NRC Research Press

ARTICLE

Cultural importance of white pine (*Pinus strobus* L.) to the Kitcisakik Algonquin community of western Quebec, Canada

Yadav Uprety, Hugo Asselin, and Yves Bergeron

Abstract: Trees and forests have always played a significant role in the cultural and spiritual lives of societies. Understanding the cultural importance of tree species is necessary to develop socially acceptable forest management and restoration strategies. White pine (*Pinus strobus* L.) used to be abundant in northeastern North America, including on the ancestral territory of the Kitcisakik Algonquin community (western Quebec, Canada). The community is calling for restoration and sustainable management of white pine on their ancestral territory. As a first step towards this goal, key informant interviews were used to document the cultural importance of white pine to the Kitcisakik community. White pine was perceived as an important component of traditional life, providing several goods and services. White pine is featured in legends, is used as a medicine, provides habitat for flagship wildlife species, and is a prominent part of cultural landscapes. White pine is a cultural keystone species for the Kitcisakik Algonquin community. Local people point to extensive logging as the reason behind white pine decline on the ancestral territory. They suggest that mixed plantations should be used in a culturally adapted restoration strategy.

Résumé : Les arbres et les forêts ont toujours joué un rôle important dans la culture et la spiritualité des sociétés. La compréhension de l'importance culturelle des espèces arborescentes est nécessaire pour développer des stratégies de restauration et d'aménagement socialement acceptables. Le pin blanc (*Pinus strobus* L.) était autrefois plus abondant dans les forêts du nord-est de l'Amérique du Nord, notamment sur le territoire ancestral de la communauté algonquine de Kitcisakik (Québec, Canada). La communauté revendique la restauration et l'aménagement durable du pin blanc sur son territoire ancestral. Un premier pas vers cet objetif a été franchi en réalisant des entrevues avec des informateurs clés de la communauté afin de documenter l'importance culturelle de l'espèce. Le pin blanc était perçu comme une composante importante de la vie traditionnelle, fournissant de nombreux biens et services. L'espèce figure dans des légendes, est utilisée comme plante médicinale, procure de l'habitat à des espèces fauniques d'intérêt, et est une constituante importante des paysages culturels. Le pin blanc est une espèce culturelle clé de la communauté algonquine de Kitcisakik. Les gens de la communauté ont identifié la surexploitation des forêts de pin blanc comme raison principale du déclin de l'espèce sur leur territoire ancestral. Ils ont suggéré que des plantations mixtes pourraient être utilisées dans une stratégie de restauration culturellement adaptée.

Introduction

Trees and forests have considerable cultural, spiritual, and ecological significance for people around the world (Dudley et al. 2005; Trigger and Mulcock 2005). They provide goods and services that benefit society in various ways. It is sometimes forests, as part of cultural landscapes, or often specific tree species that are deeply ingrained in the cultures and beliefs of societies. However, the ways in which societies benefit from trees differ widely, as patterns of resource use are shaped by the values, priorities, perceptions, and expectations of each cultural group. For example, aboriginal communities living in or close to forested areas view their surrounding landscape as a cultural entity (Berkes and Davidson-Hunt 2006; Ramakrishnan 2007). Forests are sacred for them and considered an integral part of their collective identity and culture (Young 1999). Many native trees have long held special significance to society — partly valued as economic resources, but also as sources of inspiration, symbols of place, and metaphors for life (Trigger and Mulcock 2005; Turner et al. 2009). The banyan tree (*Ficus benghalensis* L.) in Nepal, the baobab (*Adansonia* spp.) in Madagascar, and the monkey puzzle tree (*Araucaria araucana* (Molina) K. Koch) in Chile are examples of such culturally important tree species (Dudley et al. 2005).

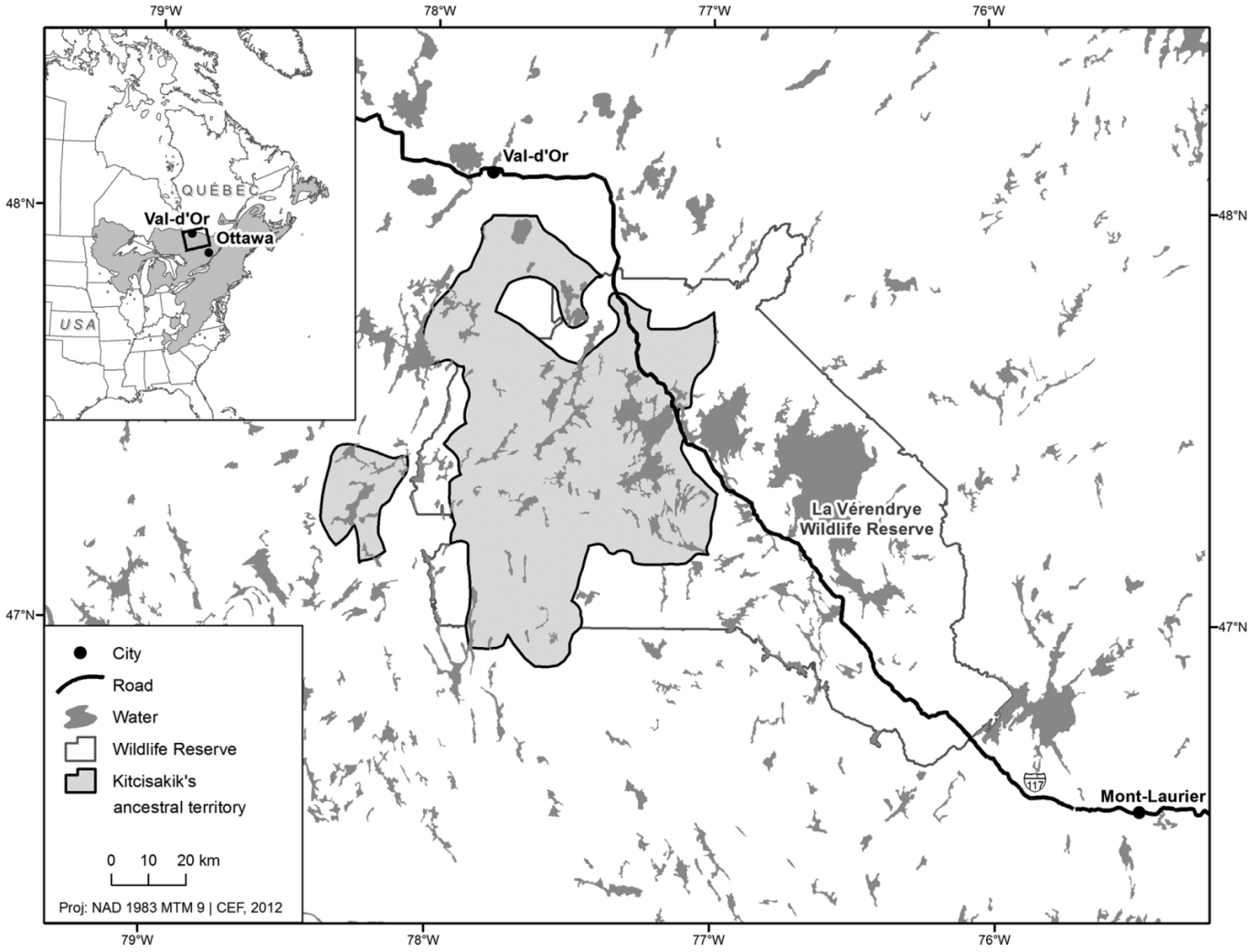
Garibaldi and Turner (2004) were among the first to coin the term "cultural keystone species" while referring to the importance of western red-cedar (*Thuja plicata* Donn ex D. Don) to Northwest Coast cultures. Species that have fundamental roles in diet, production of material goods, medicine, and (or) spiritual practices and beliefs can be designated as cultural keystone species (Garibaldi and Turner 2004). According to Platten and Henfrey (2009), cultural keystone species are essential to maintaining the complexity of social–ecological systems. The cultural keystone species concept provides a framework for assessing the impacts of environmental change on a particular group of people and their way of life (Garibaldi and Turner 2004). As such, it is a useful tool for ecological conservation and restoration.

