Hum Ecol (2010) 38:401–414
DOI 10.1007/s10745-010-9325-3

Fire, Agency and Scale in the Creation of Aboriginal Cultural Landscapes

Andrew Martin Miller · Iain Davidson-Hunt

Published online: 1 April 2010

Abstract Much recent literature explores controlled burning practices used by people of different cultures to manipulate landscapes. Because humans have only recently been able to suppress fires occurring at larger scales these studies focus on activities occurring at the scale of sites as making the greatest contribution to creating cultural landscapes. In this study we examine the role of fire in the construction of Anishinaabe cultural landscapes in the boreal forest of northwestern Ontario. Through our work with elders of Pikangikum First Nation we examined Anishinaabe knowledge and relationships to fire occurring across spatial and temporal scales. Pikangikum residents perceive forest fires as beings which possesses agency and who intentionally create order in landscapes. This notion suggests that cultural landscapes are more than the physical remains of the sum of human activities. The possibility of non-human agents having a role in the creation of meaningful spaces prompts us to call for a reassessment both of the scale of inquiry and the nature of cultural landscapes. We conclude with a discussion of the benefits and potential constraints to inclusion of indigenous cultural landscapes in current co-management arrangements.

Keywords Anishinaabe · Pikangikum First Nation · Traditional burning · Cultural landscape · Agency · Scale

A. M. Miller (✉) · I. Davidson-Hunt
University of Manitoba,
Winnipeg, MB, Canada
e-mail: ummil239@cc.umanitoba.ca

I. Davidson-Hunt
e-mail: davidso4@cc.umanitoba.ca

Introduction

American cultural geographer Carl O. Sauer (1889–1975) introduced the concept of cultural landscapes to foreground the role of humans in shaping landscapes (1925, 1927). "The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the area is the medium, the cultural landscape is the result," (Leighly 1963: 343). His approach emphasized the "centrality of the material and observable record of humans" in shaping biophysical structures of landscapes (Agnew *et al.* 1996: 240). Through extensive documentation of the ways humans shaped landscapes Sauer realized that cultural landscapes are fashioned in many ways including one's own labor and the directing of others' labor in association with a variety of materials and technologies.

Due to his work in this area Sauer is often seen as the progenitor of a long lineage of scholars who continue to study the material and observable record of human impacts on landscapes. Much of this work has continued to focus on built structures such as terraces, irrigation systems and earthen works and other signs of agricultural activities (Birks *et al.* 1988). Other scholars pursued Sauer's interests in revealing and documenting the ways by which humans impact the biological organisms, populations and communities that form the structures of a landscape (Anderson 2005). Conceived in these terms the cultural landscape, or anthropogenic landscape as some prefer, becomes a mosaic of cultured resource patches and travel routes linking such patches (Anderson 2005; Davidson-Hunt and Berkes 2003; Trusler and Johnson 2008). The patches and routes are made up of physical structures, organisms, populations and communities created through human agency set within a natural milieu.

We have found this material approach useful in our work in documenting the structures and exchange dynamics of cultural

landscapes of Indigenous North Americans (Davidson-Hunt 2003; Turner *et al.* 2003). However, in our recent research undertaken with the Anishinaabe [Ojibwa] of Pikangikum First Nation, Ontario we found that the basic framework of counter posing cultured patches and routes against a natural milieu to be problematic. Our Anishinaabe colleagues did not agree with our basic proposition that the only agency that is expressed in fashioning the landscape is that of humans. They proposed that a variety of different actors each expressing their own agency and as a result leaving a material record extends beyond the patch and corridor model describing areas of human activity (Davidson-Hunt and Berkes 2003) to encompass the entire landscape.

In this paper we examine this proposition by focusing on a particular technology, fire, which has been a long standing (Stewart 2002; Lewis 1993; Sauer 1925) and recent (Anderson 2005; Boyd 1999; Pyne 1995) interest of scholars studying how human agency modifies landscapes. In this journal alone recent work has documented how humans have modified landscapes through fire in California (Anderson 1999); northern Canada (Lewis and Ferguson 1988); Australia (Bird *et al.* 2005; Russell-Smith *et al.* 1997; Lewis and Ferguson 1988); Indonesia (Russell-Smith *et al.* 2007); Mali (Laris 2002); Brazil (Mistry *et al.* 2005) and the Mediterranean (Blondel 2006). Elsewhere, authors have explored the pyrotechnologies of indigenous North Americans for the Pacific Northwest (Boyd 1999), California (Anderson 2005; Keeley 2002; Lewis 1993), the Great Basin (Stewart 2002), Northern prairies (Boyd 2002) the Great Lakes region (Loope and Anderton 1998; Dorney and Dorney 1989), New England (Day 1953) and the western Appalachian Mountains (Delcourt *et al.* 1998) among others. Much of this work, following Sauer's lead, utilized the material and observable record to demonstrate that most societies occupied and modified their landscapes. This work has been important for those societies in a colonial context in order to demonstrate their claims to territory (Stewart 2002) and recently such practices have been suggested as the basis for sustainable resource management systems (Anderson 2005). However, in all cases we examined the research has continued to focus exclusively on the role of human agency in creating cultural landscapes as a mosaic of human-modified organisms and patches within a natural milieu. We have been unable to encounter the acknowledgment of the role other beings may have in contributing to an intentionally ordered landscape.

Whereas most authors simply do not consider non-human initiated fires some firmly position space influenced by natural fires as outside of cultural space. Anderson (2005: 3) suggests that "...there were some places that had little or no intervention from native peoples and these would qualify as true wilderness." Lewis and Ferguson (1988) recognize that human-modified patches, or what they call a pattern of yards and corridors exist alongside a forest patterned by natural fires. As important as these works have been for the recognition of the ability of indigenous peoples to manage their territories this perspective reaffirms the dualistic natural and cultural division present within geography, biology and anthropology (Wylie 2007: 154–155) and obscures our understanding of cultural landscapes as they are conceived by people residing in them who may not divide nature and culture so sharply.

Because the present research was not restricted to an inquiry at any particular scale but instead arose from an investigation into the meaning and importance of fire to Pikangikum residents and their environment we discovered two points. First, Pikangikum knowledge and relationships with fire is by no means limited to its potential role in managing vegetation at the scale of sites but includes knowledge of fire as it occurs at both smaller and larger scales. Second, Pikangikum residents' understandings of fire's role in shaping landscapes prompt us to question underlying assumptions about how cultural landscapes are conceived and how this concept is employed.

We suggest that a Pikangikum cultural landscape is more than the sum of human-modified patches and travel routes alongside a forest patterned by natural fires. Our approach to cultural landscapes is more akin to that of Ingold (2000: 189) who suggests that we "...move beyond the sterile opposition between the naturalistic view of the landscape as a neutral, external backdrop to human activities, and the culturalistic view that every landscape is a particular cognitive or symbolic ordering of space." Our goal is a more holistic understanding of cultural landscapes informed by our Anishinaabe colleagues and other scholars who suggest that cultural landscapes are both material and symbolic and include a society's unique worldview, ontology, history, institutions, practices and the networks of relationships between human and nonhuman beings (Hierro and Surrallés 2005; Buggey 2004).

Agency, Scale and Cultural Landscapes

In order to situate our research it is necessary to briefly consider two key concepts related to cultural landscapes, namely, agency and scale. We define agency following Giddens (1979) as the capacity to make choices. Scholars who have worked with the Anishinaabe (Black 1977; Hallowell 1960), other Algonquin peoples (Martin 1982), circumpolar peoples (Ingold 2000) and our own work with the people of Iskateewizaagegan and Pikangikum (Davidson-Hunt *et al.* 2005; O'Flaherty *et al.* 2009) suggest that for many the range of actors who exhibit agency in shaping the environment exceeds that of human actors. In fact, for many sub-arctic peoples human societies are only one of

many societies composed of actors who exhibit agency both as individuals and collectively. For the Ojibwa, the term Anishinaabe refers to humans who are situated in a place, territory or a landscape and can be applied to all such human societies; it is often translated as 'the people'. Along with the Anishinaabe are other societies who also exhibit agency and for which Hallowell (1960, p. 22–23) coined the term "*other-than-human peoples*". Starting from this first order proposition of the Anishinaabe requires that we begin by asking: who are the actors who fashion a landscape in a given place through fire?

