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Burning, fire prevention and landscape productions among the Pemon, Gran Sabana, Venezuela: Toward an intercultural approach to wildland fire management in Neotropical Savannas

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ABSTRACT

Wildland fire management in savanna landscapes increasingly incorporates indigenous knowledge to pursue strategies of controlled, prescriptive burning to control fuel loads. However, such participatory approaches are fraught with challenges because of contrasting views on the role of fire and the practices of prescribed burning between indigenous and state fire managers. Also, indigenous and state systems of knowledge and meanings associated with fire are not monolithic but instead characterized by conflicts and inconsistencies, which require new, communicative strategies in order to develop successful, intercultural approaches to fire management. This paper is based on long-term research on indigenous Pemon social constructs, rules and regulations regarding fire use, and traditional system of prescribed burning in the Gran Sabana, Venezuela. The authors review factors that act as constraints against successful intercultural fire management in the Gran Sabana, including conflicting perspectives on fire use within state agencies and in indigenous communities, and propose strategies for research and communicative planning to guide future efforts for more participatory and effective fire management.

1. Introduction

Indigenous knowledge is becoming an increasingly vital component of wildland fire management in mixed forest–grasslands environments. This development is driven in part by a greater appreciation of the ecological value of indigenous practices, in particular prescriptive burning strategies, to maintain low fuel loads and create fire breaks to prevent incursion of fire into forest patches. Australia, in particular, has become a leader in participatory fire management that emphasizes preventive burning in close collaboration with aboriginal fire managers (e.g. Cooke, 2000; Marsden-Smedley and Kirkpatrick, 2000; Russell-Smith, 2000; Williams et al., 1998; Whitehead, 2003: 415), but such participatory strategies have also made inroads in northern and southern Africa (Sonko et al., 2002; Jurvélius, 2004), Nepal (Sharma, 2006), Bolivia (Pinto, 2008), and Indonesia and Thailand (Moore et al., 2002). In the United States, the importance of prescriptive, controlled burning to maintain low fuel loads have long been common practice in grasslands and Western forests.

However, the development of participatory approaches to wildland fire management in protected areas is fraught with challenges stemming from contrasting cultural constructions and meanings attached to fire and burning. Even though prescriptive burning principles are becoming more widely accepted among fire managers world-wide and the ecological value of indigenous fire management has been extensively documented (e.g. Kull, 2002a, b, c; Laris, 2002, 2004; Lewis, 1989; Mathews, 2005; Mistry et al., 2005; Rodríguez, 2007; Sletto, 2008; McGregor et al., 2010; Miller and Davidson-Hunt, 2010; Shaffer, 2010, Rodríguez et al., 2011; Verran, 2002), effective, participatory fire management is often hampered by assumptions of indigenous irrationality and a lack of understanding of the social and cultural dimensions of indigenous fire use. In this article, therefore, we argue for a reconceptualization of participatory fire management as *intercultural* fire management, to foreground the significant, cultural dimensions of fire and burning that must be more fully understood in order for state and indigenous fire managers to develop democratic, reflective and respectful working relationships.

We base our discussion on our decade of research in the Gran Sabana, a mixed forest-grasslands savanna in Canaima National

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Park, which abuts the borders of Guyana and Brazil in far southeastern Venezuela. The Gran Sabana is a significant conservation priority in Venezuela in part because of its geopolitically strategic location, but also because it is the headwaters of the Caroní River. The Caroní supplies a series of large hydroelectric plants which produce the majority of Venezuela's hydroelectric power, and fire management in the Gran Sabana is under the purview of Electrificación del Caroní (EDELCA),[2] the parastatal electricity company that operates the hydroelectric dams. EDELCA has long pursued a strategy of fire suppression in an attempt to prevent the loss of riverine forest, which would increase erosion rates and lead to sedimentation in the hydroelectric dams. A particularly important target of EDELCA's fire management strategies is the indigenous Pemon, who have a long tradition of burning the grasslands in part as a means to reduce fuel loads in grasslands–forest boundaries. To stop what EDELCA managers see as the Pemon's uncontrolled and destructive burning practices, the agency emphasizes surveillance, fire fighting, and educational programs to halt traditional practices.

