulted in the loss of millions of acres because of fraudulent or coercive land transactions or the failure to pay taxes after the land passed out of trust. On many reservations, unallotted lands were open to homesteading by non-Indians. Between 1887 and 1934, Indian land holdings fell from 138 million acres to 48 million acres (Deloria and Lytle 1983). This was a loss of land whose magnitude was the size of the state of Montana, one of the largest states in the United States. The allotment and homesteading also created the checkerboard pattern of land ownership on reservations outside of Arizona and New Mexico; this checkerboard of land holdings and the existence of multiple heirs to allotments complicate federal and tribal jurisdiction, and create obstacles to land management (McDonnell 1991).

The Allotment Act was one of several federal policies that were intended to break up tribes and assimilate tribal members into non-Indian society. Boarding schools were established, traditional culture was suppressed, and local Indian agents essentially governed tribes on reservations. The original 'trust responsibility' of the federal government was implemented by the Allotment Act, which determined that individual allotments would be held in trust by the federal government until an individual was declared competent. Similarly, the federal government held tribal land in trust and asserted its management authority over that land.

Early in the twentieth century, the Forestry Branch of the Office of Indian Affairs asserted control over forest policy on reservations, assisted for a brief period by the U.S. Forest Service, which was established during the period of the allotment policy. On most reservations, loss of self-government and subsequent control by the BIA prevented indigenous people from having much influence on forestry management (McQuillan 2001; Sassaman and Miller 1986). In spite of their low power, however, the practices of American Indians may have influenced the BIA, particularly regarding the use of fire and uneven-aged management.

The story of the Yurok in California presents a well-documented example of the removal of indigenous people from their lands (Huntsinger and McCaffrey 1995), with consequences both for the land and for the people. The land changed because the shift in power was from people who valued oak savannas for food for themselves and browse for animals they hunted, to people who valued Douglas-fir for making lumber. The indigenous people burned to exclude Douglas-fir; the colonists excluded fire to encourage Douglas-fir and enclose the openings with timber. Tribal people became impoverished as their ability to obtain livelihood from the land was removed, at the same time as they were also increasingly excluded from their fisheries. Eventually the Yurok obtained rights to land adjoining the Hoopa Valley Indian Reservation. That reservation represents a different type of history, in which some Indians were confined to a reservation, which assured them some land but remained under the control of the BIA (Harris et al. 1995).

In contrast to the Yurok and most other tribes under BIA control, the Menominee of Wisconsin were able to avoid allotment and exert some influence on forest



management. But they had to confront both the U.S. Forest Service and the Forestry Branch of the BIA to change forestry practices and policy. The Menominee had pressed for a law in 1908 to govern the management of their forests based on their principles of sustained yield, and had to pursue legal court action to enforce the 1908 law. Their opponents in court were lawyers defending the decisions of foresters trained in contemporaneous forest management (Davis 2000; Trosper 2007). The Menominee were awarded judgment with compensation because of federal government harvest rates that had exceeded the 1908 authorization.

The allotment policy ended with the passage of the Indian Reorganization Act (IRA) in 1934. Although the IRA allowed tribes to establish their own governments, forests remained under the control of the Bureau of Indian Affairs, which succeeded the older Office of Indian Affairs. A change in power in the U.S. Congress in 1952 led to the policy of termination, which was a policy to remove the trust relationship between the federal government and Indian tribes, and place the tribes under the control of states. Forty California Tribes and about 15 other tribes were singled out for termination. The Menominee were on the list; their victory in court over the 1908 Act created a vulnerability under termination, because they were told that in order to obtain the funds they had to agree to termination.

Many tribes fought the termination policy, which came to an end when self-determination became federal policy under the Nixon Administration in 1975. The Menominee Reservation that had been terminated was returned to federal status (Davis 2000; Huff and Pecore 1995; Pecore 1992), as were many other tribes that had been terminated. One exception was the Klamath of Oregon, whose land remained in the Winema-Fremont National Forest; the Klamath did retain some aboriginal rights, such as hunting rights in that forest. The Taos Pueblo in New Mexico, which had been fighting to protect the land and water of the watershed above their village, successfully had those lands returned to their control (Gordon-McCutchan 1991).

After the start of the self-determination movement, a group of Northwest Indian tribes organized the Intertribal Timber Council (ITC) in 1976. In an effort to change the thinking of the BIA, as well as to share ideas among the tribes, the ITC began a series of annual symposia, and published the proceedings of each of them. These proceedings are excellent source material for tracing the gradual change in BIA policy as well as gradual change of the direction of the management of forests on Indian reservations (<http://www.itcnet.org/>).

Several acts at the end of the twentieth century changed the relationship between the federal government and tribes regarding forest management. Most significant of these were the Indian Self-Determination Act of 1975 and the National Indian Forest Resources Management Act, which restructured the relationship with the BIA; and the Tribal Forest Protection Act of 2004. Following that act, the U.S. Forest Service and the Bureau of Land Management established rules that allow tribes to create cooperative relationships with the Forest Service on lands of significance to the tribes. Federally recognized Indian tribes in the United States now manage more than 18 million acres of forested landscape, with the Bureau of Indian Affairs involved to varying degrees (the Second Indian Forest Management Assessment

Team [Second IFMAT] 2003). Some tribes contract all management functions under the authority of the Self-Determination Act, reducing the BIA's role to oversight. For tribes that aren't contracting or compacting, the BIA plays a greater role in forest management.

### 5.2.2.2 Canada

Canada had three different general patterns of dispossession, and the consequences for forest management also varied. The timing of colonial control also had a different relationship to the timing of modern forest management and settlement. For instance, as the forests of the Great Lakes states were being cleared in the nineteenth century to support the growth of cities in the United States, the forests of British Columbia remained untouched. Harvest of those forests occurred a century later. Parts of the boreal forest in Canada remain unharvested even at the start of the twenty-first century (Hayter 2003; Korber 1997; Lendsay and Wuttunee 1999; McGregor 2000, 2002; Scott 2001; Smith 1998, 2001; Stevenson and Webb 2003).

The three general patterns of dispossession can be classified by type of treaty (Mann 2003; Richardson 1993; RCAP 1996c). Early treaties in the east were treaties of peace, not dispossession of land. The treaties in the middle of the country (which were numbered from 1 to 11) were viewed as treaties of cession by the Canadian state, leaving indigenous people with small reserves; however, indigenous people thought the treaties were arrangements to share the land. The extent of control over ceded lands became subject to treaty interpretation (Dickason 1997). The interpretation of treaty rights between the contradictory ideas of sharing compared to cession presents a major ongoing concern in Canada, particularly in relation to issues around access to resource rights (Macklem 1997; Smith 1998; Venne 1997). As a government commission found, 'the representatives of the Crown had come to see treaties merely as a tool for clearing Aboriginal people off desirable land' (RCAP 1996d).

Despite legally binding treaties, aboriginal people have for centuries been relegated to the fringes of Canadian society. More often than not, they have been seen as 'irrelevant to present-day concerns' (Berger 1991). There is a long history in Canada of oppression and colonization directed specifically at aboriginal people (Berger 1991; Boldt 1993; Borrows 2010; Little Bear et al. 1984; Miller 1989). Colonization was institutionalized and legislated in the Indian Act of 1876, which continues in many ways to regulate the lives of registered 'Indians' in Canada. Ongoing colonial policies and legislation have undermined aboriginal peoples access to their territories (McDonald 2003; Notzke 1994; RCAP 1996d).

In Quebec, British Columbia, Newfoundland and Labrador, Yukon, and the Northern Territories, no treaties were signed in the early years of settlement. Disputes over land ownership in those regions became very heated in the late twentieth century, and 'modern treaties' or rather comprehensive agreements are currently being contemplated through negotiation processes. Rather than one or two pages, such agreements are long and detailed, as illustrated by the James Bay and Northern

Quebec Convention signed in 1975 and the Nisga'a Final Agreement, ratified in 2001 (Hayward 2001). See <http://www.gov.bc.ca/arr/firstnation/nisgaa/default.html>.