Forest managers understand the economic and environmental importance of trees, but they seldom grasp their cultural and symbolic significance and the traditions that surround them (Schroeder 1992; McDonough 2003). However, in recent years, evolving forest management policies have moved to incorporate social and aboriginal values (UN 2007; Trosper and Parrotta 2012). There is indeed a pervasive public support for new approaches of sustainable forest management that significantly involve public input and meaningfully manage forests for multiple values (Robinson and Hawley 1997). In this context, managing forests

Received 17 December 2012. Accepted 24 March 2013.

Y. Uprety and H. Asselin. Canada Research Chair in Aboriginal Forestry, NSERC-UQAT-UQAM Industrial Chair in Sustainable Forest Management, Université du Québec en Abitibi-Témiscamingue, 445 boulevard de l'Université, Rouyn-Noranda, QC J9X 5E4, Canada.
Y. Bergeron. NSERC-UQAT-UQAM Industrial Chair in Sustainable Forest Management, Université du Québec en Abitibi-Témiscamingue, 445 boulevard de l'Université, Rouyn-Noranda, QC J9X 5E4, Canada.
Corresponding author: Yadav Uprety (e-mail: Yadav.Uprety@uqat.ca).

Fig. 1. Location of Kitcisakik ancestral territory in western Quebec. The inset shows the distribution of white pine in eastern North America (after Wendel and Smith 1990).



only for timber is no longer acceptable, especially in landscapes occupied and used by aboriginal peoples. This raises the crucial issue of how the interests and knowledge of all people can be incorporated into forest management (Cheveau et al. 2008; Trosper and Parrotta 2012).

Although aboriginal worldviews generally give equal importance to all species (Turner 2005), particular species can be more prominent in certain circumstances. For example, the Kitcisakik Algonquin community of western Quebec is concerned by the reduced abundance of eastern white pine (*Pinus strobus* L.) on its ancestral territory. White pine has indeed been overharvested over the last few centuries in northeastern North America and its abundance has severely decreased (Liu 1990; Delwaide and Filion 1999; Thompson et al. 2006; Barrette and Bélanger 2007), including in the Abitibi-Temiscamingue region (Asselin 1995), where the ancestral territory of the Kitcisakik Algonquin people is located. Extensive logging to meet timber demand eliminated white pine seed sources and allowed early successional hardwood species to replace white pine forests (Weyenberg et al. 2004). The Kitcisakik Algonquin are calling for restoration and sustainable management of white pine on their ancestral territory. However, white pine management is challenging because of specific site requirements, slow initial growth rate, susceptibility to damage from white pine blister rust (*Cronartium ribicola* J. C. Fisch.) and white pine weevil (*Pissodes strobi* Peck.), and heavy browsing (White et al. 2002; Major et al. 2009).

Before culturally adapted white pine restoration and management scenarios can be elaborated for the Kitcisakik territory, it is crucial to document why and how the species is important to the community. Furthermore, aboriginal people possess considerable traditional ecological knowledge (TEK) that can inform scientific approaches to adaptive management (Berkes 2008). Hence, this study sought to document the cultural, spiritual, and ecological importance of white pine to the Kitcisakik Algonquin community, as well as TEK related to this species.

Methods

Study area

The study area is the ~5000 km² territory occupied by the ~430 members of the Kitcisakik Algonquin community. Aboriginal peoples of Canada include First Nation, Metis, and Inuit communities. The Kitcisakik community is part of the Algonquin First Nation. Its territory is located primarily within the boundaries of the Réserve Faunique La Vérendrye in western Quebec, less than 300 km north of Ottawa (Ontario), the Canadian capital (Fig. 1). The average annual temperature in the study area is 1.2–3.3 °C and the average precipitation is 914–1014 mm/year, with 22%–33%

falling as snow (Val-d'Or and Mont-Laurier weather stations, Environment Canada; http://www.climate.weatheroffice.gc.ca/climate_normals). The study area is located in the balsam fir (*Abies balsamea* (L.) Mill.) – yellow birch (*Betula alleghaniensis* Britton) bioclimatic domain (Saucier et al. 1998). Mixed forest types are dominant, with balsam fir and yellow birch sometimes accompanied by sugar maple (*Acer saccharum* Marsh.), red maple (*Acer rubrum* L.), quaking aspen (*Populus tremuloides* Michx.), paper birch (*Betula papyrifera* Marsh.), black spruce (*Picea mariana* (Mill.) Britton, Sterns & Poggenb.), white spruce (*Picea glauca* (Moench) Voss), red pine (*Pinus resinosa* Aiton), jack pine (*Pinus banksiana* Lamb.), and white pine. Pure white pine stands are rare.

Until the 20th century, the Kitcisakik Algonquins (Algonquins refer to themselves in their own language as *Anicinapek*, in plural, and *Anicinape*, in singular, which means "true people") maintained a seminomadic lifestyle based on hunting, trapping, fishing, and gathering that was strongly dependent on the forest (Saint-Arnaud et al. 2009). In the early 1900s, the arrival in the area of nonaboriginal settlers had important consequences on land use and occupation, as well as on the social organization of the community (Leroux et al. 2004). Nevertheless, people from Kitcisakik still rely massively on subsistence activities, as the welfare rate reaches 80% in the community (Papatie 2004). Members of the Kitcisakik community now live on what is considered "crown land" (under governmental jurisdiction), and they are still struggling for legal recognition of their ancestral territory by the Canadian government. In the meantime, most of the territory has been allocated to forestry companies and more than 60% of productive forests have been clear-cut over the last 40 years (Saint-Arnaud et al. 2009). Prior to that, selective logging for large-diameter hardwoods and pines (white and red) was practiced for several decades (Asselin 1995).