However, the agency's persistent emphasis on fire suppression instead of participatory fire management, we will argue here, has had the unintended consequence of disrupting ecologically beneficial, indigenous prescriptive burning practices. The agency's emphasis on fire suppression stems, in part, from profound misunderstandings of indigenous fire management principles (Rodríguez, 2004, 2007; Sletto, 2006, 2008). In this article, therefore, we seek to explore the social dimensions and practices of indigenous fire management in order to outline a strategy for intercultural fire management; that is, a form of participatory wildland fire management that is built on a fundamental understanding of the often contrasting forms of knowledge that govern indigenous and scientific approaches and understandings of fire and landscape.

We begin by presenting the rationale for a form of intercultural fire management in the Gran Sabana that incorporates principles of indigenous fire use, followed by a review of Pemon indigenous knowledge associated with fire, focusing in particular on a) the different meanings of fire for Pemon, b) Pemon rules and regulations of fire use, and c) the Pemon system of prescribed burning. This association of cultural meanings, rules and regulations and everyday practices are fundamental to Pemon fire management, and, we suggest here, must undergird an intercultural approach to fire management in the Gran Sabana and beyond. In the third section, we discuss factors that continue to hamper the development of intercultural fire management, including conflicts within state agencies and indigenous communities, followed by a discussion of possible strategies to guide the development of intercultural fire management. We have noted in recent years a growing interest in building new, more participatory approach to fire management in Venezuela, evidenced by workshops sponsored by EDELCA and Simon Bolivar University (Fundación la Salle y Ediciones IVIC, 2007)[3] at the VII Venezuelan Congress of Ecology in 2007, and we seek to contribute to this emerging discussion.

We build our argument here on research conducted over the past 10 years, first as our own dissertation research (Rodríguez, 2002; Sletto, 2006) and, more recently, as participants in workshops and research projects that have examined participatory mechanisms for habitat conservation in the Gran Sabana (Bilbao and Vessuri, 2006). In Table 1, we summarize the research methods we have used to integrate qualitative, participatory and ecological research approaches, which, we propose, should serve as a foundation for an intercultural approach to fire management in indigenous landscapes. It is important to note that we have conducted most of our investigations about fire with the Taurepan Pemon, one of three linguistic subgroups of the Pemon who live primarily in the southern part of the Gran Sabana. We have also pursued ethnographic work with Arekuna Pemon in Kavanayen and Liworiwo in the northern part of the Gran Sabana, where participants expressed similar attitudes to fire and the work of EDELCA, but we have worked less with the Kamarakoto Pemon who reside primarily in ecologically different, forested areas west and north of the Gran Sabana.

2. Why intercultural management of fire in the Gran Sabana?

The wisdom of pursuing fire suppression strategies in mixed forest–grasslands ecosystems is increasingly being questioned. Instead, fire managers are increasingly focusing on understanding indigenous, traditional uses of prescriptive fire to maintain low fuel loads and prevent extensive wildfires in fire-prone landscapes (Press, 1987; Lewis, 1989; Laris, 2002; Mbow et al., 2000). In the case of Australia, for example, indigenous people have long burned

Table 1
Research methods for intercultural fire management in indigenous landscapes.