In the work on cultural landscapes scale emerges out of a Cartesian understanding of space and time in which both can be reduced to a common metric. The former refers to a cadastral grid and the later to a temporal perspective that posits a point of origin and a linear progression of time from that point forward. In this sense, if scale is mapped on an axis of space and time the origin would represent something small in size and of short duration. Larger scale events could become larger in space, time or both. In the study of cultural landscapes this idea of scale has been utilized to distinguish human practices that might be considered to be small in scale, such as the pruning of a branch, to those of a larger scale, the burning of a meadow (Anderson 1999). A landscape, in this perspective, is considered to be a large scale unit made up of a mosaic of smaller scale units, often called patches that together form an anthropogenic landscape. Fires lit by humans result in a cultural landscape mosaic made up of patches. Because large fires were considered beyond the ability of humans to influence until historically very recently, their impacts were considered to be part of the natural domain and thus discounted from consideration as cultural landscapes.

In the boreal forest this perspective on scale has influenced much of the work on understanding the use of fire by humans to shape the boreal forest in Canada. Extensive documentation exists that Canadian aboriginal peoples historically utilized controlled fires at smaller scales, in carefully chosen locations and under selected climatic conditions to achieve specific changes to vegetation communities (Davidson-Hunt 2003). Controlled burning practices encouraged game species, berry patches, and other plant resources to occur in greater abundance at specific locations and maintained important landscape features such as portages, campgrounds and trails (Lewis 1982, Lewis and Ferguson 1988). The cumulative effect of these practices created a variably-scaled mosaic of successional communities offering increased species diversity across the landscape to serve as resources over time (Lewis 1982; Lewis and Ferguson 1988; Davidson-Hunt and Berkes 2003; Berkes and Davidson-Hunt 2006). How indigenous people think about fire occurring at larger scales has not been considered outside of recent work on fire policy (Miller *et al.* 2008; Natcher 2004). In this paper we recognize that scale is problematic but find that through its use we can focus on our principle question of whether an Anishinaabe cultural landscape is a mosaic of patches within a natural milieu, or, is the whole landscape cultural and fashioned by a variety of actors acting throughout the range of scales? It provides a framing that allows us to avoid the prevalent dichotomy of natural versus anthropogenic fire found in this literature.

In this paper we examine cognitive and symbolic understandings and everyday practices related to fire as it occurs at a variety of scales shared with us by our Anishinaabe collaborators. Many of their quotes are included within the text. We conclude with our thoughts on how an Anishinaabe ethnoecology of fire shifts our understanding of the potential of indigenous cultural landscapes to play a role in resource management planning.

Pikangikum First Nation and the Whitefeather Forest

Pikangikum First Nation is an Anishinaabe community in northwestern Ontario (Fig. 1). Also known as Northern Ojibwa, the Anishinaabe (as they call themselves) are members of the Algonquian language group. Pikangikum has an officially recognized population of 2,185 people living on an 80 hectare reserve (INAC 2006) and lies north of the 51st parallel which marks the northern limit of commercial forestry in the province of Ontario. Historically, this has also been the northern limit of intensive fire suppression by the Ministry of Natural Resources. Pikangikum is accessible by a 50 km ice road during the winter, by boat or floatplane during the season of open water approximately from mid-April to early November, or by small commercial planes arriving at a community airstrip. Many members of the community seasonally pursue a variety of livelihood activities that includes hunting of waterfowl, small game and moose (*Alces alces*), trapping of furbearers, fishing and collecting non-timber forest products. Many of these activities take place on family traplines. Eighteen traplines constitute a portion of the traditional territory of the people of Pikangikum and make up 1.2 million hectares of the Whitefeather Forest Planning Area (WFPA) (Pikangikum First Nation and Ministry of Natural Resources 2006). Currently Pikangikum First Nation and Ontario Ministry of Natural Resources (OMNR) are engaged in a dialog that will contribute to determining the future role of fire within the Whitefeather Forest landscape (Miller *et al.* 2008). The Whitefeather Forest Management Corporation (WFMC) of PFN recently received environmental assessment approval for their commercial forestry license and are engaged in a dialogue with the Ontario Ministry of Natural Resources (OMNR) to develop a fire management strategy.

Forests within the WFPA are conifer dominated, with greater presence of shade-intolerant deciduous species in forest openings and areas recently disturbed by wind throw, insects, annual flooding or forest fire. Many of the dominant species (e.g. jack pine [*Pinus banksiana* Lamb.], black spruce [*Picea mariana* Mill.], and trembling aspen [*Populus tremuloide*s Michx.]) are fire-dependent, requiring intense heat to open seed bearing cones or to stimulate sprouting from roots (Rowe and Scotter 1973). Lakes, streams and muskegs (wetlands) compose a substantial part of the overall landscape. Water bodies serve as avenues for travel by boat and barriers for terrestrial travel during the warm months. Temperatures are below freezing for 6 months each year and can reach −35°C during the coldest months. Travel is facilitated by snow machines on a network of forest trails and frozen waterways during this time of year.

Fire in the Boreal Forest

As with many regions of the boreal forest in northern Canada, the Whitefeather Frost Area has historically been shaped by two varieties of fire each with distinct spatial, temporal and ecological characteristics: those caused by lightning and those caused by human activity (Fig. 1 and 2). This section will briefly touch upon boreal forest fire as it behaves at larger scales; we describe smaller scale anthropogenic burning in subsequent sections. As Fig. 1 demonstrates, the Whitefeather Forest is a landscape where periodic large scale fires substantially affect species distribution, stand structures and landscape heterogeneity. Lightning caused fire is a keystone ecological process within the Canadian boreal forest (Weber and Stocks 1998). Physical legacies of fire include the death of large numbers of plants, altered habitats and resources available to animals, consumption of organic soils, creation forest openings, seed release and the sprouting of underground roots by fire-dependent species (Rowe and Scotter 1973). Most lightning generated fires in the boreal forest are less than 0.1 hectare, due to their tendency to extinguish themselves in accompanying rain and more recently due to active federal and provincial fire suppression activities. Fires larger than 200 hectares make up less than 3% of the total number of fires, yet account for about 98% of total acreage burned (Weber and Stocks 1998). Many regions of the boreal forest have a fire return interval of between 60–100 years (Weir *et al.* 2000).

Methodological Orientation

The initiative for this research emerged out of a long-standing collaboration with Pikangikum to consider how their knowledge can be applied to the management of the Whitefeather Forest, a 1.2 million hectare portion of the traditional territory of Pikangikum First Nation residents. It is the result of collaborative research undertaken with community elders and senior trappers of Pikangikum between June 2006 and August 2008 under the Whitefeather Forest Initiative Cooperative Research Agreement which established standards of research between the Whitefeather Forest Management Corporation (WFMC) and the University of Manitoba. This community-led initiative seeks to bring community economic opportunity and cultural renewal through the development of natural resource opportunities in a manner compatible with customary stewardship activities, livelihoods and values (Pikangikum First Nation and Ministry of Natural Resources 2006). Following this process, community elders reviewed our project proposal in the context of its contribution to the Whitefeather Forest Initiative. Our research is intended to provide community elders an opportunity to present their knowledge of fire's importance within the Whitefeather Forest landscape, and its contribution to Pikangikum customary activities and livelihoods in a land-use planning context.

Elders recommended participants from among their number and other trappers to interview and led field investigations with researchers. Between June 2006 and May 2008 we conducted a total of 43 interviews with 30 elders. Elders also accompanied us on 12 field trips spanning 30 days to areas recovering from fire and sites of historic burning activities. Interviews were recorded, transcribed and coded for analysis of key themes related to understandings of fire and its impact on the land and community. WFMC employees acted as translators for unstructured interviews with Anishinaabe speaking elders. Results were presented and verified by the elders in a community meeting with OMNR in February 2007 and again in a focus group meeting in March 2007. Recorded interviews and other documentation were archived in the WFMC research office in Pikangikum First Nation. Paintings accompanying the text were created by Pikangikum artist Mario Peters following conversations with elders in the Anishinaabe language in which they describe their understandings of fire practices. The paintings utilize the Woodland Art style traditional to the region and remain the property of the WFMC.