The intensification of industrial forestry activities on the territory has engendered feelings of unlawful misappropriation of the land and has led to frustration, tensions, and conflict (Saint-Arnaud et al. 2009). Since the late 1990s, the community has a Forest Committee (now called the *Aki* [Land] Department) that has been mandated by the community to protect its interests in the forest management planning process, to assess the state of the forest, to identify sites of cultural interest and high conservation value forests, and to develop research priorities (Papatie 2004). Following decisions from the Supreme Court of Canada, government officials and forestry companies have the obligation to consult and accommodate aboriginal people during forest management planning (Gouvernement du Québec 2008; Tikina et al. 2010; Government of Canada 2011). The *Aki* Department thus participates in consultation, but as it often occurs late in the planning process, the role of the community in decision making remains marginal.

Data collection and analysis

The study stemmed from a request from the Kitcisakik *Aki* Department, thus ensuring its legitimacy and facilitating active participation from community members (Asselin and Basile 2012). The research protocol was approved by the Research Ethics Board of the Université du Québec en Abitibi-Témiscamingue (UQAT). Qualitative data were collected through key informant interviews. Key informants were selected based on peer selection by applying chain referral, also called snowball sampling, in which participants suggest other local holders of knowledge (Gamborg et al. 2012). A community facilitator appointed by the *Aki* Department helped identify and contact participants. The subject and the objectives of the study were explained to the participants to obtain clear and informed consent.

An interview guide was prepared to facilitate semidirective interviews. The guide included 21 questions and was validated by the *Aki* Department. It was subdivided into two parts: (*i*) cultural and spiritual importance of white pine and (*ii*) traditional ecological knowledge related to white pine. Not all questions were always asked or answered, depending on the turn of the conversation and on the knowledge of the respondents. Photographs were used to make sure that respondents clearly identified white pine (and could differentiate it from red pine or jack pine). Photographs were also used to show damages due to blister rust and weevil. Native names of trees and animals were often used to facilitate communication, as most respondents were more comfortable with Algonquin than French or English names. Interviews were conducted in French, with the help of a local Algonquin–French translator for the three oldest participants.

We interviewed 15 community members (5 women and 10 men) during May–June 2012, representing 29% of the population ≥45 years old (according to the latest data available from the Canadian Department of Aboriginal Affairs and Northern Development). Informants from older age groups (≥45 years) were selected, since they were expected to have observed the long-term history of white pine on their territory (Souto and Ticktin 2012). Four respondents were aged 45–49 years (all men), three were 50–54 years (all men), four were 55–59 years (all women), and four were >65 years old (including one woman). These individuals included a healer, hunters, a former timber logger, and members of past and present Band Councils. Interviews lasted approximately 30 min. They were scheduled at the convenience of the participants and took place in a location chosen by them. Interviews were audiorecorded to facilitate transcription and content analysis whenever the consent was granted by the respondents.

Content analysis was used to extract the main themes from the interview transcripts (May 2002). The framework developed by Garibaldi and Turner (2004) was used to determine if white pine is a cultural keystone species for the Kitcisakik Algonquin community. This framework consists of six different elements that must be considered when identifying a cultural keystone species (Table 1). This study was conducted in parallel with another study that assessed the ecology and reproductive biology of white pine on the Kitcisakik Algonquin territory (Y. Uprety, H. Asselin, Y. Bergeron, and M.J. Mazerolle (submitted for publication)). Data from this study and from a review of the relevant literature on white pine ecology were compared with the TEK documented in the present study. The results and interpretations presented in this paper were discussed with the Kitcisakik *Aki* Department. The community facilitator who was present in all interviews ensured that everyone was properly cited.

Results

Content analysis of the interviews revealed key features of cultural importance and TEK relating to white pine (Table 2). The following sections elaborate on these perceptions.

Perception of white pine

Since only knowledgeable persons were interviewed, all respondents were familiar with white pine, referred to locally as *Cigwâtik*. There was no specific pattern of knowledge distribution between male and female respondents. White pine was perceived as a majestic tree and was considered as the "king" or "chief" (*Okima*) of the forest because of the giant trunk size and height (relative to the other common tree species in the area). Interestingly, respondents were generally referring to mature or old white pine during the interviews, sometimes associating white pine with old-growth forest. Several respondents said that magnificent landscapes of old-growth forest with white pine made them feel relaxed and at peace. Furthermore, they said that wind produces a pleasant, appeasing sound when blowing through pine trees. Tall white pine trees were also said to be important for providing shade.

The use of tall white pine trees for orientation was reported by several respondents. White pine trees towering above the canopy are used as landmarks and can even be used for orientation "at night, under the moonlight". The orientation of the branches is also used as an indicator of wind direction (and thus cardinal

Table 1. White pine rating for the six elements used to identify cultural keystone species (Garibaldi and Turner 2004): 5 = "yes, very high"; 4 = "yes, high"; 3 = "yes, moderate"; 2 = "yes, low"; 1 = "yes, although low or infrequent"; and 0 = "no, not used."

No.	Elements that indicate a cultural keystone species	Rating
1	Intensity, type, and multiplicity of use	
	• Is the species used intensively (routinely and (or) in large quantities)?	5
	• Does the species have multiple uses?	5
2	Naming and terminology in the language, including use as seasonal or phenological indicators, names of months or seasons, place names	
	• Does the language incorporate names and specialized vocabulary relating to the species?	2
3	Role in narratives, ceremonies, or symbolism	
	• Is it prominently featured in narratives and (or) ceremonies, dances, songs, or as a major crest, totem, or symbol?	5
4	Persistence and memory of use in relationship to cultural change	
	• Is the species ubiquitous in the collective cultural consciousness and frequently discussed?	5
5	Level of unique position in culture	
	• Would it be hard to replace this species with another available native species?	5
6	Extent to which it provides opportunities for resource acquisition from beyond the territory	
	• Is this species used as a trade item for other groups?	1
Total		28

Note: The higher the sum total for all questions, the more likely that the species is a cultural keystone species. The highest possible rating is 35. Ratings for each question are based on the information gathered from the interviews.

Table 2. Key features of cultural importance and traditional ecological knowledge relating to white pine in the Kitcisakik Algonquin community.

No.	Key feature	Percentage of respondents
1	Important as a habitat or food source for many species of wildlife, including eagle and moose, which are important cultural species	100
2	Many intangible services are obtained from white pine, e.g., it provides shade, acts as a landmark, protects from lightning strikes, and acts as a water filter	100
3	Logging is a major factor responsible for the decline of white pine on the ancestral territory	100
4	Mixed plantations could be a good option for white pine restoration and management	80
5	White pine is an important timber species	80
6	White pine is an important traditional medicine	75
7	The cultural and spiritual roles of white pine cannot be replaced by another species of native origin	62
8	Fire used to play an important role in the life cycle of white pine	40
9	Damage due to white pine blister rust and white pine weevil is sometimes seen in open areas but is not perceived as a serious problem on the territory	27

points), as branches are often longer on the side opposite to dominant (western) winds. The clear understory of white pine forests was also said to be important, as it facilitates movements (especially during portage) and allows hunters to see animals from afar.