In the early years of colonization, there was minimal regulation of forest use, mostly because resources were assumed to be bountiful and conservation was not an issue for some time (Lambert and Pross 1967). Later, the need for conservation was recognized and forest policy and management frameworks were developed. Beyers and Sandberg (1998) and Levy (1994) provide a more thorough historical account of forest policy in Canada and Ontario. On-reserve forests are an important source of livelihood for First Nations. Unfortunately, the forests tend to be in poor condition because of a long history of Crown mismanagement. The 1867 British North America Act (BNA Act) divided powers among the federal and most provincial governments. In relation to aboriginal people and their territories, the BNA Act gave jurisdiction of Indians and lands reserved for Indians to the federal parliament (Erasmus 1989). The responsibility for the management of natural resources fell to the provinces; thus the traditional territory that aboriginal groups enjoyed since time immemorial came under provincial jurisdiction (Bombay et al. 1996). This arrangement of confederation without the consent of aboriginal people has been a source of problems ever since. Aboriginal groups have effectively been stripped of their authority and jurisdiction over the land upon which they relied (National Aboriginal Forestry Association 1993).

The Indian Act was enacted after the BNA Act to provide for federal control of aboriginal groups. An important consideration in the Indian Act is that the Crown retains authority and vested interest in assets, which are held and managed in trust for the Indians, thus complicating the use of land for collateral in business enterprises. Although the act is inadequate in scope in terms of forest management, it remains in force (Auditor General of Canada 1994).

Recognition and protection of aboriginal rights in the 1982 Constitution Act has provided some leverage for indigenous peoples, now recognized to include Indians (or First Nations), Inuit, and Métis peoples. Major court decisions have clarified aboriginal rights and government obligations, leading to some changes in resource management regimes. Colonial legislation and policies, however, continue to permeate conflicts and resource management with changes occurring in isolation as provincial governments attempt to narrowly interpret court decisions. In some localized areas of Canada, resource management is coordinated through negotiation, including forest management (McGregor 2000, 2002; Ross and Smith 2002; Scott 2001; Smith 2001, 2007). The localized nature of these co-management arrangements have not precipitated broad national or provincial legislation or policy changes to date.

Although there are exceptions, the legislative and policy frameworks that govern Canada's forest industry continue to alienate and exclude aboriginal people from forest management. This involves restricting access to forest resources (e.g., harvesting timber and non-timber resources) and denying access to decision-making such that aboriginal cultural and traditional uses and values continue to be unaccounted for (McGregor 2011; National Aboriginal Forestry Association 1993). There has been in the past considerable conflict over forest resources between aboriginal and non-aboriginal society (Notzke 1994). Aboriginal assertions of rights

and court decisions in their favour have recently led to a somewhat more favourable climate for aboriginal involvement in decisions affecting their lands. Despite these small inroads into the current system, the state of aboriginal forestry in Canada is unfortunately still characterized by exclusion.

Perhaps Canada will move into a period that is similar to the shift in control that has occurred as a result of self-determination in the United States. While the recognition of aboriginal rights in the 1982 Constitution Act is providing some impetus in that direction, reluctance by provinces to comply with federal court rulings makes the outcome uncertain.

### 5.2.2.3 Mexico

The lands occupied by the indigenous communities in Mexico were abruptly transformed during the colonial period by the introduction of livestock and new cultivars such as wheat, barley, and sugar cane. The coastal zones and plains were the first areas to be opened for intensive agriculture, and, in response, local indigenous communities took refuge in the mountains.

During the second half of the nineteenth century, the *Leyes de Reforma de la Constitución Federal* profoundly changed access to the land and natural resources of Mexico by promoting the privatization of national territories to increase local and foreign investment, by granting concessions for the commercial exploitation of forests, mines, and petroleum to American and British companies, and by funding the construction of railroads and an extensive network of roads. The net effect of these policies on indigenous communities in forested regions was the loss of their rights to harvest and sell forest resources and the geographic isolation caused by the placement of roads. Numerous indigenous communities saw the land titles granted by the vice-royalty during the Spanish Colonial period become invalid. During the dictatorship of Porfirio Díaz (1880–1909), it is estimated that the indigenous groups in Mexico lost control over 90% of their lands (Klooster 1996).

The Constitution of 1847 recognized the absolute right of private property over land and natural resources. No resource-use regulations of any kind were established, such that the extraction of forest products was done in the same way as mining—i.e., to obtain the largest benefit possible in the shortest amount of time, with no attention paid to regeneration or forest recuperation. Timber extraction during this period could best be described as ‘forest mining.’ New regulations that recognized the sovereignty of the Mexican Nation over all the land and water within its territory were not put into place until the Constitution of 1917 at the end of the Mexican Revolution.

The re-allocation of territory following the Mexican Revolution provided a more equitable distribution of agricultural lands and promoted productive farming and livestock management. However, this re-allocation effort did not grant absolute property rights to the *ejidos* (farming cooperatives), as the Mexican government maintained the right to grant concessions on communal lands. As a result, the *ejidos* were essentially tenants on the land that could make use of local resources; i.e., they were given usufruct rights but could not sell the land.

These regulations permitted the state to grant concessions on ejido and community lands for the use and exploitation of certain resources, such as minerals, oil, and wood products. In the case of indigenous communities that had been given deeds by the vice-royalty and could prove it, the re-allocation of lands restored their ownership to these territories.

The Forestry Law of 1926 established the inalienable character of community forests and stipulated that harvesting in communal forests could be conducted only by ejido cooperatives, and, as a result, numerous cooperatives were formed in forested areas. Unfortunately, this law was not accompanied with a policy to train and support the communities for managing their forests. The new owners of these forests were left without funds, markets, or the technical expertise for managing forest resources (Merino-Perez and Segura-Warnholtz 2005).

During the 1930s, the government of Lázaro Cárdenas realized an even greater re-distribution of lands, and at the conclusion of his presidency over 6.8 million ha of forest had been handed over to ejidos. This area represents about 18% of all the forests in Mexico (Merino-Pérez 2004).

Between 1934 and 1940, Lázaro Cárdenas promoted the organization of forestry cooperatives to facilitate the exploitation of these new community forests. The lack of investment policies, adequate training, and oversight, however, resulted in a pattern of uncontrolled, indiscriminate logging with little concern about long-term sustainability. This situation, together with the existing policies to promote the spread of agriculture and cattle, had a devastating effect on the most valuable forest in the country. The Mexican government responded by establishing national parks in forested areas above 3,000 m above sea level to protect the forests growing on the slopes of major mountains and to prohibit the extraction of wood products in these regions; people continued to live in the designated areas. The majority of the national parks in Mexico were established during this period.

From 1940 to 1970, the extraction of forest products was completely banned in selected areas of different states to try and stop the illegal logging and deforestation that was rampant. Logging, for example, was banned in parts of Veracruz, Chiapas, Puebla, Hidalgo, Distrito Federal, Morelaos, Durango, and Jalisco. At the same time, government policies regarding community and ejido forests were concentrated on establishing concessions with private companies, initially for exploiting timber and later with government-run companies to strengthen the link with the overall industrial development of the country and the export market for forest products. These types of concessions were operated in the forests of Quintana Roo, Oaxaca, Michoacán, Guerrero, Jalisco, Durango, and Chihuahua, the principal producers of forest products in the country.

Although the re-allocation of agrarian lands had recognized and re-instated the rights of indigenous communities over their territories with respect to forests, the federal government continued to grant logging concessions to private companies without consulting local communities or involving them in harvest activities. These concessions covered large extensions of forest, frequently including the territory of several indigenous communities, and were operable for 25 years. It is important to note that the concession holders invested large amount of money in these areas,

building an extensive network of roads to the most productive parts of the forest. It was frequently the case that these roads did not service the local villages, which continued to be isolated from existing markets.