Our work is rooted in a qualitative and phenomenological ethnoecological approach. Ethnoecology arises from a broader field of the ethnosciences rooted in cognitive anthropology and interested in *emic* understandings of the rules or what Bernard calls the grammars of cultures (Bernard 1988, 226). Due to its cognitive roots much of this work has focused on a society's specific taxonomies for domains like kinship or of organisms like plants (ethnobotany) (Davidson-Hunt *et al.*

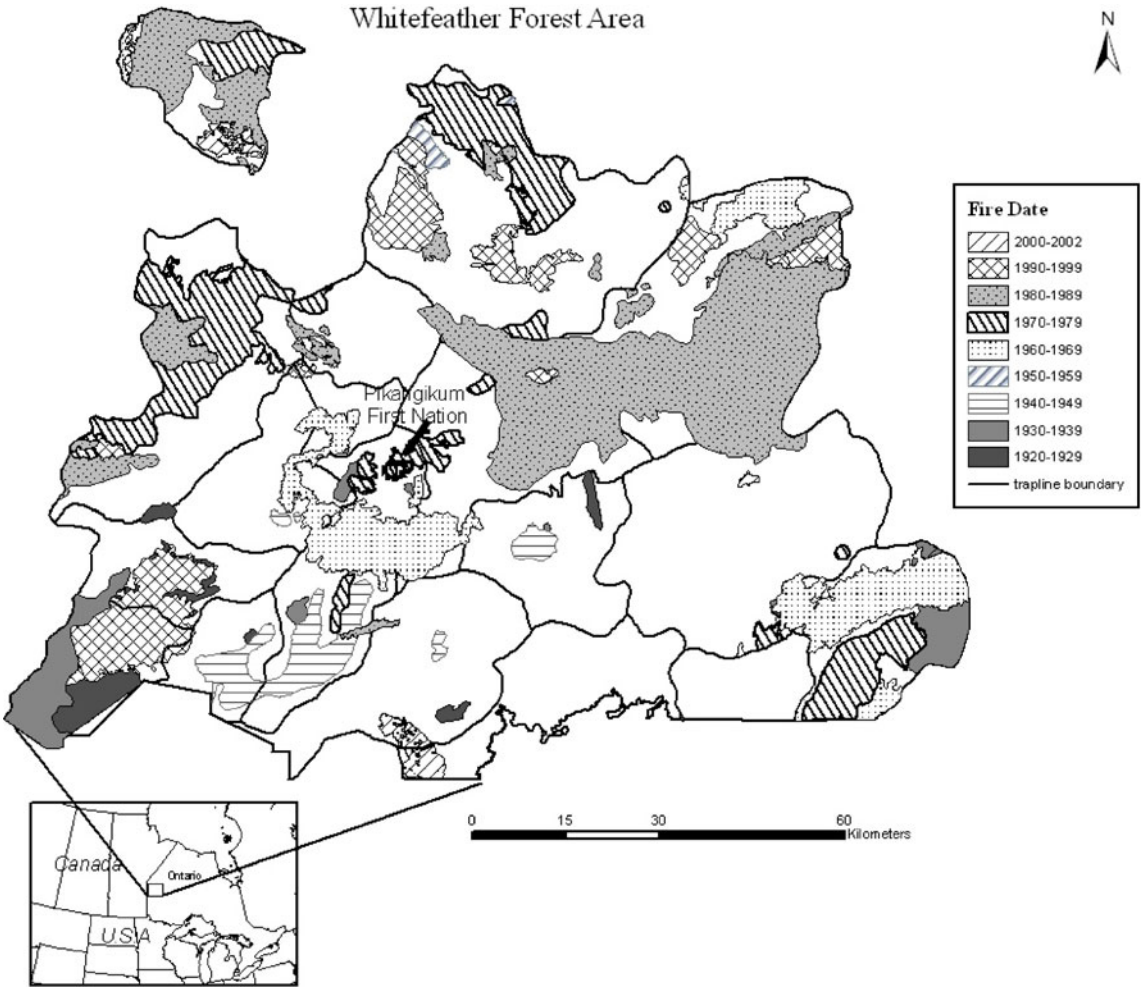

Fig. 1 Boreal forests within the traditional territory of Pikangikum First Nation, Ontario is dominated by a mosaic pattern of even aged stands of varying ages created by periodic large fires

2005) and birds (ethno-ornithology) (Diamond and Bishop 1999) or other phenomenon like soils (ethnopedology) (Barrera-Bassols and Zink 2003). One approach to ethnoecology is to then look at how a society understands the relationships amongst organisms they encounter in their environment (Clément 1998).

Over time the focus of ethnoecology has moved beyond a narrow cognitive and linguistic scope to an approach that considers an *emic* understanding of a specific phenomenon, like fire, through an integrated framework that probes symbolic, cognitive and the everyday practices related to the phenomenon (Toledo 2002). (Posey *et al.* 1984) also pushed ethnoecology towards an applied approach so that the research was not just of scholarly interest but also provided knowledge that could support autochthonous approaches for local development (Beaucage and the Taller de Tradicíon Oral del Cepec 1997). In taking an ethnoecological methodological orientation we focused not just on the linkage between the observable material record and burning practices but also the symbolic and cognitive dimensions of fire and related practices from the perspective of the Pikangikum Anishinaabe.

Results

According to Pikangikum elders the land they inhabit is occupied by numerous beings who possess agency similar to humans, with the ability to think, make decisions and pursue their own life projects (Hallowell 1960). Among these beings are plants, animals, rocks and other beings described in Pikangikum teachings and stories. One of the hallmarks of members of this category of "other-than-human persons" (Hallowell 1960) is the ability to transform themselves or the environment and the ability to respond in unpredictable, capricious, or "willful ways". Fire is considered by Pikangikum elders to possess a number of characteristics which indicate its status as a living sentient being. Among these is fire's ability to grow rapidly when weather conditions are right and to resist all efforts by

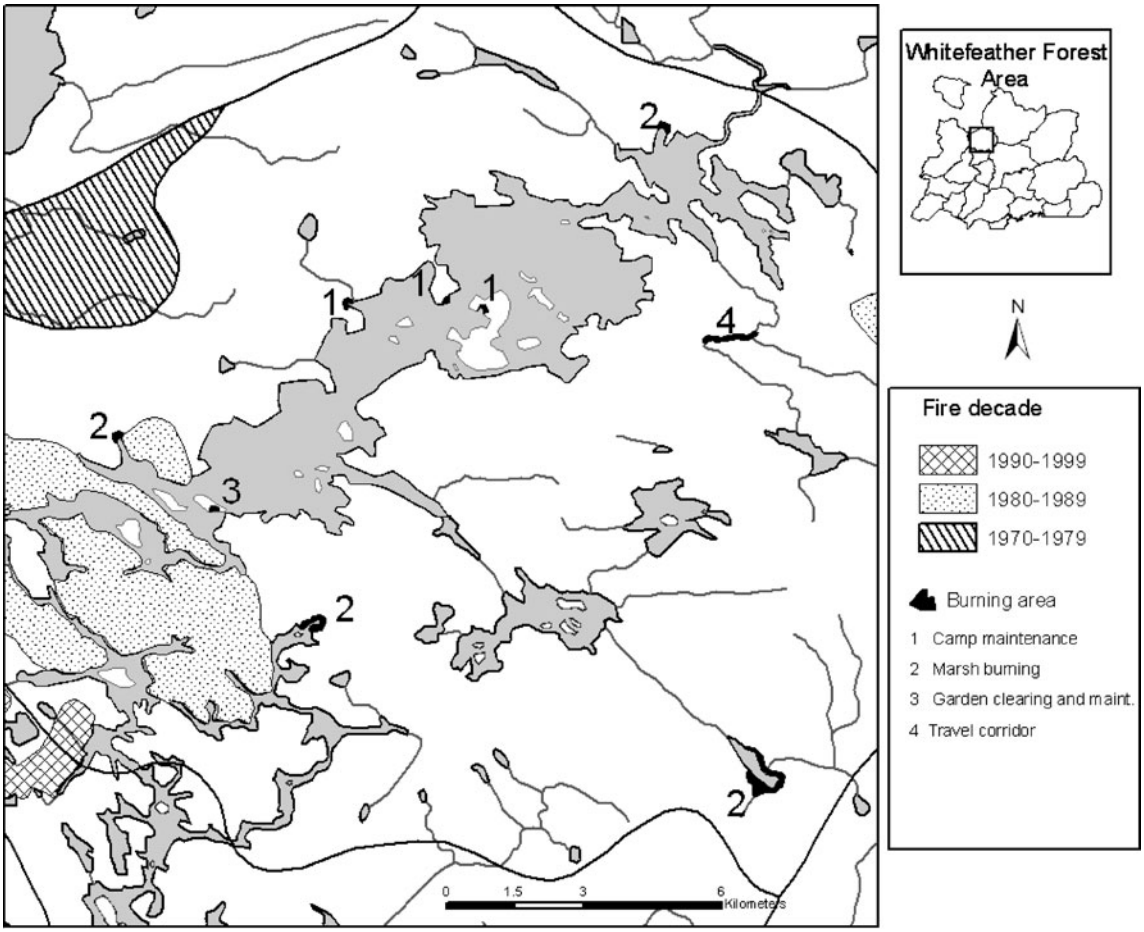

Fig. 2 Controlled burning of vegetation was conducted for a variety of purposes but was restricted to specific locations where fires could be effectively controlled. This map shows the locations of controlled burns conducted on one trapline between 1940 and 1970

people to put them out. In these circumstances fire eventually "decides to go out". Under extreme conditions a large fire can create clouds of smoke that contain lightning.