Cultural and spiritual importance

When asked about the cultural and spiritual significance of white pine trees and forests, all respondents said that their culture and beliefs were connected to this species. Some respondents said that white pine was part of traditional stories and myths, thus highlighting its cultural and spiritual salience. White pine was considered a sacred tree and was believed to give protection to the people. An elder said "I talk to him so that he protects me because it is the largest and tallest tree in our forests". When asked if it would be possible to replace the role of this species in their culture by another native tree species available on the territory, most of the respondents that answered this question said it would not be possible.

All respondents said that bald eagles (*Haliaeetus leucocephalus* L.) nest on the tops of tall white pine trees. Eagles are sacred in the Algonquin culture, helping people get through grief. One woman said "they fly away with our problems". An elder said "The eagle protects us. When things go well, the eagles are there."

Medicinal value

Most of the respondents were knowledgeable about the medicinal properties of white pine. Even though they were reluctant to disclose the detailed medicinal recipes, respondents identified various ailments that were treated using white pine cones, roots, twigs with needles, and bark: heart diseases, high blood pressure, tooth problems, muscle pain, wounds, and swellings. Some respondents also said that white pine can be used as a tonic to strengthen the system.

Two respondents mentioned that white pine was used to prepare remedies after it was struck by lightning. A healer said "when lightning falls on a white pine, it makes a powder that is used to treat decayed teeth." The "yellow roots" collected from mature white pines were used to treat heart diseases. Twigs and needles of young white pine trees were boiled and given to the people with high blood pressure. Bark was also used to treat high blood pressure. Cambium was applied on wounds and swellings. Half of the respondents said that other medicinal plant species were associated with old-growth white pine forests, without specifying species names.

Food and habitat for wildlife

Respondents were asked to list the wildlife species that they had observed eating white pine seeds, branches, or bark. This question had two objectives: determine white-pine-dependent wildlife and species that are potentially threatening to white pine by predating seeds or feeding on branches or bark. According to the respondents, red squirrels (*Tamiasciurus hudsonicus* Erxl.) eat the seeds and porcupines (*Erethizon dorsatus* L.) eat the bark.

As previously mentioned, eagles preferred big white pine trees for nesting. Some duck species also nested in woodpecker holes on large white pine trees. The base of supercanopy white pine trees also provided denning sites for black bears (*Ursus americanus* Pal.). Moose (*Alces alces* L.) used white pine trees as shelter in winter

and during the rut, in addition to occasionally feeding on young stems. White pine forests are a major habitat for furbearers such as marten (*Martes americana* Tur.), fisher (*Martes pennanti* Erxl.), and wolverine (*Gulo gulo* L.). According to the respondents, these species are less abundant than before because there is less white pine left. One of the respondents said that "if you set a trap beneath a white pine, it will attract animals into the trap."

Other services provided by white pine

Children made art craft with needles, cones, and cone scales. White pine was considered as a good timber species by most of the respondents, although it was not better than other softwood species (*Pinus*, *Picea*, *Abies*, *Thuja*, or *Larix*). However, some respondents mentioned that white pine attracts lightning and that they would not use it as a construction material. White pine wood was also used to make furniture. One respondent said that large white pine trees were used to construct dugout canoes in the past. Old white pines were also used as fuelwood, but some respondents mentioned that it produces black smoke. According to one respondent, white pine cones were used to dye fishing nets and remove human scent. White pine was said to act as a water filter, providing potable water.

Threats to white pine

All of the respondents said that logging was the main reason for white pine decline on the territory. There was a consensus among the respondents that white pine was less abundant today than in their childhood because of clear-cut logging, although the decline had already started back then because of selective logging. They were concerned that forestry companies might log the remaining white pines in the near future. According to the respondents, forests were "more alive" when there were more large white pines. Although some of the respondents mentioned that squirrel was a major predator of white pine seeds they did not mention it as a threat. Two of the respondents also indicated that recent windfalls (ca. 1992 and 2006) killed several white pines. Lightning strikes were also said to occasionally kill some big white pine trees, although forest fires are now very rare on the territory.

When we showed pictures of damage from blister rust and weevil, none of the respondents cited these as potential reasons for white pine decline on the territory. Nevertheless, a few respondents were familiar with these problems and they indicated that they were mostly prevalent along road sides and in pure plantations. Some respondents also noticed that diseases appeared on residual white pine trees after logging when machinery passed too close.

Management and restoration

When asked if fire plays a role in white pine's life cycle, some of the respondents indicated that fire used to play an important role in white pine ecology but could not elaborate. They nevertheless said that surface forest fires have been very rare on the territory for almost a century and no longer provide suitable seedbeds for natural white pine regeneration.

According to the respondents, there were very little, if any, white pine restoration efforts on the territory. They were highly dissatisfied with the fact that forestry companies were more interested in logging than in restoration. They deplored that companies cut white pine and plant jack pine (more valued by local sawmills).

When asked about the appropriate measures for white pine restoration, all of the respondents said that mixed plantations would be necessary. However, opinions varied about the other species that should be planted along with white pine. The most cited species were white spruce (4 times), balsam fir (3 times), and birch (2 times). Three respondents suggested that plantation along with balsam fir might not be a good option, as there is a legend saying that white pine and balsam fir are enemies. Some of the respondents noticed that white pine was in competition with hardwoods, mostly with quaking aspen and paper birch. One of the respondents suggested pure white pine plantations, not very dense, and control of hardwood species.

Two of the women respondents were worried about the medicinal efficacy of planted white pine. They said they never tried to use planted white pines for medicinal purposes. A healer said "I dig into the earth at the foot of mature white pines and pick up the yellow roots to treat heart diseases. Would there still be yellow roots if trees are planted rather than naturally grown? I don't know." Another respondent said that "cedars [*Thuja occidentalis* L.] planted in cities do not work as medicinal plants."

Respondents were not familiar with the optimal growth conditions for white pine. They said that it would be wise to plant white pine where it used to grow. They mentioned that restoration should take place all over the territory (in every family hunting ground where it used to be present) and at higher densities near settlements.