With the enactment of the Forestry Law in 1943, selected forest areas were designated as national supply zones in an attempt to integrate certain forested regions with local private industries known as Forest Exploitation Industries (Unidades Industriales de Explotación Forestal). The ejido and indigenous communities included in these areas were allowed to harvest timber, but they could only sell it to the local industries. At the same time, the technicians required for forest operations were usually supplied by the state or the local industry. Although the initial idea was that these industries would serve as a source of employment for indigenous groups, in practice each industry usually had its own group of trained technicians (Bray and Merino-Perez 2004).

Overall, the economic benefit of these activities to indigenous communities was nominal. The company paid a fixed stumpage price for the wood that was established by the government, and these fees were received directly by the Secretary of Agriculture who used part of these funds to cover the costs of public services for the inhabitants of the region.

In the 1950s, the Instituto Nacional Indigenista established a centre in the Tarahumara zone of Chihuahua to promote the training and education of the local forest stewards and to act as an intermediary among the indigenous communities, the ejidos, and timber buyers. At the end of this decade, the Fondo Nacional para la Promoción Ejidal (FONAFE) was created to use a portion of the forest taxes revenue to develop the productive capacity of local communities.

During this period there were attempts by several indigenous groups to regain control over the use of their forests, but none were successful. Several communities managed to have roads built to their communities and to negotiate permission for community members to work in timber harvesting; the latter allowed them to get trained in various timber-related activities. These advances were not trivial, and implied long struggles, imprisonment, and the occasional assassination of local leaders. After continued and increasingly vociferous pressure from indigenous groups, the first community forestry enterprise was established in Durango in 1965.

The period from 1971 to 1986 was characterized by the spread of forestry concessions to logging companies and state forestry enterprises. There was also, however, much interest during these years on the part of professional forestry groups to promote the development of indigenous communities and forestry ejidos by enhancing their technical and productive capabilities. It was hoped that this would help increase the overall productivity of the forestry sector in Mexico. With this in mind, formal partnerships were brokered between the forest industry and several indigenous communities, but the majority of these associations were inequitable and inefficient and produced local conflicts. In spite of this, a number of community forest enterprises were created during this period, initially with financial support from FONAFE. By 1975, 21% of the total volume of wood produced in the country came from these community-based enterprises. Community forestry enterprises were formed in 15 states, including those with the greatest amount of forest cover.

Although the first community forestry enterprises were dedicated exclusively to harvesting and extraction, as revenues increased and the level of technical expertise improved, several communities started sawmills to capture a higher percentage of the actual value of the resource. These changes were reflected in the Forestry Law of 1986, which stopped granting concessions to private enterprises and initiated a process to dismantle government-run forest industries. The law also established the right of ejidos and forestry communities to contract technical forestry services to assist them in the development of management plans. This opened a whole new phase in the management of forests in Mexico. The Mexican government relinquished control over the technical aspects of forestry, and permitted the owners of the forests, in partnerships or by themselves, to actually manage forest resources and take an active role in the production and commercialization of these products. Numerous indigenous communities in the mountains, however, had to go on strike, block roads, and disrupt work to exercise this right because most of the local forest industries were in collusion with government officials and forest technician groups. In contrast, the Forestry Law of 1986 was rigid with respect to the type of forest management that had to be implemented, and stipulated the exact silvicultural system that had to be used.

Community forestry enterprises that were able to gain access to markets and form local groups of technicians started to consolidate during the end of the 1980s. Other groups were unable to achieve this level of success and remained suppliers of raw material; i.e. they sold stumpage or sawlogs to various buyers. The administration of President Carlos Salinas de Gortari (1988–1994) was noteworthy for introducing programmes of decentralization and deregulation in the Mexican countryside. A new Forestry Law (1992) was drafted that greatly simplified all aspects of forest exploitation from extraction to milling. The law also eliminated technical forestry services from the government, opening the door for the creation of new private companies of professional foresters to provide these services.

In the background to all of these changes was the total economic transformation of the Mexican forestry sector caused by the General Agreement on Tariffs and Trade in 1986. Once the commercial borders of Mexico were opened to forest products from the United States, Canada, and Chile, the prices for locally produced timber plummeted. Yet, in spite of this, none of the community forestry enterprises in Mexico went bankrupt or stopped operating (Bray and Merino-Perez 2004).

Since the creation of the Comision Nacional Forestal (CONAFOR) in 2003, a significant percentage of the total investment in the forestry sector in Mexico has been designated for plantation establishment. The economic impact of these investments has yet to be realized as none of these plantations are of harvestable size.

### **5.3 Contribution of Traditional Knowledge to Modern Forest Management**

Given the great power inequality during colonial dispossession of indigenous peoples, those people were not able to contribute their ideas to the development of forestry management. The idea that fire could be used to manage forests was

derided as 'Piute [Paiute] Forestry' by the Assistant Chief of the U.S. Forest Service as his agency sought to exclude all fire from forests in the United States (Greeley 1920). Both fire and indigenous ideas were suppressed and excluded. The anthropologist Omar Stewart was unable to publish his manuscript documenting the use of fire by native peoples, for obscure reasons possibly related to the fact that fire suppression was at its height in the 1950s when he tried to publish the book (Lewis 2002; Stewart 2002).

Serious consideration of indigenous knowledge in forest management did not occur until indigenous peoples were able to assert their authority over forest lands, and this situation is a pattern of the late twentieth century, as described in the previous section that summarized colonization. Inequity still exists regarding Indian sacred sites. The indigenous view that sacred sites must be protected in order to protect the integrity of the natural and spiritual world is disregarded by the land management agencies. Western managers also still do not make the connection between indigenous control and uses of traditional resources on their traditional landscapes, and the health and well-being of those communities. Some see a direct connection between alienation from spiritual landscapes and the high levels of violence, intoxicants, and suicide that so mar Native communities in North America (Parkins et al. 2006).

Once indigenous people are able to manage their own lands, as on reservations in the United States, they still may not be contributing ideas to modern forest management in general. A measure of such contribution could be the citation of indigenous ideas in current textbooks; such citations are hard to find. For instance, the third edition of Kimmins' *Forest Ecology: A Foundation for Sustainable Forest Management and Environmental Ethics in Forestry* (Kimmins 2004) confines indigenous contributions to slash-and-burn agriculture, a reference to Omar Stewart, and recognition of 'local people with experienced-based wisdom' (p. 610). The author regards 'experience-based' knowledge as less valuable than scientific knowledge, in spite of referring to it as 'wisdom.' The fourth edition of *Forest Management* (Davis et al. 2000) also does not include references to indigenous contributions, according to its index. In Quebec, the 2008 edition of the legally mandated forest management manual *Manual d'aménagement forestier du Québec* now includes a short mention of the necessity to address indigenous values and knowledge in forest management, in regard to FSC certification requirements. In Smith (1997), *The Practice of Silviculture: Applied Forest Ecology*, 9th edition, there is no mention of indigenous forest management practices or of fire-use by tribal groups. 'In most parts of the world the most common natural disturbance is fire...which was kindled by lightning and volcanic eruptions long before people put it to use and abuse' (p. 162, Kinds of Natural Regenerative Disturbance). The text describes reforestation following agricultural land use, yet does not recognize those centuries-old abandoned fields were the result of native-white conflicts in eastern North America. In Kohm and Franklin (1997), *Creating a Forestry for the 21st Century: The Science of Ecology Management*, very few contributors reference Native American management or utilization of forest resources other than use of special forest products (Molina et al. 1997). In *Forest Ecosystems* (Perry et al. 2008), the historical and



modern role of indigenous knowledge and forest stewardship is recognized and may be an improvement in text content.

Recognition in textbooks follows recognition in the professional literature, and in the professional literature, the contributions are expanding. The Second Indian Forest Management Assessment Team (Second IFMAT), for instance, recognized that ‘...the condition of Indian forests can also yield valuable lessons for society in general; indeed, Indian forests have the potential to be models of integrated resource management and forest sustainability from which we can all learn.’ There is also growing recognition that Indians used fire for beneficial purposes, and that the resulting knowledge might be helpful. Even with improved self-determination of tribes in the United States, the record is mixed on reservations according to the Second Indian Forest Management Assessment Team (Second IFMAT 2003). The winter 2005–2006 edition of the journal *Evergreen* provides summaries of efforts on some reservations.