> *Fire retires in the evening. It rests at night and flares up during the day. Beginning around 10 am, it is active. Even on a calm day fire can make its own wind. This is not actually a wind. The wind is within the fire. Another evidence that fire is alive is that it can spread itself by sending balls of fire ahead. It can jump ahead with these. Several times I have seen the cloud of smoke from the fire become a thunderbird cloud—a cloud with lightning within it.*
>
> Elder and former Fire Crew Boss, Tom Quill. Interview February 19, 2007.

Pikangikum elders understand fire (*eshkotay*) as belonging to one of three categories: thunderbird fire (*beenesay eshkotay*) referring to lightning and the forest fires it starts; Anishinaabe fire (*Anishinaabe eshkotay*) which refers to fires started and controlled by indigenous people; and Whiteman's fire (*wahmiteegoshe eshkotay*) also called "the other fire" (*muhyaukee eshkotay*) referring to electricity. This third type of fire although similar in some ways to thunderbird fire will not be addressed in this paper. Elders have three sources of the knowledge which they posses of fire: personal use of fire in domestic activities, using fire as a means to manipulate vegetation in cabin areas and resource sites within traplines and as professional fire fighters (Dunning 1959). The first two types of experience arise from interaction with Anishinaabe fire. The third type of experience arises from interacting principally with thunderbird fire.

Elders recognize that human life simply would not be possible in the harsh climate of northwestern Ontario without mastery of fire for heating, cooking, smoking meat and fish, and historically for hide preparation. It is considered by many to be a gift of the Creator. All types of fire have the dual characteristics of being both a source of life and potentially a source of great destruction. As a result elders teach that respect for fire is essential. A person demonstrates respect by understanding the behavior and

impacts of fire in different circumstances and tailoring their actions accordingly.

> *I pray every morning and one of the first things that I am thankful for is the fire. I thank the Creator for the fire that he gave us is still helping me to survive...Fire is used for means of survival. Survival for life. If you respect fire, the fire will be good to you. It will keep you warm on cold days. Keep you warm. But you also have to have respect and be careful with the fire. You have to use it wisely. If you use it wisely it will keep you. If not it will burn all of your possessions. ...Fire can destroy and the reason why it destroys is to make things alive. ... And the other thing that I am thankful for is the water. Water is also important. It is a sacred element. You know when we eat, it nourishes our bodies. We get strength and good health. So fire does the same thing. It helps us physically. It strengthens our health.*
>
> Elder, Solomon Turtle. Interview April 17, 2007

Thunderbirds (*beenesaywug* pl.) (Fig. 3) are powerful beings who dwell on mountain tops and in thunderclouds and are associated with specific sites across the landscape. They are the subject of many stories within the Pikangikum oral tradition. Thunderbirds are born in nests located on islands or hill tops. According to oral tradition, long ago there were no trees on the land, so thunderbirds constructed their nests of rocks. These features are locations of power and are treated respectfully. Young thunderbirds arise from these nests in the early summer. Although potentially dangerous, thunderbirds are generally beneficial for their role in renewing forest growth and for protecting humans from horned serpents who live underground (*meshekenaybegook*). Were it not for the thunderbirds, these serpents would surface and destroy the Anishinaabe.

> *So this is what the thunderbird does. It makes a lot of thunder, a lot of noise in the sky, a lot of thunder because these creatures under the ground want to come up to the surface. The thunderbirds job is to keep these creatures under the ground so that they won't come on top. They are large serpents. .... The thunderbird also acts as a protector for the land, for the people too. If these creatures came out of the ground they would destroy us. Destroy the people.*
>
> Elder, Oliver Hill. Interview August 29, 2006.

Anishinaabe communities in the Great Lakes region also recognize the conflict between the thunderbirds and their counterparts, the horned serpents or as they are also known, the water lynx (*Meshebishew*) (Smith 1995). Elders point to the sounds of frequent thunder in the early summer as an indication that old thunderbirds are teaching the younger ones how to use their bolts of lightning.

Thunderbirds are the source of lighting fires which renew the growth of new vegetation which are important food sources for many species of animals (Fig. 2).

> *The Creator has a match and that match is the thunderbird. He brings that match to the land when the forest gets too old and can't grow anymore. So the thunderbird comes to earth. After the forest is burnt new growth starts. Animals get tired of eating old food. Just like you and me. The Creator knows that animals need new food. After the fire there is fresh food to eat.*
>
> Elder, Whitehead Moose. Interview July 20, 2006.

Other elders express their understanding of the Thunderbirds in terms suggesting it is a being that has free will rather than being a tool for the use of the Creator as the above quote suggests. For example, elders report that by offering tobacco or singing special songs they could appease the thunderbirds and cause approaching storms to pass around the supplicant. Thunderbirds are related to all birds but have a special affinity to solitary sandpipers (*Tringa solitaria*, *chedooae*), common nighthawks (*Chordeiles minor*, *payshk*), swallows (Family: Hirundinidae, *shashawahnepesee*), belted kingfishers (*Ceryle alcyon, ookeshkemahnesee)* and American kestrels (*Falco sparvarius*, *pepekooshaense*). Mistreating these birds by destroying their nests or eggs will cause thunder to sound, a sign that the thunderbirds have been angered and may seek revenge upon the offender.

Living with Fire

Fire continues to have many direct livelihood applications relevant to Pikangikum residents including heating, cooking and smoking meat and fish. Fire is also the keystone disturbance agent of the boreal forest (Weber and Stocks 1998) affecting spatially and temporally the arrangement of resources available for people and the game and fur bearing species they hunt. Landscape users must know both where and when to find resources within a landscape comprised of heterogeneous patches of vegetation in varying stages of successional development (Davidson-Hunt and Berkes 2003). In this section we describe fire's role in creating ordered spaces within the Pikangikum cultural landscape and the corresponding spatial and temporal dimensions of knowledge possessed by Pikangikum of these processes (Fig. 4).

Fire is used first and foremost by Pikangikum residents for heating, cooking and smoking of meat and fish. Each of these purposes requires a qualitatively different kind of fuel to create the desired heat and smoke. The type of wood needed for a specific task requires that a person make decisions about the kind of wood that should be sought to satisfy a need and

Fig. 3 Beenesay eshkotay—Thunderbird fire is ignited by lightning (*puhkeenun*) created by the blinking of the thunderbird's eye. Although the land appears destroyed after a fire under ground roots survive and act as a source of renewal

correlate that to a mental map of the mosaic of disturbance patches in the landscape. Most people in Pikangikum utilize only standing dead trees for fire wood rather than cutting green trees and waiting for them to season. Jack pine is the preferred fuel wood because of its high heat potential. Black spruce in contrast produces thick sooty smoke and sparks that may cause a chimney fire. Recently burned areas are good places to find standing dead trees. Trees which have been hit by lightning are not used as fire wood because it is believed that doing so angers the thunderbird that created it. If one of these trees is burned, it will beat its wings causing the weather to warm. Poplar which is dry and almost crumbling is used to dry and smoke meat and fish. Newly dead poplar is referred to as *kuhpuhpuhkeenay*. This name contains the root word for grasshopper (*puhpuhkeenay*) which reminds people of its tendency to shoot dangerous sparks like a leaping grasshopper.

Many houses in Pikangikum continue to rely on firewood as the primary source of heat. Having an adequate family wood pile through the winter and being able to provide wood to community members who are not able to cut it themselves contributes to a person's reputation as a good provider. Householders must keep track of where suitable firewood is available, in order to keep a sufficient supply of fire wood for heating. Because of demand for wood cutters have to travel several kilometers by snowmobile several times a week to wood cutting areas.