Discussion

The social and ecological significance of forests and trees is relatively less studied for aboriginal peoples of Canada than for other cultural groups, e.g., indigenous people of the Amazon (Berkes and Davidson-Hunt 2006). We have documented the cultural and spiritual importance and the traditional ecological knowledge of white pine in the Kitcisakik Algonquin community. Some of the respondents were reluctant to share information about medicinal uses of white pine. This reluctance could possibly be explained by the respondents wanting to keep cultural and spiritual aspects confidential or having concerns about the respect of intellectual property rights (Karjala et al. 2002), especially as legal protection is insufficient in Canada (Uprety et al. 2012*a*). There is evidence that traditional knowledge has been used by scientists in the past with no consideration for, or validation from, aboriginal people (Berkes 2008). Nevertheless, respondents were generally open to discuss other topics and there was very strong coherence between interviews. This, combined with the fact that many widely varied topics were covered, provides sufficient material to use the keystone species framework (Garibaldi and Turner 2004).

White pine as a cultural keystone species

White pine is culturally, spiritually, and ecologically very important to the Kitcisakik Algonquin people. They expressed strong feelings of attachment and spiritual connection to white pine trees and forests. The oldest white pine trees can live up to 450 years and grow as tall as 70 m (Anonymous 1993). The tops of the largest trees float in the air, far above their smaller neighbors (Schroeder 1992). This characteristic makes white pine a unique species of northeastern North American forest landscapes and justifies why it is used as a landmark by people from Kitcisakik. People from the Scandinavian boreal forest also use tall trees as landmarks (Östlund et al. 2002). The reason why respondents were mostly referring to mature or old white pine might be because supercanopy trees are more conspicuous. This also suggests that scattered white pines were remnants of former more extensive pine stands (Stearns 1992). Furthermore, forest inventory data from the Quebec Ministry of Natural Resources show that younger age classes (regeneration, 30 and 50 years) are under-represented in the study area.

White pine provides many ecosystem services to the people of Kitcisakik (Table 2). It is also important for wildlife, providing food and shelter, notably to flagship species such as bald eagle and moose. Some of the medicinal uses of white pine documented in our study are unique and different, and some are comparable to the uses by other aboriginal groups of the Canadian boreal forest (Uprety et al. 2012*a*). While the use of white pine bark (cambium) to treat wounds and swellings was already documented, the uses

Table 3. Correspondence of traditional ecological knowledge with scientific studies concerning white pine.

Characteristic	Traditional ecological knowledge	Scientific ecological knowledge
Damage due to blister rust or weevil	Sometimes seen on the territory, but mostly in open areas such as plantations or road sides. Not perceived as a major threat on the territory.	Prevalent on the territory, mostly in open areas such as plantations and along road sides (Uprety et al. (submitted for publication)).
Role of fire	Fire used to play an important role in white pine ecology.	Fire is an important agent for white pine distribution, ecology, and reproductive biology (Frelich 1992).
Potential areas for restoration	Restoration plantations should be established in areas where white pine used to be present.	Restoration efforts should focus on sites where the target species was present (Uprety et al. 2012*b*).
Best restoration strategy	Mixed plantations (with various companion species).	Mixed plantations with Norway spruce (Coulombe et al. 2004).
Understory vegetation	Absence of understory vegetation (makes it easier to walk when chasing game).	Understory plants are usually sparse in white pine forests (Wendel and Smith 1990).
Aesthetic value	White pine trees are landmarks, they are part of magnificent landscapes, and white pine stands are good places for resourcing.	Many tourists and outdoor enthusiasts prefer forests containing white pine, particularly those with large old trees (MNR 2008).
Nesting habitat for eagles	Eagles prefer tall white pine trees for nesting.	Some older supercanopy trees are favoured by bald eagles for nesting (Rogers and Lindquist 1992).
Importance for other wildlife species	Porcupine, squirrel, moose, bear, fisher, and woodpecker are associated with white pine.	Inner bark is a favorite winter food of porcupines (Rogers and Lindquist 1992). Squirrel, moose, and fisher are dependent on white pine for food and shelter (Quinby 1989; Naylor 1994).
Impact of logging	Extensive logging is a major factor responsible for white pine decline on the territory.	Logging is reported as one of the major factors responsible for white pine decline throughout its distribution range (Carleton et al. 1996; Weyenberg et al. 2004).
Impact of windfall	Major windfall events contributed to reduce white pine abundance on the territory.	Severe windstorms gradually reduce the pine component and advance succession towards hardwoods (Frelich 1992).
Competition from other species	Hardwood species such as trembling aspen and paper birch, and conifer species such as balsam fir outgrow white pine and increase understory shade above critical level.	Competition from fast-growing species, especially in productive sites, is a major problem (Wendel and Smith 1990; Ostry et al. 2010). A significant negative effect of balsam fir basal area was found on white pine regeneration abundance (Y. Uprety, H. Asselin, Y. Bergeron, and M.J. Mazerolle (submitted for publication)).
Lightning strikes	White pine receives lightning strikes and saves houses and people.	Tall trees attract lightning strikes (Ruffner and Abrams 1998).

of white pine against heart diseases, tooth problems, and to strengthen the system are new from the present study. Other reported uses of white pine by North American aboriginal people include use of pitch on boils by the Delawares and use of a needle infusion on cuts, bruises, sores, and scabs by the Iroquois (Arnason et al. 1981).

For the Kitcisakik Algonquin, white pine is the "king" of trees, offering protection. People often go into white pine forests for resourcing. White pine also possesses important symbolic and spiritual value to other aboriginal cultures, e.g., the Menominee (Wood and Dewhurst 1998) and Iroquois (Schroeder 1992) people of the northeastern USA. In other cultures, other tree species are regarded as living beings equivalent in status to humans (Turner et al. 2009). Cedar (*Thuja*) is known as the "tree of life" by the northwest coastal peoples of British Columbia (Stryd and Feddema 1998). In other areas, birch (*Betula*) is the "tree of health, wisdom, and safety", cedars are the "trees of paradise", and ash (*Fraxinus*) is the "tree of rebirth" and is planted as protection against evil creatures (Coder 1996).

The more widely or intensively a plant is used, the greater its cultural significance (Turner 1988). However, cultural significance varies in quality, intensity, and exclusivity, and this must be considered in any effort to evaluate or measure the importance of a plant (Turner 1988). Although criticisms have been raised about the framework developed by Garibaldi and Turner (2004) (see Platten and Henfrey 2009), it provides a good way of assessing both the tangible and intangible values of a species (Kanowski and Williams 2009). Platten and Henfrey (2009) emphasized that a cultural keystone should be understood as a "complex" involving several material and nonmaterial system elements, rather than a "single biological species". Following Bohensky and Maru (2011), we used the framework developed by Garibaldi and Turner (2004) as a tool to provide social context to link indigenous and scientific knowledge for management and restoration. Therefore, using this framework, white pine can be designated as a cultural keystone species for the Kitcisakik Algonquin community (Table 1). It has high spiritual and medicinal value and is featured in many narratives. The high cultural significance of the species is also reflected by the fact that, according to most of the respondents, this species cannot be replaced by another native tree species available on the territory. This could explain why the community is calling for restoration of the species on its territory. Even if information was lacking about the existence of specialized vocabulary relating to white pine or opportunities to trade white pine products with other indigenous groups (criteria 2 and 6 of Garibaldi and Turner (2004); Table 1), the total ranking for white pine (28/35) was comparable to that of species identified as cultural keystones in Garibaldi and Turner (2004).