In Canada, widespread recognition of the potential contribution of indigenous peoples and their knowledge to sustainability first began to manifest itself in various international commissions, conferences, protocols, and conventions. For example, the 1992 Convention on Biological Diversity makes explicit recognition of indigenous peoples and their knowledge (Higgins 1998; NAHO 2007a; Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a). As signatory to the Convention on Biological Diversity (CBD), Canada has shown substantially increased interest in traditional forest-related knowledge in recent years (Battiste and Henderson 2000; Ellis 2005; MacPherson 2009; Manseau et al. 2005; McGregor 2004). Traditional forest-related knowledge in environmental and resource management is thus now emerging as a field of study, complete with theory, research approaches, models, and applications (Berkes 1999, 2008; Grenier 1998; Houde 2007; Inglis 1993; Johnson 1992; McGregor 2002).

In Canada, the use of traditional knowledge in sustainable forest management has been influenced by the Convention on Biological Diversity (CBD), a legally binding international agreement, and has found expression in national forest policy in Canada since 1992. The Canadian Council of Forest Ministers’ National Forest Strategy in 1992 makes clear the importance of incorporating native values in sustainable forest management and planning in Canada. Aboriginal contributors to the 1992 Strategy stressed the importance of the forest to aboriginal peoples and the need to have native and non-native parties work together to protect cultural and spiritual forest values (CCFM 1992, p. iii). In 1998, the National Forest Strategy was renewed. The updated version more specifically identified the goal of increasing engagement between aboriginal peoples and the rest of the forest community in the area of ‘traditional forest values and modern Aboriginal aspirations and needs’ (CCFM 1998, p. 35).

In 1998, the National Forest Strategy was renewed for another 5 years. The National Forest Strategy Coalition specifically mentions the role of the CBD. A key action item is to ‘incorporate traditional knowledge in managing forest lands and resources in accordance with the Convention on Biological Diversity’ (NFSC 2003, p. 15). Traditional forest-related knowledge gained further recognition in the

following Strategy in 2003, before being ignored in the most recent version, released in 2008. Canada has reported on progress of traditional forest-related knowledge in forest management in international forums (Bombay 1996; Brubaker 1998). In 1999, the Canadian Forest Service conducted a review of the case studies funded by the First Nation forestry programme for case studies on the implementation of Article 8(j) and related provisions under the Convention on Biological Diversity (Canadian Forest Service 1999).

In spite of this limited recognition, traditional knowledge and the views of Indian people are contributing in four areas in particular: the use of fire as a management tool, uneven-aged silviculture, long-term monitoring, and developing integrated resource management.

### ***5.3.1 Fire As a Management Tool***

The idea that indigenous people in North America used fire as a management tool has gradually become more and more accepted. Recognition of the importance of human manipulation of the pre-Columbian landscape has allowed forest historians to reinterpret data, and scientists to improve their understanding of forest ecosystems. Those interested in ecosystem management and restoration have particularly used the growing literature on the indigenous use of fire. Prominent goals of indigenous management, respecting the diversity and productivity of the landscape and maintaining balance, is similar to the goals of non-indigenous management to restore ecosystem functioning.

Kimmerer and Lake (2001) provide a useful summary of the contributions that indigenous fire management can make in changing the management of forests. They focus on five aspects of fire management: seasonality, frequency, extent, site, and outcome. Indigenous burning tended to occur in cool seasons rather than the heat of summer, allowing the beneficial effects of fire to outweigh the catastrophic consequences. Fire frequency also could be shifted in comparison to a regime based on ignition by lightning; generally, and increase in frequency accompanied by a decrease in fire extent and severity. Sites that would normally not burn, such as riparian areas with plants important for basket making, would be burned to improve outcomes of interest to humans (Kimmerer and Lake 2001).

Harold Weaver recognized the importance of fire for ponderosa pine when working on reservations, and he established control plots on the Colville Indian Reservation which have been maintained since their establishment. Under the direction of Wallace Covington, Victor Morfin revisited the plots and provided analysis of the effects of different fire regimes. This study provides the quantitative support that might not be available from other data sources regarding the impact of fire as a management tool (Morfin 1997).

Recently, contributions have expanded rapidly. After Stephen Pyne summarized the evidence of the use of fire by indigenous peoples (Pyne 1982), other researchers have documented contributions (Lake 2007; Miller et al. 2010), and the U.S. Forest Service published an extensive bibliography (Williams 2003). Archaeologists

(Delcourt and Delcourt 1997, 2004; Dods 2002) and ecologists (Nowacki and Abrams 2008) are also contributing to this literature. The Confederated Salish and Kootenai Tribes reclassified their forest based on four fire regimes (Confederated Salish and Kootenai Tribes 2000). The Ontario Department of Natural Resources has started to work with the Pikangikum First Nation on fire in the boreal forest (Miller et al. 2010).

### ***5.3.2 Uneven-Aged Silviculture***

Because their clients had some influence over forest management, the BIA has used uneven-aged management systems for forest harvest to a greater extent than used by other forest land owners. As a consequence, forests on Indian reservations in the United States are a fertile site for learning about the consequences of uneven-aged silviculture on forest structure (Becker and Corse 1997; McTague and Stansfield 1994, 1995).

### ***5.3.3 Long Term Monitoring***

The Continuous Forest Inventory (CFI) programme of the Bureau of Indian Affairs provides measurement of forest growth on a 10-year interval for all forested lands on reservations in the United States, using a system of fixed plots. This system, which originated on the Menominee Indian Reservation and spread to the rest of the Bureau, provides an excellent basis for long-term monitoring of forest conditions. McTague and Stansfield (1994) used the continuous forest inventory data for the Fort Apache Indian Reservation in Arizona to estimate growth-and-yield equations for ponderosa pine managed with an uneven-aged system. This study would not have been possible without both uneven-aged management and the CFI data (McTague and Stansfield 1994, 1995).

### ***5.3.4 Integrated Resource Management***

The management of forest lands for multiple purposes has become a reality on Indian reservations as tribes have implemented self-determination policy. Terminology has varied, with 'total resource management' being popular with the Intertribal Timber Council, which used that term as a theme for one of its annual timber symposia. The BIA forestry division has a small programme that supports tribes if they wish to engage in integrated resource management planning.

The Flathead Indian Reservation in Montana provides an example of planning for integrated resource management. In 1985, when the Salish and Kootenai Tribes

**Box 5.1** Combining Traditional Forest-Related Knowledge and Ecological Science on the Flathead Indian Reservation

As tribes in the United States worked to implement the federal policy of self-determination, the Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation were able to assert de facto decision-making authority when their dependence on forest revenue was removed by the signing of a hydroelectric power licence that gave an annual rental twice the average value of timber harvest. As a result, the Tribal Council was able to endure delays that the BIA required for complying with the wishes of the Tribes' Tribal Council. The Council had refused to approve a forest management plan written by the BIA, with an approved annual cut of 54 million board feet; it later modified the annual cut to 38 million board feet. In the 1990s, the tribes set out to write their own plan. They changed the classification system of the forest from cover type to type of fire regime, using four different fire regimes defined by return frequency ('nonlethal,' fires every 5–30 years; 'mixed,' fires 30–100 years; 'lethal,' 70–500 years; 'timberline,' 30–500 years). Silvicultural prescriptions were rewritten to accommodate the characteristics of fire regimes; principles of ecosystem management were used throughout the plan, with the pre-contact fire regimes as the first step in defining desired conditions. A substantial public participation process examined five different management strategies; the tribes selected the 'Modified Restoration' option, which had an annual cut of 19 million board feet (Confederated Salish and Kootenai Tribes 2000; Tecumseh Professional Associates 1999). Restoration refers to creation of conditions under the pre-contact fire regimes, modified to take account of current desired outcomes. The reduction in timber harvest from previous BIA recommendations is due to consideration of 10 other factors, such as wildlife, forest health, fisheries, and culture.