Different areas of the landscape are safer than others for constructing camp fires. Fires lit in areas with deep organic soils can smolder below the surface of the ground and become hard to detect and put out.

> *One of the things we have to tell our young people when they are out in the bush is to make their fires on rock, not on soil. Deep soils can catch fire. If you do put your fire in that area you really need to put that out, really soak it with water. Eventually it will pread if you miss a burning coal by a whisker. You really have to soak the moss.*
>
> Elder Oliver Hill, Interview January 29, 2008.

Underground fires can flare up when the weather warms and fuel dries out. Campfire site selection is somewhat relaxed during winter months when the ground is frozen and snow is deep. After the spring thaw camp fires are placed on bedrock or shore lines where water is on hand to suppress escaped fire. Dense conifer stands with low-hanging dead branches are particularly dangerous places to light campfires. Fires are never lit in these areas. People are very sensitive to fires started by visitors to tourist camps within the Whitefeather Forest Area. They point to differences between where and how White people and people from Pikangikum choose to use fires.

> *This kind of camp fire with the rocks all around it, our people would not build a fire like that. They would only build fires where it was safe. That's the White hunters doing that. Our way was to build fires on a big rock—near the water. Never someplace where the fire might go into the ground. We were always very careful with fire. We have a clean record. We would build a fire by the shoreline.*
>
> Elder Mathew Strang. Interview June 12, 2006.

Fire behavior is linked to weather, topography, soil type and fuel conditions. Elders describe fire behaviors observed under different forest conditions and suggest appropriate ways of dealing with these situations (Table 1). A lightning strike or carelessly set fire can burn down into deep organic soil, smolder for months or even an entire winter and reemerge when the temperature rises and duff dries out. The path that a fire takes is always from the west to the east following prevailing winds. Water bodies such as lakes and wetland areas frequently act as barriers to the spread of fire. However, wetlands can dry out sufficiently to burn. Wind or updrafts from rising heat from a fire can also carry burning debris aloft over lakes to ignite fuel on the opposite shore. Elders with fire fighting experience describe their practice of keeping track of the closest body of water in case they needed to escape a flare up or a change in wind direction. Forest fires started by carelessness are the most destructive because these most often start when temperature, wind and fuel moisture in forests create the potential exist for rapid fire growth and spread. In contrast, according

Table 1 Pikangikum elders recognize several named fire behaviors which are best confronted with different suppression strategies

Fire type	Anishinaabe term	Description	Action
Crown fire	*Keesheeyahkeetaah*	Fire moving rapidly through the tops of trees. Very dangerous.	Impossible to fight with hand tools. Escape.
Underground smoldering fire	*nooswuhkeekay auhnuhmuhguhmeeg*	Slow moving—Difficult to detect. Frequently occurs when fire gets into roots of large balsam fir.	Fire fighter needs to feel under the ground with bare or gloved hand. Requires "a good sniffer"—one who can smell new smoke several days after fire has stopped active burn.
Fire burning up a hill	*Aaheekkuhmuhcheewayauhkeetaak*	Fast moving fire	It's not safe to fight an up hill moving fire from above.
Fire burning down hill	*neesuhcheewee yuhkeetay*	Slow moving fire	Usually burns itself out.
Fire burning on level ground	*keetuhqwaag auhkee*	Usually can be contained	Can be fought using hand tools. Clear vegetation and organic soil.

to elders, thunderbird fires often extinguish themselves with rain that accompanies these storms.

Recovery from a forest fire is known by elders to begin within days of the fire event. Much of the process of recovery is attributed to the inherent agency of the animals, plants and the land (Miller and Davidson-Hunt in review). According to elders, the regrowth stimulated by fires is good for many animal species that people hunt. This is taken as evidence that the Creator is caring for the people and for the other animals by periodically sending thunderbirds to renew the land.

> *Rabbit* [sic. snowshoe hare] *favors new growth area. When you look at rabbit I think it is like a food chain for animals. Rabbits have three litters a summer. Fox, lynx, marten all depend on rabbit. The Creator has to care for all animals so he sends thunderbird to earth to make food for rabbit. We like to eat rabbit too. So he burns for us too*.
>
> Elder, Whitehead Moose. Interview July 20, 2006.

Even before forest fires are completely extinguished animals begin to reoccupy areas that have been burned. Moose and rabbits appear in burnt areas while smoke is still rising to eat smoked leaves and char bark because "they like the taste". Many burned areas become preferred hunting spots for moose in the years immediately following the burn. Hill tops within burn areas offer good look out points for hunters. Many hunters return to these sites for years until regenerating trees begins to obscure vistas between 10 and 15 years after the burn. Unburned islands of habitat within large burns are noted as being important to wildlife such as snowshoe hares. Because snowshoe hares are important prey for many fur bearing predators, trappers monitor areas where snowshoe hare tracks are abundant for signs of marten, lynx, fisher and fox. Snowshoe hares are also important wild meat for trappers.

Forest fires impact land use in a number of important ways. Fires can force trappers to temporarily reorient their use of their trapline while specific resources recover from the fire. This is especially true for trapping of fur bearing animals such as American marten (*Martes americana*), fisher (*M. pennanti*) and lynx (*Lynx canadiensis*) which are associated with mature forests during the winter when trappers are seeking them. A trapper must shift to a different part of his own trapline, switch activities to exploit different resources, negotiate with another trapper for the use of his area or forego trapping. Relearning how to get around one's trapline and where important species can be found following a fire takes time and effort. Trails and portages that access different parts of the trapline are also impacted by fire. Trees killed by fires begin to fall and block trails and portages several years after the fire. Travel by boat can also become more dangerous because of increased number of dead trees in waterways.

Historically the people of Pikangikum set fires in the spring and fall when temperatures and fuel conditions created easily controlled burns. The most common purposes for setting fires were to clear dead plants and refuse around cabins, to clear and prepare garden areas, to create habitat areas for muskrats and ducks (Figs. 2, 4 and 5), to maintain river travel corridors, and to promote growth of grasses for winter storage pits and dog beds. These fires were qualitatively different than lightning fires which occur when weather and fuel conditions may increase fire behavior rates (Johnson 1992). Controlled burning in Pikangikum was largely stopped by provincial forest managers in the 1950's, although many elders witnessed or participated in controlled burns in their youth. The last recorded controlled burning of a marsh was in 1996. Fire is still used in the community of Pikangikum to clear rubbish and dead grasses from around peoples' houses in the spring time.

> *Pishashkooseewuhseekaag* (Fig. 5) was *to burn the old grass so that new grass would grow. As a young*

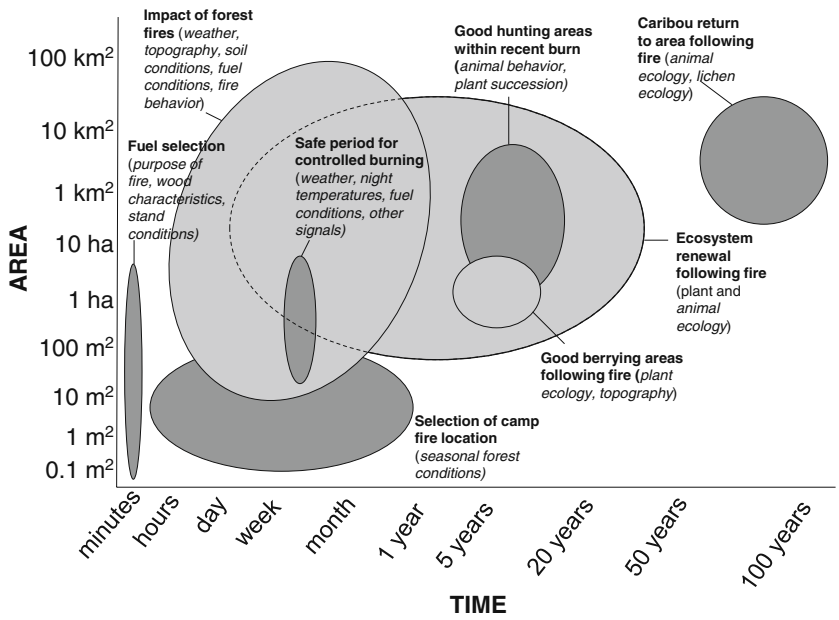

Fig. 4 Spatial and temporal dimensions of knowledge related to fire use and its impacts held by Anishinaabe elders, and the areas of expertise they require

boy I would see my father perform this, perform this burning the old grass. He usually did it in the early spring when the ice was still on the lake. Emijayskwaak clear ice. It was the time when the ducks were back, when they were hunting ducks. That was the time. ...The real reason was to burn the old grass out. The reason why he wanted that grass to grow was so that he could use that grass to put into his potato pits.