Method	Purpose
Classic and participatory ethnography	To document indigenous social constructions and spiritual attachments to the landscape. To document indigenous conceptions and principles of fire and fire management, including eliciting knowledge and perspectives from different social groups. To document social constructions and perspectives regarding fire use among state fire managers and other stakeholders.
Reflexive meetings and workshops	To facilitate indigenous deliberations about cultural change and desired futures. To facilitate indigenous deliberations about past and current uses of fire and its impacts, including the environmental health of their territories. To facilitate dialogue between different stakeholders regarding uses of fire and its impacts.
Participant observation	To document traditional indigenous uses of fire and principles of fire management. To facilitate informal, critical deliberations about current uses of fire and its impacts. To document typologies and spatial extent and patterns of current fire use in different landscape formations.
Participatory mapping	To develop base maps of indigenous place names, landscape formations, and sites of cultural significance in terms of traditional fire management. To facilitate deliberation about current uses of fire and its impacts, cultural change, and desired futures.
Field measurement	To document spatial extent and typologies of burn patters, and landscape formations affected. To systematically conduct destructive sampling of fuel loads in different landscape formations.
Remote sensing and GIS analysis	To develop georeferenced base maps of indigenous landscape formations and sites of different topologies of indigenous fire management. To conduct spatial statistical analysis to assess relationships between state fire management practices and indigenous fire management systems.

[2] Since 2009, EDELCA changed its name to CORPOELEC. We use the acronym EDELCA here because it is still most commonly used in Venezuela.

[3] Organizers of these activities were Dr. Bibiana Bilbao, Laboratorio de Dinámica de Comunidades y Procesos Ecológicos (LABPROECO), Universidad Simón Bolívar and Dr. Selma García, Departamento de Manejo Ambiental, Gerencia de Gestión Ambiental, CVG-EDELCA and coordinator of Proyecto Riesgo.

to maintain low levels of fuel and prevent larger and more destructive fires (see e.g. Williams et al., 1998; Russell-Smith, 2000: 94, Cooke, 2000). Since "fire is an integral component of savanna environments" (Whitehead, 2003: 415), the main question for fire management officials in Australia is not how to prevent the use of fire, but how to use controlled fire to promote a distinct mosaic of burned and unburned savanna, which in turn serves to prevent more extensive fires while enhancing biodiversity and promoting a diversity of landscapes. This type of participatory fire management is supported by a growing body of ethnographic literature (e.g. McGregor et al., 2010; Miller and Davidson-Hunt, 2010; Shaffer, 2010; Mistry et al., 2005; Braithwaite, 1991, 1996; Haynes, 1985; Lewis, 1986, 1989; Press, 1987; Verran, 2002), which suggests that indigenous fire management has been crucial for maintaining low fuel levels and controlling the distribution, diversity and relative abundance of plant and animal resources (Lewis, 1986).

As a result, a global effort is now underway to reintroduce indigenous burning practices as a permanent tool in landscape management (Lewis, 1989; Puyravaud et al., 1995; Marsden-Smedley and Kirkpatrick, 2000; Moore et al., 2002; Laris, 2002; Sonko et al., 2002; Jurvélius, 2004; Mistry et al., 2005; Sharma, 2006; Pinto, 2008; McGregor et al., 2010; Miller and Davidson-Hunt, 2010; Shaffer, 2010). In some cases this is already being done with relative success, including in the United States and Canada, where decades ago there was a strict policy against the use of fire in wilderness areas (Weber and Taylor, 1992; Pyne, 1995, 1997). Australia is a pioneer with this type of initiative,[4] but also some Africa, Asian and Latin American countries have begun to take steps in this direction (Pinto, 2008; Moore et al., 2002). These efforts are part of a global shift toward participatory models in order to develop more democratic, just and culturally appropriate approaches to conservation management (Stevens, 1997; Brechin et al., 2003).

These new approaches to conservation management have included the development of new institutional arrangements for shared decision-making in conservation planning in protected areas (Stevens, 1997; Borrini-Feyerabend, 1999), often in the context of community-based conservation initiatives (Berkes, 2007), and new research methodologies for integrating different knowledge systems, such as participatory rural appraisal and action research. In particular, our approach to "intercultural" fire management is informed by recent advances in participatory landscape management, which aims to develop methods for integrating indigenous and "local" landscape management practices with Western science methods in order to facilitate more democratic and effective landscape management (Beunen and Opdam, 2011; Selman, 2004; Valencia-Sandoval et al., 2010; Velásquez et al., 2009).