Another innovation by the Salish and Kootenai Tribes was the establishment of a tribal wilderness area in the Mission Mountains, which form the eastern boundary of the Flathead Indian Reservation. Subsequently, a substantial public involvement process has been undertaken to plan for fire and fuels management in the buffer zone at the foot of the mountains in order to allow restoration of fire in the wilderness and to address healthy ecosystem concerns for adjacent lands (Carver et al. 2009; Krahe 2001; Watson et al. 2008).

became joint licensees for Kerr Dam, located on the Flathead Indian Reservation, their dependence on forest income fell and they were able to insist that the BIA establish interdisciplinary teams for the evaluation of all timber sale proposals. They were able to do this because the BIA's threat to delay income if timber sales had to be re-planned no longer carried force. Subsequently, they wrote their own management plan, taking over that function from the BIA (Box 5.1) (Confederated Salish and Kootenai Tribes 2000).

## 5.4 Development of Good Practices

### 5.4.1 *Good Practices in Education*

Some universities and tribal colleges have established forestry programmes to support education of indigenous people in contemporary forestry management; most of these programmes acknowledge traditional knowledge. Programmes exist at the University of British Columbia in Vancouver, British Columbia; Lakehead University in Thunder Bay, Ontario; Salish Kootenai College in Pablo, Montana; College of the Menominee Nation in Keshena, Wisconsin; Northern Arizona University in Flagstaff, Arizona; the State University of New York; and Humboldt State University in Arcata, California. Tribal colleges, being closer to their communities, can develop stronger links. Universities, especially those sponsored by states or provinces, have to overcome considerable suspicion resulting from years of difficulties resulting from research practices and public policy. These barriers are not easy to overcome, because of their strong connection to the colonial practices of their government sponsors, which reflect differences in power. Profound differences between traditional knowledge holders and universities regarding epistemology also creates barriers, as does the attempt by many scientists to draw a strong line separating knowledge, ethics, and religion (Drew and Henne 2006; James 2001).

Differences in approaches to epistemology—the study of the origins of knowledge—affect relationships between educational organizations and indigenous knowledge holders. Several authors have explored the differences in assumptions about the source of knowledge and the best methods for passing knowledge across generations (Bala and Joseph 2007; Davidson-Hunt and O’Flaherty 2007; Houde 2007; Moller et al. 2004; Shackeroff and Campbell 2007). Because these profound differences are not easy to accommodate without substantial changes to educational institutions, building links in education between Western science and traditional knowledge in education remains challenging (Kimmerer 2002).

For instance, many traditional knowledge holders regard a long personal experience with particular areas as essential to knowing about that land; such people have little tolerance for theories based on knowledge from elsewhere. Many scientists, however, seek generalizations and place high regard for knowledge of written materials that describe a variety of places (McQuat 1998). While recognizing that universal theories remain undeveloped in forest ecology, scientists nonetheless regard knowledge of particular places as incomplete (Davidson-Hunt and O’Flaherty 2007; Nadasdy 2003b). This affects education as well as other aspects of good practices.

In universities, young people are able to obtain their PhDs and become licensed as experts. In traditional communities now disconnected from their traditional territories, few young people can accumulate the experience needed to become recognized as experts. Just the difference in the ages of professionals in the two cultures can create problems. Without the certification of a professional degree, traditional

elders cannot become professors at universities, although special arrangements can recognize their knowledge. With a PhD but without experience, young scientists working with elders risk being unable to attain the respect needed to truly share knowledge (Snively 2006).

In spite of these problems, colleges and schools of forestry have been successful in educating indigenous foresters. In the United States, the School of Forestry at Northern Arizona University, the University of Montana, Oregon State University, and the University of Idaho have all had American Indians complete degrees from bachelor to doctorate. The University of British Columbia, University of Alberta, Université Laval, University of New Brunswick, Université de Moncton, and University of Toronto have all graduated First Nations students in forestry. Northern Arizona University's multi-resource approach to forestry has proved to be especially appealing to indigenous students.

#### ***5.4.2 Good Practices in Research***

While changes to educational practices may overcome the barriers of the structure of educational institutions, changes to practices in research also require adjustments and can be carried out in good measure by individuals engaged in research (Battiste and Henderson 2000; McGregor 2010; Roots 1998; Smith 1999). Several guides are available (Battiste and Henderson 2000; Crowshoe 2005; Grenier 1998; Roots 1998; Smith 1999) to include the consideration of traditional forest-related knowledge in environmental and resource management. Many academic and federal agency researchers must comply with Institutional Review Board standards and follow guidelines established for ethical conduct of human subjects (Amdur and Bankert 2002). Some First Nations and American Indian tribes have established and others are beginning to require similar reviews of research methods and agreements with outside researchers. Approvals of research are generally granted by tribal councils, cultural committees, or tribal department leaders after discussion. The John Prince Research Forest provides an example of successful co-management of research (Box 5.2).

Good research practices involve development of community-based research in which those holding traditional knowledge are able to formulate research questions and control research methods in conjunction with scientists (Brant Castellano 2004; Davidson-Hunt and O'Flaherty 2007; Huntington 2000; Lewis and Sheppard 2005; Long et al. 2003; Macaulay et al. 1998; MacPherson 2009; Menzies 2001, 2004; Piquemal 2000; Sheppard et al. 2004). Participatory action research (PAR) methods can foster closer relationships between indigenous groups and scientists, although parties need to negotiate terms and conditions of research practices and who is responsible for data collection, storage, and reporting of results (Caldwell et al. 2002). Challenges can arise between Western scientific approaches to research and what is acceptable to indigenous groups (Davis and

### **Box 5.2** Co-Management of Research on the John Prince Research Forest

Founded in 1999, the John Prince Research Forest is a joint venture between the Tl'azt'en Nation and the University of Northern British Columbia. It is located on the traditional territory of the Tl'azt'en Nation, north of the city of Fort St. James, British Columbia. A board of directors with equal numbers of representatives from both parties governs the research forest, which operates on Crown land with a special use permit from the BC government. The vision statement for the research partnership states:

'Internationally recognized, the John Prince Research Forest is well known for both its ecological approach to forest stewardship and its leadership in building successful partnerships between Aboriginals and non-Aboriginals. Integrating traditional and current scientific approaches into resource management and research has achieved long term sustainable and sound management.

The co-management approach between the University of Northern BC and the Tl'azt'en Nation serves as a model for effective partnerships. Professional capacity and high respect for both partners has been built through innovative educational approaches. The John Prince Research Forest, together with its founding partners, is recognized in Canada and beyond, for its vision, leadership and research on the cooperative management of natural resources.'

The vision has been implemented with a number of research projects with funding from research sources in the governments of British Columbia and Canada. The board of directors also has a policy of sharing benefits with the families who hold keyohs, the traditional form of land tenure, within the research forest. The holder of the provincially recognized traplines in the forest is also a participant. Research projects have involved the people of the Tl'azt'en Nation, with research outputs such as a set of aboriginal criteria and indicators of sustainable forest management (Grainger et al. 2006; Karjala 2001; Karjala and Dewhurst 2003).

Reid 1999). The Whitefeather Forest provides an example of successful integration of different knowledge systems (Box 5.3).

With support from the Ford Foundation, the Community Forestry Research Fellowship programme at the University of California, Berkeley, supported many PhD students in conducting research with communities, including aboriginal communities, in the United States. The book edited by Wilmsen et al. (2008) provides many insightful case studies of participatory research. Wulfhorst and others provide a set of criteria for the evaluation of participatory research. They discuss the importance of three criteria: community-centred control, reciprocal production of knowledge, and attention to the distribution of benefits (Wulfhorst et al. 2008).