Elder, Norman Quill. October 30, 2007.

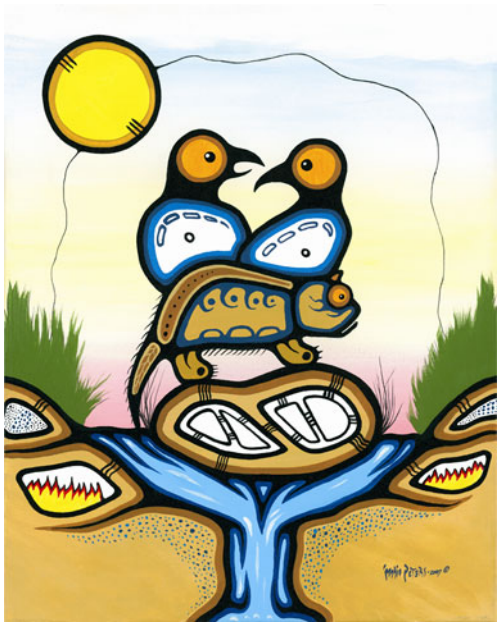

Fig. 5 *Pishashkooseewuhseekaag*—Spring burning of the marshes. Fires were lit in marshes in the Spring when ice on the lakes was beginning to break up but the ground was still frozen. Burning created luxuriant regrowth of grass, habitat for ducks and muskrats that could also be harvested for insulation

Relative to naturally occurring wildfires, Pikangikum burning practices affected small portion of the overall landscape (Fig. 2). Fires were set with specific goals in mind although they often achieved several goals (e.g. creating habitat for moose) were often attracted to willow on the edges of burnt muskrat marshes.

It was not for nothing that we lit fires. We always did it for a purpose. It was always very serious.

Elder, Oliver Hill. Interview April 13, 2007.

Most elders indicated the proper season for burning was the late spring between March and April when the ice just begins to break up. Others state that fires could also be set in the fall if the proper signals were observed. Ideally, grassy areas intended for burning should be free of snow while the margins with woody vegetation should have snow cover. As others have documented (Lewis 1982, Lewis and Ferguson 1988) this allows for the fast burning of light fuels which never reach high enough temperature to ignite adjacent forest fuels. Signals for spring burning include: a change in the color of lake ice from cloudy to clear as it begins to melt, small streams beginning to flow again and when daytime temperatures are warm while nighttime temperatures continue to fall below freezing. These signals occur only in a narrow window of several days to several weeks.

In order to take advantage of them, trappers need to be moving across their land monitoring conditions across the areas the wish to burn.

We did this as we were traveling only when the ice was still on the lake. Where ever we were traveling and we saw that it would be useful to the land if we

burned. Our people received this teaching to burn certain places from the Creator. They knew it as part of our culture.

Elder, Charlie Peters. Interview October 5, 2006.

Another key to successful burning is the weather and wind direction. Fires were set in the late afternoon on a warm calm day or with wind that was blowing in the direction of open water. These precautions were taken so that sparks would not be blown into the bush and thus threaten the homes and food of other animals. Elders timed burns in the afternoon so that the cold nighttime temperatures would slow the rate of ignition and spread of the fire. Controlled burning thus requires a knowledge of climatic and fuel conditions that exist within a narrow window of several days to several weeks each year and knowledge of conditions and span an area not extending beyond what can be burned in a single afternoon.

Blueberries (*Vaccinum* spp.) are a favorite food. Elders report that good crops of blueberries are present around rocky areas 3 years after a fire and may last as long as 10 years. Berries become ripe in August (*Atitayminowigeezis*, "berries coming ripe month"). Some elders report traveling half a day in order to harvest berries from prime collecting areas. Berries following fires are also utilized by many animals including bears, game birds and foxes.

Where fire comes to rock areas, blue berries come after the fire. That feeds a lot of animals. We eat blueberries too. Fire makes good food areas. Mature forest cannot make good food areas.

Elder, Whitehead Moose. Interview July 20, 2006.

Surprisingly, only one elder reported improving berrying sites as an intended outcome of controlled burning. This stands in contrast to reports of other boreal forest peoples burning forest patches specifically to create berrying sites (e.g. Lewis 1982; Lewis and Ferguson 1988; Natcher *et al.* 2007). Elders comment that berrying sites are productive for up to 10 years after a fire. Elders are not able to predict what areas will have berries following a fire based on landforms. A hunter must travel through their lands in order to find good berry areas and monitor them in subsequent years. Black bears (*Ursus americana*) are frequently found in berry patches following fires. Several elders express the opinion that bears are capable of starting fires by scraping their claws against rocks to throw a spark. According to elders, bears do this because they know that berries will grow after a fire and be available as food. This statement is a clear expression of the view that bears are sentient and capable of starting fires in order to improve availability of forest resources.

Woodland caribou (*Rangifer tarandus*) are a threatened species in the province of Ontario (Ontario Woodland Caribou Recovery Team 2008). Elders regard them as requiring many of the same things that human beings need: freedom to roam widely and find partners, forest homes in which to live and raise their family, and the ability to take what they need from the land to survive (O'Flaherty *et al.* 2006). Woodland caribou are wide ranging species whose winter food consists of terrestrial and arboreal lichens which require a range of habitats over the course of the year, including winter feeding areas with abundant lichen, early spring and fall travel corridors and spring–summer calving areas on islands and in mushkeg areas. Large fires can either destroy these areas or fragment them and making them inaccessible by causing their trails to disappear. Elders and hunters have observed that following fires, caribou are often absent for prolonged periods of up to five or six decades but have always returned.

There were caribou around in that area for many years but a fire drove them away. Now they are coming back because after many years their food is growing again. So you see the caribou is part of the thunderbird cycle too.

George B. Strang 3-1-2008

Management Implications of Indigenous Cultural Landscapes

Our research provides an empirical illustration of the claim made by ethnographers that indigenous conceptions of territory may not match competing dominant worldviews that define indigenous territories as bounded spaces and resources (Hierro and Surrallés 2005). Our work with the people of Pikangikum First Nation demonstrates that cultural landscapes arise through continually renegotiated interactions between human and non-human beings who are understood by a specific people as being present within that place. As such, the cultural landscape concept is an important tool which indigenous peoples are employing to re-establish their relationships to territory, the beings which inhabit it and the ecological processes which contribute to its creation.

Despite the historic inability of Pikangikum residents to fully control large forest fires it should be evident that large fires have indeed contributed to the creation of Pikangikum cultural landscapes. It is the perception of Pikangikum residents that landscape patterns are created through the intentional actions of beings, such as thunderbirds, whom western managers do not recognize. These landscape mosaics are viewed as ordered places, intentionally created by the thunderbirds so human beings and other members of the land community can successfully make a living. They are not neutral spaces bereft of human values and meanings that surround more meaningful places which humans

manage and travel through. There is no such neutral place within the Pikangikum landscape.

The study of indigenous peoples' land management practices and their importance to the maintenance of sites should continue to be priorities with peoples for whom they are poorly understood. However, the depth of fire ecology knowledge demonstrated by Pikangikum residents should alert us to the importance of expanding the scale of inquiry to more fully encompass indigenous understandings of the ecological and cultural processes by which a cultural landscape emerges as both material and symbolic, biocultural (c.f. Maffi 2001) or what some have called a social-ecological system (Berkes *et al.* 2003). Much ethnoecology and allied disciplines have tended to focus on the material outcomes in the tradition of Sauer (1925) at the scale of sites and travel routes as opposed to landscapes as emergent, dynamic and scalable.

Inclusion of indigenous cultural landscapes into co-management arrangements offers both opportunities and challenges. This paper presents some of the ways Pikangikum elders understand fire to operate at scales relevant to the management of sites. Elsewhere we have discussed the manner in which Pikangikum residents assess fire risk and propose their Anishinaabe understandings of fire as a tool for fire management (Miller *et al.* 2010). The greatest challenge we see is inherent in bringing together indigenous worldviews and those held by managers trained in the western scientific tradition. At the heart of the disjuncture between these worldviews is the lack of agreement on the ethical role of humans within the environment. While land managers trained in the scientific tradition are comfortable with the management of nature, which is viewed as existing apart from human beings, this divide is less firmly acknowledged by our Anishinaabe partners. From their perspective, human beings exist within a network of beings and forces which exhibit agency and require ethical consideration (O'Flaherty *et al.* 2009).