Comparing traditional knowledge and ecological studies

All of the ecological information gathered from the interviews corresponds to scientific findings (Table 3), illustrating that traditional knowledge and science could be used in complementarity (Moller et al. 2004; Rist et al. 2010; Uprety et al. 2012*b*). The role of fire in white pine ecology was recognized by the respondents. However, this knowledge was uncertain as there have been no large forest fires on the territory since the 1920s (Lesieur et al. 2004; Grenier et al. 2005) and respondents have thus never wit-

nessed the impact of fire on white pine. Relatively frequent, low-intensity surface fires coupled with infrequent, high-intensity stand-replacing fires favor the establishment of white pine (Frelich 1992). Increased fire activity gives a competitive advantage to white pine over other fire susceptible species (Bergeron et al. 1997). Such fire regimes maintain and regenerate white pine by preparing seedbeds and eliminating competition. Logging has now replaced fire as the major agent of disturbance on the Kitcisakik territory (Lesieur et al. 2004).

The tops of tall white pine trees were referred to as preferred nesting habitat for eagles, and the bases of those supercanopy trees were used as denning sites for bears. Studies have shown that white pine is indeed a preferred tree for eagles and bears (Rogers and Lindquist 1992; MNR 2008). The irregular crowns of supercanopy white pines enable birds with large wingspans to land and nest (Rogers and Lindquist 1992). Particular assemblages of bird species were also found to be associated with supercanopy pine trees (Kirk et al. 2012). In Ontario, white pine snags were preferred by woodpeckers for feeding and nesting, and the larger, more decayed snags were preferred (Quinby 1989). These woodpecker holes are also used by secondary users such as wood duck (DeGraaf and Shigo 1985). About 80% of the forest-dwelling wildlife found in central Ontario used forest associations containing red or white pine (Naylor 1994).

Importance of cultural values and traditional ecological knowledge recognition

In recent years a step has been taken to include social and cultural values in forest management (IUFRO 2007). Equally important is to incorporate traditional forest-related knowledge that can assist in interpreting and responding to feedback from the environment and to guide resource management (Berkes et al. 2000; Turner et al. 2000; Trosper and Parrotta 2012). Recognizing these two important aspects can better promote cultural diversity, meet peoples' aspirations, and encourage their participation in forest management.

Turner et al. (2008) explored a range of "invisible losses" in aboriginal contexts that are not widely recognized or accounted for in decisions about resource planning and decision making: cultural and (or) lifestyle losses, loss of identity, health losses, loss of self-determination and influence, emotional and psychological losses, loss of order in the world, knowledge losses, and indirect economic losses and lost opportunities. White pine is an inseparable cultural entity of the Kitcisakik aboriginal people and most of these "invisible losses" are likely to happen in the near future if the white pine decline continues.

The intrinsic ecological worth and cultural and spiritual significance (Trigger and Mulcock 2005) of white pine as perceived by the Kitcisakik Algonquin community should be respected in forest management. As Brynaert (1985) suggested, the forestry industry must recognize that exercising its rights to utilize timber resources embodies a responsibility not to degrade or infringe upon the legitimate interests of other resource users. Considerable effort will be required to reach a high level of participation of local communities and efficient incorporation of TEK (Cheveau et al. 2008; Saint-Arnaud et al. 2009). This study, by documenting the cultural importance of white pine to the Kitcisakik Algonquin people, will hopefully help design culturally adapted restoration and management strategies.

Acknowledgements

We are grateful to the members of the Kitcisakik community for their participation in the study and for sharing their valuable knowledge. We thank Monique Pâquet, Charlie Papatie, and Martine Carrier for their help in conducting the interviews. Thanks to Mélanie Desrochers (Centre for Forest Research, Université du Québec à Montréal) for helping with the Fig. 1 design. We also thank two anonymous reviewers for their constructive comments on an earlier version of the manuscript. The study was supported by the Social Science and Humanities Research Council of Canada (SSHRC). Scholarships provided to Y.U. by the Aboriginal Peoples Research and Knowledge Network (DIALOG), Centre for Forest Research (CEF), Centre de recherche sur la gouvernance des ressources naturelles et du territoire (CRGRNT), Chaire Desjardins en développement des petites collectivités, and Association québécoise de gestion de la végétation (AQGV) are highly appreciated.

References

Anonymous. 1993. Flora of North America. Vol. 2. Oxford University Press, New York.

Arnason, T., Hebda, R.J., and Johns, T. 1981. Use of plants for food and medicine by Native Peoples of eastern Canada. Can. J. Bot. **59**(11): 2189–2325. doi:10.1139/b81-287.

Asselin, M. 1995. L'Abitibi-Témiscamingue : trois sous-régions, une région. *In* Histoire de l'Abitibi-Témiscamingue. *Edited by* O. Vincent. Institut québécois de recherche sur la culture. pp. 21–65.

Asselin, H., and Basile, S. 2012. Éthique de la recherche avec les Peuples autochtones : Qu'en pensent les principaux intéressés? Éthique publique, **14**(1): 333–345.

Barrette, M., and Bélanger, L. 2007. Reconstitution historique du paysage préindustriel de la région écologique des hautes collines du Bas-Saint-Maurice. Can. J. For. Res. **37**(7): 1147–1160. doi:10.1139/X06-306.

Bergeron, Y., Leduc, A., and Li, T. 1997. Explaining the distribution of *Pinus* spp. in a Canadian boreal insular landscape. J. Veg. Sci. **8**: 37–44. doi:10.2307/3237240.

Berkes, F. 2008. Sacred ecology. Taylor and Francis, Philadelphia.

Berkes, F., and Davidson-Hunt, I.J. 2006. Biodiversity, traditional management systems, and cultural landscapes: examples from the boreal forest of Canada. Int. Soc. Sci. J. **58**(187): 35–47. doi:10.1111/j.1468-2451.2006.00605.x.

Berkes, F., Colding, J., and Folke, C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecol. Appl. **10**(5): 1251–1262. doi:10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2.

Bohensky, E.L., and Maru, Y. 2011. Indigenous knowledge, science, and resilience: What have we learned from a decade of international literature on "integration"? Ecol. Soc. **16**(4): 6. doi:10.5751/ES-04342-160406.

Brynaert, K.A. 1985. Recreational and cultural use of the forest. For. Chron. **61**(2): 166–167. doi:10.5558/tfc61166-2.

Carleton, T.J., Maycock, P.F., Arnup, R., and Gordon, A.M. 1996. In situ regeneration of *Pinus strobus* and *P. resinosa* in the Great Lakes forest communities of Canada. J. Veg. Sci. **7**: 431–444. doi:10.2307/3236287.