Community-centred control is their first criterion. Because community members participate as researchers, they become actual owners of the research, likely to use

### **Box 5.3** Joint Learning on the Pikangikum Land Base: The Whitefeather Forest Initiative

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In 1996, leaders of the Pikangikum First Nation of northern Ontario, Canada, were concerned that forest harvesting south of their homeland was going to extend into their lands. They engaged the Ontario Ministry of Natural Resources of the Province of Ontario (OMNR) in a land use planning process. They established the Whitefeather Forest Management Corporation (WFMC) to put them in the driver's seat as they built relationships with university researchers interested in traditional knowledge, environmental nongovernmental organizations, other First Nations, and other non-Pikangikum organizations (Smith 2007).

As a consequence of their efforts, they created a land use plan, *Cheekahnahwaydaymungk Keetahkeemeenann—Keeping the Land: A Land Use Strategy for the Whitefeather Forest and Adjacent Areas* (PFN and OMNR 2006). The strategy combined Anishinaabe knowledge with Western science, and was a joint effort with the Ontario Ministry of Natural Resources. In 2009, the WFMC and the OMNR were working together to comply with environmental assessment requirements.

Working with university researchers, the Pikangikum elders have produced a number of publications explaining their worldview and desired approach to caring for the land in their traditional territory. Utilizing both their approach and that of Western science has proved to be a challenge (O'Flaherty et al. 2008, 2009). Cooperative research has produced unique research results, such as their 'cultural landscape framework,' which explains the Pikangikum approach to interpreting change in their territory (Shearer et al. 2009). University researchers have articulated the joint learning process (Davidson-Hunt 2006; Davidson-Hunt and O'Flaherty 2007). They have provided guidance for the relationship between humans and woodland caribou and they have also articulated the current Pikangikum view of the role of fire in the boreal forest (Miller et al. 2010).

the results. Community control also increases credibility, particularly when all groups in a community participate. Good community-centred control also builds trust and shared development of locally applicable best available science.

Reciprocal production of knowledge begins by recognizing the different goals of communities and most researchers. When a research project meet the goals of both, then research can proceed successfully. Recognizing the goals of communities involve recognition as well of all groups in the community, including those usually marginalized. Knowing that political agendas matter in different ways to communities and researchers aids in improving joint knowledge production.

A third strength of participatory research is that action benefiting a community is more likely, because the community has participated in formulating and prioritizing research questions and in generating answers. A result is that 'extension,' getting



results to users, is much less important; the research process is a type of extension. The same results may appear differently to the community, which desires action, and to the researcher, who wishes to contribute to academic knowledge.

Wilmsen and Krishnaswamy (2008) consider the many challenges to participatory research, stemming primarily from funding agencies and universities. Funding agencies tend to separate community development from research; therefore, participatory research projects that do both do not fit well in either category. Universities have a rhythm of study for graduate students that goes rather quickly from the viewpoint of communities who need to work on learning the importance of research for development and other desires (Wilmsen and Krishnaswamy 2008).

Two of the chapters in the book edited by Wilmsen et al. (2008) deal specifically with Native American issues. Long and others describe the consequences when a stream restoration project was threatened by water runoff following a catastrophic fire on the Fort Apache Reservation in Arizona (Long et al. 2008). One consequence of the research project was that the community had obtained the ability to force compromise from officers of the BIA in efforts to protect a bridge. Hankins and Ross consider how the general issues of participatory research work for Native American scholars, who are more inclined to accept community knowledge as valid. They find that participatory research methods address most of the key issues Native American communities raise when dealing with researchers (Hankins and Ross 2008).

Problems in research can occur because of different ethical systems. Destructive sampling, for instance, shows disrespect for the tree if it is not subsequently utilized. Yet transporting such trees to a mill may not appear to be cost-effective to a growth-and-yield researcher (McTague and Stansfield 1994, 1995). While radio-collaring is not an acceptable technique for studying human migration, it is acceptable for scientific study of moose or caribou; traditional elders may see such collars as disrespectful of animal autonomy. Kluane elders objected to the disruption caused by helicopters in counting Dall sheep, in addition to complaining that such counts were not accurate, a conflict over both ethics and methodology (Nadasdy 2003b). Additional conflicts about sampling methods and adequate statistical rigour to confidently draw conclusions can arise between indigenous groups and scientists who have fundamentally different approaches for research methods, data analysis, and determination of causal factors (Ford and Martinez 2000).

Another example of good practices in tribal forest research that serves both parties' management objectives and interest was a joint research project between the Confederated Tribes of Warm Springs and Oregon State University in northern Oregon, which examined the various silvicultural treatments by seasonality (winter compared to summer) of ground-based harvesting systems on huckleberry rejuvenation and productions (Anzinger 2002). Another example is the effects of landscape-level wildlife damage, e.g., black bear cambium consumption, on tree regeneration linked to forest composition and structure on the Hoopa Indian Reservation in northwestern California (Matthews et al. 2008).

Aboriginal organizations are developing their own research protocols to protect traditional knowledge (Assembly of First Nations of Quebec and Labrador 2005; CIHR 2007). Important principles include OCAP—ownership, control, access, and possession—by aboriginal peoples of the research process (NAHO 2007b).

The overarching paradigm of research with respect to aboriginal people includes a shift to a paradigm of research *with* aboriginal peoples rather than *on* them (McNaughton and Rock 2003).

### 5.4.3 *Good Practices in Forest Management*

In Canada, the National Aboriginal Forestry Association has recommended good practices (Bombay 1992; Bombay et al. 1996; Rekmans 2002). Aboriginal forestry is being developed as a concept for education (Parsons and Prest 2003) and management (Wyatt 2008). Traditional forest-related knowledge can contribute to improving forest management practices in several distinct ways.

First, traditional knowledge can be used as an additional source of information in forest management planning, the essential first step of controlling practices. Contemporary forest planners typically use computer-based geographic information systems (GIS) to integrate a wide variety of data sources, including forest types and inventories, soil and geology maps, fauna habitats, visual landscapes, and social values. It is now common across Canada for indigenous communities to be requested to provide traditional forest-related knowledge for inclusion in plans, and a number of books are available describing data collection and mapping methods. Information provided frequently includes camp sites, travel routes, areas of spiritual or cultural significance, and fauna habitats. This information is then used in forest plans to identify areas that should be protected from logging or other management activities, or areas where logging may be permitted with modified practices to respect particular values. However, this approach expects that indigenous communities will turn over their traditional information to forestry companies or government agencies, something that many groups are reluctant to do. Similarly, traditional knowledge exists within a cultural context. Collecting information for inclusion in a GIS strips traditional forest-related knowledge of associated knowledge that cannot be recorded on a map, such as cultural norms concerning how a resource may be used or the ecological or spiritual importance of a particular site. Traditional forest-related knowledge can certainly be a source of useful information for good practices, but this approach limits the extent of the potential contribution (Wyatt et al. 2010).

Involving indigenous people, as holders of traditional forest-related knowledge, in determining forest management practices can be seen as a logical response to the limitations of treating such knowledge simply as another source of information. Public consultations have become widespread in forest management across Canada, and distinct processes are now obligatory under provincial law in Québec, British Columbia, and Ontario. Consultation can provide a forum where indigenous elders, or other holders of traditional knowledge can speak directly with forest managers and planners, providing information as they judge necessary and appropriate. Consultation processes may encourage participants not only to provide information, but also to contribute to modifying forest plans and practices on the basis of this information, as occurred in Clayoquot Sound (Box 5.4).

**Box 5.4** Scientific Panel for Sustainable Forest Practice in Clayoquot Sound

During the period prior to 1993, a large environmental conflict developed over the logging of timber in Clayoquot Sound, on the west coast of Vancouver Island in British Columbia, Canada. Much of the island had been logged; not only was Clayoquot Sound one of the last unlogged areas, it was also important for recreation and fishing. International environmental organizations became involved along with local organizations, leading to protests and a logging bridge blockade resulting in arrests and negative worldwide publicity. As a means to resolve the issue, the provincial government appointed a panel of scientists to evaluate the situation.