Bridging understandings between local communities and western managers is the first step in incorporating indigenous cultural landscapes into current management practices. Creating shared understandings of landscape processes in multi-cultural contexts involves resolving differences in taxonomies, practices and worldviews held by management partners (O'Flaherty *et al.* 2009). For example, when we began our investigations of fire with Pikangikum elders we were initially stymied by the mismatch between the types of fire they recognized and those we understood. The gloss term "forest fires" we used had no direct correspondence to the elders' understandings of fire which included more specific terms (*Anishinaabe*, *beenesay* and *wahmiteegoshe* fires) which alluded to specific sources of ignition and fire behaviors. The sophistication and accuracy of the elders' knowledge of fire ecology was widely recognized by OMNR managers. However, the practices and worldviews in which this indigenous knowledge is contextualized, challenges the mandate and institutional traditions of OMNR to manage forest fires with a risk management approach using scientific principals and relying heavily on technological tools.

Indigenous cultural landscapes can lead to novel resource management approaches (Davidson-Hunt 2003; Long *et al.* 2003) but require that indigenous land management institutions (rules in use) be able to express their values in the shaping of management decisions affecting their territories. New economic activities such as commercial forestry may realign Pikangikum interactions with fire and other beings in their landscape. As timber harvests become possible it is likely that increased fire suppression within merchantable stands may be supported by Pikangikum residents. These potential changes should not be regarded as implicitly being in conflict with the maintenance of an Anishinaabe cultural landscape. Pikangikum elders have expressed their desire to have relationships with fire on their own terms as expressions of their own values (Miller *et al.* 2010). Nor should it be assumed that the relationships to fire (and the lands they affect) which Pikangikum residents will choose will be identical to those expressed by non-Anishinaabe Canadian society.

It is unclear how successful indigenous ontologies may be in penetrating the institutional frameworks of the dominant science-based management paradigm, based as they are on the divide between culture and nature. Similar to what we have found for forest management (O'Flaherty *et al.* 2009), fire management has a moral dimension. Currently, OMNR directs management decisions for both forests and forest fires following political, technical and scientific guidelines in which the moral guidelines for fire management offered by residents of Pikangikum may find little traction. From the Anishinaabe perspective fires started by thunderbirds create the possibility for life for the Anishinaabe and the other non-human societies with whom they share the landscape. Resolving the incommensurability between the Anishinaabe and scientific ontologies will require mutual understandings attainable only through a process of dialog. If this is the approach taken, we suggest that the Anishinaabe could contribute their knowledge of fire to risk management, fire fighting and prescribed burning.

Acknowledgements Funding for this project was provided by Sustainable Forest Management Network (Davidson-Hunt, PI), Social Sciences and Humanities Research Council (Davidson-Hunt, PI), a grant from Environment Canada, Aboriginal Capacity Building Fund 2006–2007 (Whitefeather Forest Management Corp.) and a University of Manitoba Graduate Fellowship (Miller). The authors owe a debt of gratitude to the people of Pikangikum. Among them elders Oliver Hill, Whitehead Moose, Norman Quill, Tom Quill, George B. Strang,

Mathew Strang, and Solomon Turtle stand out for their participation in field trips and numerous interviews. Members of the Whitefeather Forest Management Corporation, Marcella Keejik, Charlie Pascal, Paddy Peters, Reggie Peters, and Murray Quill provided translations and technical assistance. *Meegwich*. We also wish to thank two anonymous reviews for their constructive comments.

References

Agnew, J. A., Livingstone, D. N., and Rogers, A. (1996). Human Geography: An Essential Anthology. Blackwell, Oxford.

Anderson, M. K. (2005). Tending the Wild Native American Knowledge and the Management of California's Natural Resources. University of California Press.

Anderson, M. K. (1999). The Fire, Pruning, and Coppice Management of Temperate Ecosystems for Basketry Material by California Indian Tribes. Human Ecology 27(1): 79–113.

Barrera-Bassols and Zink (2003). Ethnopedology: A Worldwide View on the Soil Knowledge of Local People. Geoderma 111(3–4): 171–195.

Beaucage, P., and the Taller de Tradicíon Oral del CEPEC (1997). Integrating Innovation: The Traditional Nahua Coffee-Orchard (Sierra Norte de Puebla, Mexico). Journal of Ethnobiology 17(1): 45–67.

Berkes, F., Colding, J., and Folke, C. (2003). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press.

Berkes, F., and Davidson-Hunt, I. J. (2006). Biodiversity, Traditional Management Systems and Cultural Landscapes: Examples from the Boreal Forest of Canada. International Social Science Journal 187: 35–47.

Bernard, H. R. (1988). Research Methods in Cultural Anthropology. Sage, New York, p. 223.

Bird, D. W., Bird, R. B., and Parker, C. H. (2005). Aboriginal Burning Regimes and Hunting Strategies in Australia's Western Desert. Human Ecology 33(4): 443–464.

Birks, H. H., Birks, H. J. B., Kaland, P. E., and Moe, D. (eds.) (1988). The Cultural Landscape: Past, Present and Future. Cambridge University Press.

Black, M. B. (1977). Ojibwa power belief systems. In Fogelson, R., and Adams, Rich-ard (eds.), The Anthropology of Power. Academic, New York, pp. 141–152.

Blondel, J. (2006). The 'Design' of Mediterranean Landscapes: A Millennial Story of Humans and Ecological Systems During the Historic Period. Human Ecology 34(5): 713–729.

Boyd, M. (2002). Identification of Anthropogenic Burning in the Paleo-Ecological Record of the Northern Prairies: A New Approach. Annals of the Association of American Geographers 92(3): 471–487.

Boyd, R. (ed.) (1999). Indians, Fire and the Land in the Pacific Northwest. Oregon State University Press.

Buggey, S. (2004). An approach to aboriginal cultural landscapes in Canada. In Krupnik, I., Mason, R., and Horton, T. (eds.), Northern Ethnographic Landscapes: Perspectives from the Circumpolar Nations. Arctic Studies Center, National Museum of Natural History, Smithsonian Institution, Washington, D.C., pp. 17–44.

Clément, D. (1998). The Historical Foundations of Ethnobiology (1860–1899). Journal of Ethnobiology 18: 161–187.

Davidson-Hunt, I. J. (2003). Indigenous Lands Management, Cultural Landscapes and Anishinaabe People of Shoal Lake Northwestern Ontario, Canada. Environments 31(1): 21–40.

Davidson-Hunt, I. J., Jack, P., Mandamin, E., and Wapioke, B. (2005). Iskatewizaagegan (Shoal Lake) Plant Knowledge: An Anishinaabe (Ojibway) Ethnobotany of Northwestern Ontario. Journal of Ethnobiology 25(2): 189–227.

Davidson-Hunt, I. J., and Berkes, F. (2003). Learning as You Journey: Anishinaabe Perceptions of Social Ecological Environments and Adaptive Learning. Conservation Ecology 8(1):5. URL: http:www.consecol.org/vol8iss1/art5

Day, G. M. (1953). The Indian as an Ecological Factor in the Northeastern Forest. Ecology 34(2): 329–346.

Delcourt, P. A., Delcourt, H. R., Ison, C. R., Sharp, W. E., and Gremillion, K. J. (1998). Prehistoric Human Use of Fire, The Eastern Agricultural Complex, and Appalachian Oak-Chestnut Forests: Paleoecology of Cliff Palace Pond, Kentucky. American Antiquity 63(2): 263–278.

Diamond, J., and Bishop, K. D. (1999). Ethno-Ornithology of the Ketengban People, Indonesian New Guinea. In Medin, D., and Atran, S. (eds.). MIT Press, Cambridge, Mass. 17–46.

Dorney, C. H., and Dorney, J. R. (1989). An Unusual Oak Savanna in Northeastern Wisconsin: The Effects of Indian Caused Fire. American Midland Naturalist 122(1): 103–113.

Dunning, R. W. (1959). Social and Economic Change among the Northern Ojibwa. University of Toronto, Toronto.

Giddens, A. (1979). Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis. Macmillan, London.

Hallowell, A. I. (1960). Ojibwa ontology, behavior and world view. In Diamond, S. (ed.), Culture in History: Essays in Honor of Paul Radin. Columbia University Press, 19–52.