Cheveau, M., Imbeau, L., Drapeau, P., and Bélanger, L. 2008. Current status and future directions of traditional ecological knowledge in forest management: A review. For. Chron. **84**(2): 231–243. doi:10.5558/tfc84231-2.

Coder, K.D. 1996. Cultural aspects of trees: traditions and myths. Cooperative Extension Service, University of Georgia, Athens, Georgia.

Coulombe, C., Bélanger, G., Lavallée, R., and Laflamme, G. 2004. A simple effective tool for controlling white pine weevil and blister rust on Norway spruce and eastern white pine. Natural Resources Canada, Quebec.

DeGraaf, R.M., and Shigo, A.L. 1985. Managing cavity trees for wildlife in the northeast. USDA For. Serv.

Delwaide, A., and Filion, L. 1999. Dendrosérie du pin blanc (*Pinus strobus* L.) et de la pruche de l'est (*Tsuga canadensis* L. [Carr.]) dans la région de Québec. Géographie physique et Quaternaire, **53**: 265–275. doi:10.7202/004853ar.

Dudley, N., Higgins-Zogib, L., and Mansourian, S. 2005. Beyond belief: linking faiths and protected areas to support biodiversity conservation. WWF International, Switzerland.

Frelich, L.E. 1992. The relationship of natural disturbances in white pine stand development. *In* White Pine Symposium Proceedings: History, Ecology, Policy and Management, 16–18 September 1992. *Edited by* R.A. Stine and M.J. Baughman. Department of Forestry Resources, University of Minnesota, St. Paul. pp. 27–37.

Gamborg, C., Parsons, R., Puri, R.K., and Sandøe, P. 2012. Ethics and research methodologies for the study of traditional forest-related knowledge. *In* Traditional forest-related knowledge: sustaining communities, ecosystems and biocultural diversity. *Edited by* J.A. Parrotta and R.L. Trosper. World Forest XII, IUFRO, The Christensen Fund, and Springer. pp. 535–562.

Garibaldi, A., and Turner, N. 2004. Cultural keystone species: implications for ecological conservation and restoration. Ecol. Soc. **9**(3): 1.

Gouvernement du Québec, 2008. Guide intérimaire en matière de consultation des communautés autochtones. Groupe interministériel de soutien sur la consultation des Autochtones.

Government of Canada, 2011. Aboriginal consultation and accommodation. Updated guidelines for federal officials to fulfill the duty to consult. Department of Aboriginal Affairs and Northern Development.

Grenier, D.J., Bergeron, Y., Kneeshaw, D., and Gauthier, S. 2005. Fire frequency for the transitional mixedwood forest of Timiskaming, Quebec, Canada. Can. J. For. Res. **35**(3): 656–666. doi:10.1139/x05-005.

International Union of Forest Research Organizations (IUFRO). 2007. The role of culture in sustaining today's forests. IUFRO, Fact Sheet. Available from www.iufro.org [accessed 26 June 2012].

Kanowski, P.J., and Williams, K.J.H. 2009. The reality of imagination: integrating the material and cultural values of old forests. For. Ecol. Manage. **258**: 341–346. doi:10.1016/j.foreco.2009.01.011.

Karjala, M.K., Sherry, E.E., and Dewhurst, S.M. 2002. Criteria and indicators for sustainable forest planning: a framework for recording aboriginal resource and social values. For. Pol. Econ. **6**: 95–110. doi:10.1016/S1389-9341(02)00117-X.

Kirk, D.A., Welsh, D.A., Baker, J.A., Thompson, I.D., and Csizy, M. 2012. Avian assemblages differ between old-growth and mature white pine forests of Ontario, Canada: A role for supercanopy trees? Av. Conserv. Ecol. **7**(1): 4. doi:10.5751/ACE-00503-070104.

Leroux, J., Chamberland, R., Brazeau, E., and Dubé, C. 2004. Au pays des peaux de chagrin : Occupation et exploitation territoriale à Kitcisakik (Grand lac Victoria) au XX^{e} siècle. Presses de l'Université Laval, Quebéc.

Lesieur, D., Lefort, P., Bergeron, Y., and Lauzon, È. 2004. Reconstitution de l'historique des perturbations naturelles et de la composition de la forêt pré-industrielle au sud de Val-d'Or. Rapport de la Chaire industrielle en aménagement forestier durable soumis à Domtar.

Liu, K.-B. 1990. Holocene paleoecology of the boreal forest and Great Lakes–St. Lawrence forests in northern Ontario. Ecol. Monogr. **60**: 179–212. doi:10.2307/1943044.

Major, J.E., Mosseler, A., Barsi, D.C., Clouthier, A., and Campbell, M. 2009. Impact of three silvicultural treatments on weevil incidence, growth, phenology, and branch level dynamics of *Pinus strobus* from large and small populations. Can. J. For. Res. **39**(1): 12–25. doi:10.1139/X08-153.

May, T. (*Editor*). 2002. Qualitative research in action. Sage Publications Inc., Thousand Oaks, California.

McDonough, M.H. 2003. Understanding the meaning and value of forests and trees. *In* Understanding community–forest relations. *Edited by* L.E. Kruger. USDA For. Serv., Pacific Northwest Res. Stat., Portland. Gen. Tech. Rep. PNW-GTR-566. pp. 145–162.

Ministry of Natural Resources (MNR). 2008. State of the resource reporting. Regional report: White pine in the lake Abitibi and lake Temagami ecoregions of Ontario. Ministry of Natural Resources, Ontario.

Moller, H., Berkes, F., Lyver, B.O., and Kislalioglu, M. 2004. Combining science and traditional ecological knowledge: monitoring populations for co-management. Ecol. Soc. **9**(3): 2.

Naylor, B.J. 1994. Managing wildlife habitat in red pine and white pine forests of central Ontario. For. Chron. **70**(4): 411–419.

Östlund, L., Zackrisson, O., and Hornberg, G. 2002. Trees on the border between nature and culture. Environ. Hist. **7**: 48–68. doi:10.2307/3985452.

Ostry, M.E., Laflamme, G., and Katovich, S.A. 2010. Silvicultural approaches for management of eastern white pine to minimize impacts of damaging agents. Forest Pathol. **40**: 332–340. doi:10.1111/j.1439-0329.2010.00661.x.

Papatie, J. 2004. Vécu et réflexion de la communauté Anicinapek de Kitcisakik avec le régime forestier des Québécois. Brief submitted to the Commission for the study of public forest management in Québec.

Platten, S., and Henfrey, T. 2009. The cultural keystone concept: insights from ecological anthropology. Hum. Ecol. **37**: 491–500. doi:10.1007/s10745-009-9237-2.

Quinby, P.A. 1989. Old growth forest survey in Temagami's Wakimika Triangle. Tall Pines Project Res. Rep. No. 2. Temagami Wilderness Society, Toronto.