The indigenous peoples of the Sound, five Nuu-Chah-Nulth First Nations, had been pursuing land claims and an interim measures agreement prior to treaty settlement. The government appointed one of the traditional leaders of the Nuu-Chah-Nulth as co-chair of the scientific panel, along with three other elders as members. The elders urged the panel to adopt Nuu-Chah-Nulth inclusive process for negotiations, and the panel agreed. This meant that everyone would be listened to with respect, and all decisions made by consensus. It also meant that ethical concerns would receive a fair hearing (Lertzman and Vredenburg 2005).

The panel recognized and incorporated two key Nuu-Chah-Nulth concepts: *hishuk ish ts'awalk* ('everything is one') and *hahuulhi* (the system of control of traditional territories by recognized hereditary leaders). The first of these recognizes the sacredness of all life forms; the second provides a basis for meaningful co-management of the resources of Clayoquot Sound. Because of this decision and the inclusive process, key elements of Nuu-Chah-Nulth traditional knowledge informed a great many of the overall recommendations of the panel. A special report on First Nations' perspectives provided 27 specific action recommendations to support the panel's general position that the Nuu-Chah-Nulth be significantly involved in all decisions regarding resources in Clayoquot Sound. Among the recommendations was explicit recognition both of traditional ecological knowledge and of the traditional system of leadership and decision-making in traditional territories. (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995a).

Informed by both science and traditional knowledge, the recommendations of the Scientific Panel in 1995 provided innovative ideas for ecosystem management. Among them was the silvicultural concept of variable retention, meaning that the previous pattern of clear-cutting was modified to leave significant areas of uncut forest. This recommendation was part of the general recommendation that planning focus on the condition of the ecosystem rather than the products removed from the ecosystem. This focus on the condition of the ecosystem implements the Nuu-Chah-Nulth concept of *hishuk ish ts'awalk*. (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995b).

(continued)

**Box 5.4** (continued)

Concurrent with the work of the panel, an Interim Measures Agreement created a decision-making structure for ecosystem management in Clayoquot Sound; central to the structure was a Clayoquot Sound Central Region Board with significant First Nations participation; no final decisions could be undertaken without agreement from the Nuu-Chah-Nulth. The decisions of the Board, however, were advisory to the relevant provincial ministers; the province retained final formal control, but usually, the decisions of the Central Region Board were confirmed by the province. Subsequent studies of the co-management arrangements revealed that the statutory situation (with the province having final say) and the utilization of scientific ecosystem terminology limited the full implementation of equal power in management decisions. Significant changes, however, had been made in comparison to previous levels of integration of the ideas of traditional knowledge and Western science (Goetze 2005; Lertzman 2006; Mabee and Hoberg 2006). The Interim Measures Agreement, however, had expired as of 2010.

There are, however, many difficulties associated with consultation, for both the general public and indigenous peoples, and consultation techniques need to be chosen carefully. Differences in knowledge and world-view may block effective exchanges; specific mandates may limit the relevance of the process; inappropriate techniques may result in poor communication or mistrust; and hierarchies of power and decision-making responsibility may limit the value of participation for an indigenous community. Feit and Beaulieu noted that Cree participation in consultation processes in northern Quebec seemed to be aimed at legitimizing existing practices (Feit and Beaulieu 2001). Perhaps in response to this situation, the Cree of northern Québec have developed their own process for appropriate and effective consultations between community members and forestry companies and for the use of traditional forest-related knowledge (Waswanipi Cree Model Forest 2007). Marsden found that the Province of British Columbia oriented its consultation policies toward justifying infringement rather than seriously taking aboriginal concerns into account (Marsden 2005).

Partnerships between indigenous communities and the forest industry have also developed in Canada, with considerable attention to evaluation of the successes and failures (Anderson 1997, 1999; Anderson and Bone 1999; Beckley and Korber 1996; Brubacher et al. 2002; La Rusic 1995; Larsen 2003; McKay 2004; Merkel et al. 1994; Trosper et al. 2008). Such partnerships are usually aimed at obtaining a share of economic benefits of forestry development or at obtaining a measure of control or influence on forestry practices. As a means of applying traditional knowledge to forest management, a partnership can enable indigenous people (either as a community or individually) to conduct forestry operations in a way that is based on their own knowledge and in respect of their own values and culture. Meadow Lake

Tribal Council in Saskatchewan and the Atikamekw of Opiticiwan in Québec are among the communities who have established timber processing plants in partnership, while numerous nations across the country have various forms of agreements or contractual relationships with industry.

In the United States, the recommendations of the Indian Forest Management Assessment Team (IFMAT) (IFMAT 1993) and the Second IFMAT (Second IFMAT 2003) provide one set of good practices. The first report documented that Indian people and the foresters in the BIA had different priorities for the management of forests. Indian people tended to prefer ‘protection’ and the use of forests for ‘subsistence.’ The non-Indians in the BIA, and to an extent the Indian employees, believed their clients preferred the use of the forests to provide income (IFMAT 1993, pp. III-3 and III-4). The groups converged by the time of the Second IFMAT, with the BIA moving toward Indian values. In their summary of the Second IFMAT, the team stated:

‘The timber-production focus of the past has begun to give way to integrated resource management to better fit the visions of tribal communities’ (Second IFMAT 2003, p. 102).

They also say the following:

... the conditions of Indian forests can also yield valuable lessons for society in general; indeed, Indian forests have the potential to be models of integrated resource management and forest sustainability from which we can all learn (Second IFMAT 2003, p. 102).

The IFMAT recommendations are tailored for the situation on reservations in the United States, where tribes should clearly be the managers of their forests and the beneficiaries of the ‘trust relationship,’ based on the federal government’s holding title to reservation lands. The two studies occurred because tribes and the Intertribal Timber Council advocated the passage of the National Indian Forest Resources Management Act (Title II of Public Law 101–630, November 28, 1990).

With tribes compacting and contracting management of forestry departments because of the Indian Self Determination Act, many reservation forests are now managed substantially in the way that their tribes want them managed. The second IFMAT report reveals a wide range of ways in which management is shared between the BIA and tribes.

The relationship between tribes and the U.S. Forest Service has also been changing. In the United States, many federal agencies, including the Forest Service, do not legally recognize ‘co-management’ with American Indian tribes, but they implement similar outcomes with contract, grants and agreements, and compliance with policies and legal mandates. The Tribal Forest Protection Act (TFPA) provides a mechanism for tribes to work with federal agencies, especially the Forest Service and the Bureau of Land Management, to protect their lands from threats arising on federal lands. The threats of wildfire, insect and disease infestations, etc. stem largely from the federal lands not being managed to as high a standard as the tribal lands, due for the most part to combined effects of litigation and reduced funding levels for fuels reduction. The TFPA is one of the few laws that recognizes the value of traditional knowledge and supports its application in TFPA project proposals. Memoranda of Understanding and Memoranda of Agreement are also important tools, as are contracts by which

agencies hire tribes to do work in accord with traditional values. Legal tools include treaties, legislation such as TFFPA, executive orders, and regulations that require consultation between tribes and federal agencies in the United States (Clinton 2000).

In Canada, some attempts have been made in the area of co-management to include aboriginal perspectives; sometimes this is not successful (Gardner 2001; Grainger et al. 2006; Greskiw 2006; Mabee and Hoberg 2004, 2006; Nadasdy 2003a, b, 2005; Natcher 1999, 2000; Natcher et al. 2005; Peters 2003; RCAP 1996a; Sneed 1997; Stevenson 1998; Wanlin 1999; Witty 1994).

Canadian authors have developed a framework for consideration of different types of co-management; Plummer and FitzGibbon (2004) have summarized this literature. They propose that three dimensions need to be examined: the form of power distribution between communities and government (on a scale from mere informing of the community of decisions made to full community control of decisions); the nature of representation that defines the community in question (commercial, national, local, indigenous groups); and the process for negotiations (whether formal or informal in nature). While their focus is on environmental management generally, they include forestry examples from Canada (Plummer and FitzGibbon 2004). After reviewing a variety of experiences in Quebec, Rodon (2003) concluded that it was more useful to think of co-management as a process and a structure by which aboriginal peoples negotiate power with governments, than simply as an organizational model. Jason Forsyth has applied a power scale to different levels of forest management—operational, tactical, and strategic—in arrangements between First Nations and the Ministry of Forests and Range in British Columbia (Forsyth 2006).