Hierro, P. G., and Surrallés, A. (2005). Introduction. In Surrallés, A., and Hierro, P. G. (eds.), The Land Within: Indigenous Territories and the Perception of the Environment. IWGIA, Copenhagen.

INAC (Indian and Northern Affairs Canada). (2006). General Information: Registered Population: Pikangikum. URL: http://sdiprod2.inac.gc.ca/FNProfiles/FNProfilesK._GeneralInformation.asp?BAND_NUMBER=208&BAND_NAME=Pikangikum (Accessed October 2, 2007).

Ingold, T. (2000). The Perception of the Environment: Essays on Livelihood, Dwelling and Skill. Routeledge, London.

Johnson, E. A. (1992). Fire and Vegetation Dynamics: Studies from the North American Boreal Forest. Cambridge University Press.

Keeley, J. E. (2002). Native American Impacts on Fire Regimes of California Coastal Ranges. Journal of Biogeography 29: 303–320.

Laris, P. (2002). Burning the Seasonal Mosaic: Preventative Burning Strategies in the Wooded Savanna of Southern Mali. Human Ecology 30(2): 155–186.

Leighly, J. (ed.) (1963). Land and life: A selection from the writings of Carl Ortwin Sauer. Berkeley: University of California Press, p. 343.

Lewis, H. T. (1982). A Time for Burning. Occasional Publications No. 17, Edmonton: Boreal Institute for Northern Studies, University of Alberta.

Lewis, H. T. (1993). Patterns of Indian burning in California: Ecology and ethnohistory. In Blackburn, T. C., and Anderson, K. (eds.), Before the Wilderness: Environmental Management by Native Californians. Ballena, Menlo Park, pp. 55–116.

Lewis, H. T., and Ferguson, R. A. (1988). Yards, Corridors and Mosaics: How to Burn a Boreal Forest. Human Ecology 16(1): 57–77.

Long, J., Tecle, A., and Burnett, B. (2003). Cultural foundations for ecological restoration on the White Mountain Apache reservation. Conservation Ecology 8(1): 4. [online] URL: http://www.consecol.org/vol8/iss1/art4/.

Loope, W. L., and Anderton, J. B. (1998). Human vs. Lightning Ignitions of Presettlement Surface Fires in the Coastal Pine Forests of the Upper Great Lakes. American Midland Naturalist 140(2): 206–218.

Maffi, L. (2001). On Biocultural Diversity: Linking Language, Knowledge, and the Environment. Smithsonian Institution, Washington, DC.

Martin, C. (1982). Keepers of the Game: Indian-Animal Relations in the Fur Trade. University of California Press, Berkeley.

Miller, A. M., Davidson-Hunt, I. J., and O'Flaherty, M. (2008). Pikangikum First Nation and Forest Fire Management: Old and New Knowledge of Fire. Sustainable Forest Management Network. Research Note Series 37. 5 pp.

Miller, A. M., Davidson-Hunt, I. J., and Peters, P. (2010).Talking about fire: Pikangikum first nation elders guiding fire management dialogue. In Miller, A. M. Living with Boreal Forest Fires: Anishinaabe Perspectives on Disturbance and Collaborative Forestry Planning, Pikangikum First Nation, Northwestern Ontario. PhD Thesis. Natural Resources Institute. University of Manitoba, Winnipeg, Manitoba. 152–177.

Mistry, J., Berardi, A., Andrade, V., Krahô, T., Krahô, P., and Leonardos, O. (2005). Indigenous Fire Management in the *cerrado* of Brazil: The Case of the Krahô of Tocantíns. Human Ecology 33(3): 365–386.

Natcher, D. C. (2004). Implications of Fire Policy on Native Land Use in the Yukon Flats, Alaska. Human Ecology 24(4): 421–441.

Natcher, D. C., Calef, M., Huntington, O., Trainor, S., Huntington, H. P., DeWilde, L., Rupp, S., and Chapin, F. S. III. (2007). Factors Contributing to the Cultural and Spatial Variability of Landscape Burning by Native Peoples of Interior Alaska. Ecology and Society 12(1): 7 http://www.ecologyandsociety.org/vol12/iss1/art7/. Accessed: August 2008.

O'Flaherty, R. M., Davidson-Hunt, I., and Manseau, M. (2006). Keeping Woodland Caribou (Ahtik) in the Whitefeather Forest. SFM Network Research Note Series No. 17. Sustainable Forest Management Network. http://www.sfmnetwork.ca/docs/e/E27%20Caribou%20in%20the%20Whitefeather%20forest.pdf. Accessed: June 2008.

O'Flaherty, R. M., Davidson-Hunt, I. J., and Miller, A. M. (2009). Anishinaabe stewardship values for sustainable forest management of the Whitefeather Forest, Pikangikum First Nation, Ontario. In Stevenson, M. G., and Natcher, D. C. (eds.), Changing the Culture of Forestry in Canada. CCI Press and the Sustainable Forest Management Network, Edmonton.

Ontario Woodland Caribou Recovery Team (2008). Woodland Caribou (*Rangifer tarandus caribou*) (Forest-dwelling, Boreal Population) in Ontario. Prepared for the Ontario Ministry of Natural Resources, Peterborough, p. 93.

Pikangikum First Nation and Ministry of Natural Resources (2006). Keeping the Land [Cheekahnahwaydahmungk Keetahkeemeenaan] A Land Use Strategy for the Whitefeather Forest and Adjacent Areas. http://www.whitefeatherforest.com/pdfs/land-use-strategy.pdf July 2008.

Posey, D. A., Frechione, J., Eddins, J., da Silva, L. F., Myers, D., Case, D., and MacBeath, P. (1984). Ethnoecology as Applied Anthropology in Amazonian Development. Human Organization 43(2): 95–107.

Pyne, S. J. (1995). World Fire: The Culture of Fire on Earth. University of Washington Press, Seattle.

Rowe, J. S., and Scotter, G. W. (1973). Fire in the Boreal Forest. Quaternary Research 3: 444–464.

Russell-Smith, J., Lucas, D., Gapindi, M., Gunbunuka, B., Kapirigi, N., Namingum, G., Lucas, K., Giuliani, P., and Chaloupka, G. (1997). Western Arnhem Land, Monsoonal Northern Australia: Notes for Prehistory, Lessons for the Future. Human Ecology 25 (2): 159–195.

Russell-Smith, J., Djoeroemana, S., Maan, J., and Pandanga, P. (2007). Rural Livelihoods and Burning Practices in Savanna Landscapes of Nusa Tenggara Timur, Eastern Indonesia. Human Ecology 35(3): 345–359.

Sauer, C. O. (1925). The Morphology of Landscape. University of California Publications in Geography 2(2): 19–54.

Sauer, C. O. (1927). Recent Developments in Cultural Geography. Recent Developments in the Social Sciences. J.B. Lippincott, Philadelphia, pp. 154–212.

Smith, T. (1995). The Island of the Anishnaabeg: Thunderers and Water Monsters in the Traditional Ojibwe Life-World. University of Idaho Press, Moscow.

Stewart, O. (2002). Forgotten Fires: Native Americans and the Transient Wilderness. University of Oklahoma Press, Norman.

Turner, N. J., Davidson-Hunt, I. J., and O'Flaherty, R. M. (2003). Living on the Edge: Ecological and Cultural Edges as Sources of Diversity for Social—Ecological Resilience. Human Ecology 31 (3): 439–461.

Toledo, V. M. (2002). Ethnoecology: A conceptual framework for the study of indigenous knowledge systems. In Stepp, J. R., Wyndham, F. S., and Zarger, R. S. (eds.), Ethnobiology and Biocultural Diversity. International Society of Ethnoecology, Georgia, pp. 511–522.

Trusler, S., and Johnson, L. M. (2008). "Berry patch" as a Kind of Place—the Ethnoecology of Black Huckleberry in Northwestern Canada. Human Ecology 36: 553–568.

Weber, M. G., and Stocks, B. J. (1998). Forest Fires and Sustainability in the Boreal Forests of Canada. Ambio 27(7): 545–550.

Weir, J. M. H., Johnson, E. A., and Miyanishi, K. (2000). Fire Frequency and the Spatial Age Mosaic of the Mixed-Wood Boreal Forest in Western Canada. Canadian Ecological Applications 10: 1162–1177.

Wylie, J. W. (2007). Landscape. Routledge, London.