Ramakrishnan, P.S. 2007. Traditional forest knowledge and sustainable forestry: a north-east India perspective. For. Ecol. Manage. **249**: 91–99. doi:10.1016/j.foreco.2007.04.001.

Rist, L., Shaankar, R.U., Milner-Gulland, E.J., and Ghazoul, J. 2010. The use of traditional ecological knowledge in forest management: an example from India. Ecol. Soc. **15**(1): 3.

Robinson, D.W., and Hawley, W.L. 1997. Social indicators and management implications derived from the Canadian Forest Survey '96. McGregor Model Forest Association, British Columbia.

Rogers, L.L., and Lindquist, E.L. 1992. Supercanopy white pine and wildlife. *In* White Pine Symposium Proceedings: History, Ecology, Policy and Management, 16–18 September 1992. *Edited by* R.A. Stine and M.J. Baughman. Department of Forestry Resources, University of Minnesota, St. Paul. pp. 39–43.

Ruffner, C.M., and Abrams, M.D. 1998. Lightning strikes and resultant fires from archival (1912–1917) and current (1960–1997) information in Pennsylvania. J. Tor. Bot. Soc. **125**(3): 249–252. doi:10.2307/2997223.

Saint-Arnaud, M., Asselin, H., Dubé, C., Croteau, Y., and Papatie, C. 2009. Developing criteria and indicators for aboriginal forestry: mutual learning through collaborative research. *In* Changing the culture of forestry in Canada: building effective institutions for aboriginal engagement in sustainable forest management. *Edited by* M.G. Stevenson and D.C. Natcher. Canadian Circumpolar Institute Press, Edmonton. pp. 85–105.

Saucier, J.-P., Bergeron, J.-P., Grondin, P., and Robitaille, A. 1998. Les régions écologiques du Québec méridional (troisième version). L'Aubelle, **124**: S1–S12.

Schroeder, H.W. 1992. The tree of peace: symbolic and spiritual values of the white pine. *In* White Pine Symposium Proceedings: History, Ecology, Policy and Management, 16–18 September 1992. *Edited by* R.A. Stine and M.J. Baughman. Department of Forestry Resources, University of Minnesota, St. Paul. pp. 73–83.

Souto, T., and Ticktin, T. 2012. Understanding interrelationships among predictors (age, gender, and origin) of local ecological knowledge. Econ. Bot. **66**(2): 149–164. doi:10.1007/s12231-012-9194-3.

Stearns, F. 1992. Ecological characteristics of white pine. *In* White Pine Symposium Proceedings: History, Ecology, Policy and Management, 16–18 September 1992. *Edited by* R.A. Stine and M.J. Baughman. Department of Forestry Resources, University of Minnesota, St. Paul. pp. 10–18.

Stryd, A.H., and Feddema, V. 1998. Sacred cedar: The cultural and archaeological significance of culturally modified trees. A report of the Pacific Salmon Forest Project. David Suzuki Foundation, Vancouver.

Thompson, I.D., Simard, J.H., and Titman, R.D. 2006. Historical changes in white pine (*Pinus strobus* L.) density in Algonquin Park, Ontario, during the 19th century. Nat. Area. J. **26**(1): 61–71. doi:10.3375/0885-8608(2006)26[61:HCIWPP]2.0.CO;2.

Tikina, A.V., Innes, J.L., Trosper, R.L., and Larson, B.C. 2010. Aboriginal peoples and forest certification: a review of the Canadian situation. Ecol. Soc. **15**(3): 33.

Trigger, D., and Mulcock, J. 2005. Forests as spiritually significant places: nature, culture and 'belonging' in Australia. Aust. J. Anthropol. **16**(3): 306–320. doi:10.1111/j.1835-9310.2005.tb00313.x.

Trosper, R.L., and Parrotta, J.A. (*Editors*). 2012. Traditional forest-related knowledge: sustaining communities, ecosystems and biocultural diversity. World Forest XII, IUFRO, The Christensen Fund, and Springer.

Turner, N.J. 1988. "The importance of a rose": evaluating the cultural significance of plants in Thompson and Lillooet Interior Salish. Am. Anthropol. **90**: 272–290. doi:10.1525/aa.1988.90.2.02a00020.

Turner, N.J. 2005. The earth's blanket: traditional teachings for sustainable living. Douglas and McIntyre, Vancouver.

Turner, N.J., Ignace, M.B., and Ignace, R. 2000. Traditional ecological knowledge and wisdom of aboriginal people in British Columbia. Ecol. Appl. **10**(5): 1275–1287. doi:10.1890/1051-0761(2000)010[1275:TEKAWO]2.0.CO;2.

Turner, N.J., Gregory, R., Brooks, C., Failing, L., and Satterfield, T. 2008. From invisibility to transparency: identifying the implications. Ecol. Soc. **13**(2): 7.

Turner, N.J., Ari, Y., Berkes, F., Davidson-Hunt, I., Ertug, Z.F., and Miller, A. 2009. Cultural management of living trees: an international perspectives. J. Ethnobiol. **29**(2): 237–270. doi:10.2993/0278-0771-29.2.237.

United Nations (UN). 2007. United Nations declaration on the rights of indigenous peoples. Available from http://www.un.org/esa/socdev/unpfii/en/declaration.html [accessed 14 July 2012].

Uprety, Y., Asselin, H., Dhakal, A., and Julien, N. 2012*a*. Traditional use of medicinal plants by aboriginal people of boreal Canada: review and perspectives. J. Ethnobiol. Ethnomed. **8**: 7. doi:10.1186/1746-4269-8-7.

Uprety, Y., Asselin, H., Bergeron, Y., Doyon, F., and Boucher, J.-F. 2012*b*. Contribution of traditional knowledge to ecological restoration: practices and applications. Ecoscience, **19**(3): 225–237. doi:10.2980/19-3-3530.

Wendel, G.W., and Smith, H.C. 1990. *Pinus strobus* L., eastern white pine. *In* Silvics of North America. Vol. 1, Conifers. *Edited by* R.M. Burns and B.H. Honkala. USDA, Washington, D.C. pp. 467–488.

Weyenberg, S.A., Frelich, L.E., and Reich, P.B. 2004. Logging versus fire: How does disturbance type influence the abundance of *Pinus strobus* regeneration? Silva Fenn. **38**(2): 179–194.

White, M.A., Brown, T.N., and Host, G.E. 2002. Landscape analysis of risk factors for white pine blister rust in the Mixed Forest Province of Minnesota, U.S.A. Can. J. For. Res. **32**(9): 1639–1650. doi:10.1139/x02-078.

Wood, D.B., and Dewhurst, S.M. 1998. A decision support system for the Menominee legacy forest. J. For. **95**: 28–32.

Young, E. 1999. Reconciliation or exclusion? Integrating indigenous and non-indigenous land management concepts for Australia's Native Title era. Asia Pac. Viewpoint, **40**(2): 159–171. doi:10.1111/1467-8373.00089.