The role of traditional land use studies has been assessed (Horvath et al. 2002; Markey 2001; Natcher 2001; Wyatt et al. 2010). Understanding how and why indigenous practitioners used forest resources is important to implementing effective management practices. Providing access to and fostering an adequate supply of forest resources is critical to survival of indigenous groups and the perpetuation of traditional knowledge and management practices.

Different systems of criteria and indicators attempt to include indigenous priorities, with several levels of comparison being possible. First, national-scale criteria-and-indicator systems may not easily translate to local-scale criteria and indicators (Beckley et al. 2002; Duinker et al. 1994; MacKendrick et al. 2004; Sherry et al. 2005). Second, local criteria and indicators may not include indigenous priorities (Karjala and Dewhurst 2003; Marlbor et al. 1999; Nilsson and Gluck 2001; Parkins et al. 2001; Sherry et al. 2005). Several studies have showed ways to include indigenous priorities in criteria and indicators (Bombay et al. 1995; Collier et al. 2002; Karjala and Dewhurst 2003; Karjala et al. 2003; Lewis and Sheppard 2005; Natcher and Hickey 2002). Smith and others have recently summarized the use of criteria and indicators in Canada (Smith et al. 2010).

Non-timber forest products are often very important for indigenous priorities regarding types of forest management (Berkes et al. 1995; George et al. 1996; Korber 1997; Kuhnlein 1991; Natcher 2004; Natcher et al. 2004; Parlee et al. 2005; Turner 2001). Many Western-scientific forestry studies can have results that are of importance to or have implications for indigenous groups who use non-timber forest

products (for huckleberries and forest stand condition, see Jones and Lynch 2007; Kerns et al. 2004). Although it is important that agency regulations and policies recognize and acknowledge indigenous rights and interests in non-timber forest products (cf the Forest Service Handbook (FSH) 2409.18—Timber Sale Preparations Handbook, Chapter 80—Uses of Timber other than Commercial Timber Sales, Special Forest Products—Botanical forest products), in the United States giving access to aboriginal people for botanical products on terms different from other forest users is controversial.

The goals of community forestry overlap in many ways with ideas of co-management. In the United States, those advocating community forestry recognize the importance of traditional and local knowledge. Based on extensive interviews and workshops, Mark Baker and Jonathan Kusel have summarized the community forestry efforts throughout the country. Their introductory chapter recognizes the importance of aboriginal practices in determining the state of forests prior to European settlement. They also recognize the Hispanic communities in New Mexico as important sources of traditional knowledge and management practices (Baker and Kusel 2003). The Seventh American Forestry Congress in February 1996 was important in demonstrating broad interest in reforming forestry in the United States; American Indians participated in that event, which was organized to give voice to all participants.

In Canada as well, discussion of community forestry often includes indigenous perspectives (Bagby and Kusel 2003; Booth and Skelton 2008; Curran and M’Gonigle 1999; Duinker et al. 1994; Greskiw 2006; McGregor 2002; Smith 2006; Stevenson and Natcher 2010). Cree people have been involved with the Waswanipi Cree Model Forest (Box 5.5 and Fig. 5.2).

## 5.5 The Present Role of Traditional Forest-Related Knowledge

Given the many developments described in the previous section, the role of traditional forest-related knowledge in forestry in Mexico, the United States, and Canada seems to be increasing. In Mexico, the 1986 change in the national forestry law gave communities more control over their forests, thus allowing them to use their own knowledge to a greater degree. Forests managed using traditional systems to produce timber, fruits, latex, and medicines extend throughout the tropical, sub-tropical, and temperate biomes of Mexico. The milpa system is still a ubiquitous feature of the Mexican landscape, and species-rich home gardens are found outside the back door of many contemporary Mayan households in Quintana Roo. Mexico has more certified community forestry enterprises than any other country in the world, each of these involving to varying degrees the application of traditional forest-related knowledge.

In the United States, the increasing implementation of self-determination on reservations has also provided tribes opportunities to increase their control of forestry operations (Miller et al. 2010, Second IFMAT 2003). This increase has led to more efforts in the area of integrated forest management. It has also allowed more attention to non-timber forest products. Community-based research, such as by the White

### Box 5.5 The Ndhoho Itschee Process—Sharing Knowledge and Development Management Strategies

Faced by expanding forestry activities on their traditional lands, the Cree of Waswanipi in northern Quebec developed their own process for bringing their traditional knowledge to forest management consultations.

Cree land users felt that they cannot be expected to detail such a complex system of knowledge to a foreigner who they see, at most, once or twice a year. They would rather enter into a system that recognizes their stewardship role about the land and values their body of knowledge. They expect that their voice will be heard because they have this knowledge. (Waswanipi Cree Model Forest 2007)

There are two principal parts of the process. First, members of the community document their past, present, and projected future land use. This ‘family map’ is considered confidential; the goal is not just to document the information, but also to involve land users in reviewing their use and in deciding what should happen in the future. The family map is used to prepare a separate map of conservation values (Fig. 5.2) that can subsequently be shared with industry and governments. At the same time, an assessment is made of the state of each trapline (traditional area for Cree resource management), enabling trappers, elders, and other users to focus on critical issues for each part of the land.

In the second part of the process, Cree representatives and planners from the forest industry and governments meet to review the values and issues identified by the Cree and to explore management strategies that can provide solutions to these. ‘This is where imagination, innovation and experience come into play.



Fig. 5.2 A conservation value map. A planning support tool accompanied by Cree objectives and desired forest conditions (Source: Waswanipi Cree Model Forest 2007)

(continued)



**Box 5.5** (continued)

The goal is to find possible solutions to the issue' (Waswanipi Cree Model Forest. 2007). Cree elders and land users, as well as outside experts, may be asked to provide insights and ideas at this point. Once solutions and strategies have been determined, then they need to be accepted by the community (as well as by government and industry). Finally, the community also joins the monitoring process to ensure that goals are attained and to bring information back to users of the land for future planning cycles.

Mountain Apache regarding riparian restoration, has involved elders in directing the questions asked and has involved tribal youth in carrying out the projects (Long et al. 2008).

Another development in the United States has been the ability of Indians to make agreements with the U.S. Forest Service through stewardship projects. The Maidu Stewardship Project was an example of a local aboriginal community, in this case not a federally recognized group, being able to implement some of their ideas in a small area (Cunningham and Bagby 2004).

Because of the strong role Canadian provinces have in land management, and the resistance from those governments to significant aboriginal participation, use of traditional forest-related knowledge in Canadian forestry has been more problematic. In spite of the problems, however, some significant examples exist. In 1995, the Scientific Panel for Sustainable Forest Practices in Clayoquot Sound completed a large study that gave traditional forest-related knowledge a key role (Scientific Panel for Sustainable Forest Practices in Clayoquot Sound 1995b). The Waswanipi Model Forest has used traditional knowledge (Waswanipi Cree Model Forest 2007). The planning document *Keeping the Land* resulted from a collaboration of the Pikangikum First Nation and the Ontario Department of Natural Resources, with significant use of traditional knowledge (PFN and OMNR 2006).

Many Canadian aboriginal communities have been active in addressing systems of criteria and indicators, in an effort to have their concerns included in the lists of criteria and monitored using indicators (Smith et al. 2010). The Sustainable Forest Management Network during its existence funded a number of research projects with significant participation by communities. The work with the Little Red River Cree Nation led to the publication of a book that has been useful as a textbook for at least one course in aboriginal forestry (Natcher 2008). Some of the research carried out by the Whitefeather Forest Management Corporation was funded by the Sustainable Forest Management Network. Two edited volumes report the results of these research projects, many of which considered issues of the relevance of traditional forest-related knowledge to forest management (Stevenson and Natcher 2009, 2010). While these examples show recognition of traditional forest-related knowledge in Canada, they are exceptions to the general rule that official forestry departments hardly use such knowledge.

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