These participatory approaches to landscape management, in turn, are premised on an understanding of "landscape" as both material *and* socially constructed (e.g. Leach and Fairhead, 2000, 2002). Landscapes are therefore site- and time-specific complexes of nature and culture that are always changing, and their management must take into account their historical, cultural production as well as their biophysical dimensions (Antrop, 2005). From this perspective, social constructions, memories and indigenous practices are essential for integrated, holistic landscape management, "and the manifold relations people have toward the perceivable environment and the symbolic meaning it generates, offer valuable knowledge for more sustainable planning and management for future landscapes" (Antrop, 2005: 21).

However, such participatory approaches to landscape management that seek the integration of local and scientific knowledge have been slow to reach the Gran Sabana, as suggested by the management practices pursued by EDELCA. When the EDELCA fire control program was instituted in 1981, the goal was to reduce the extent and frequency of indigenous burning through environmental education, fire prevention and fire fighting. Pemon involvement in fire policies has been restricted to direct employment as manual laborers (fire fighters) and as subjects of environmental education activities. While efforts have been made to involve young Pemon in some aspects of the fire control program, Pemon elders have been systematically excluded. Up until recently, scant attention had been paid to the study of local fire regimes and to the Pemon knowledge about fire management and, as a result, there had been little opportunity to understand traditional Pemon use of fire and the ecological knowledge that underpins it.

What is perhaps most striking is that despite the relatively heavy-handed fire suppression strategies pursued by EDELCA and the considerable material resources invested in this effort,[5] the number and extent of fires have remained relatively constant over time (Barreto, 1989; Gómez, 1995). In areas surrounding large Pemon communities that are subject to rapid cultural change—especially those located near the main Pan-American Highway—many authors (Dezzeo, 1994; Fölster, 1986, 1995; Fölster and Dezzeo, 1994; Huber and Zent, 1995; Kingsbury, 1999, 2001; Rodríguez, 2004; Sletto, 2006) have reported a loss of forest cover as a result of the increase in population density, which in turn is the result of acculturation policies that sought to concentrate Pemon in centralized communities (Sletto, 2006).

However, the Gran Sabana faces another problem, which—paradoxically—may be the result of a *lack* of frequent fire use in some areas. In recent years, large-scale fires have occurred in areas that previously had reported few such incidents, such as at the base of the mountain Auyantepuy. In some cases, these incidents appear to be partly the result of landscape change caused by the reduction in the frequency of small, controlled fires. The decline in indigenous practices of regular, controlled and small-scale prescriptive burning appears to have resulted in a more homogeneous vegetation cover and an accumulation of dry grass, which becomes fuel for large fires (Biddulph and Kellman, 1998; Sletto, 2006). This decline in indigenous prescriptive burning is in part due to Pemon's abandonment of previously inhabited areas, reduction in subsistence-farming practices, and a decline in fire use among people currently residing in large, acculturated Pemon communities such as Kumarakapay, a community of about 1000 inhabitants located along the Pan-American Highway.

With the passing of elders who are those who maintain these fire practices in acculturated communities such as Kumarakapay, this decline in prescriptive burning is likely to accelerate, resulting in increasing levels of fuel in remote areas of the Gran Sabana. Given this situation of rapid social and attendant ecological change, we suggest it is necessary to develop new, participatory solutions to fire management. In the subsequent section, we discuss indigenous

[4] One of the most recent examples of revival and integration of local fire management knowledge can be seen in the Management Agreement of the East Arnhem Fire District, signed in 2006 among a gas company (Darwin Liquefied Natural Gas 'DLNG'), the Northern Territory regional government, the aboriginal and ancestral land owners from the coast of Maningrida to the mouth of Katherine and Mann Rivers. Through this agreement, the gas company DLNG agrees to pay $1 million a year for a period of 17 years to the historical inhabitants of these lands, and to work in conjunction with environmental managers in the restoration of traditional burning (more information can be found online: http://www.atns.net.au/agreement.asp?EntityID=3638).

[5] $500.000 per year in 2003 according to EDELCA reports (Sletto, 2006).

practices of prescriptive fire management, including the cultural norms and constructions that undergird Pemon's constructions of the savanna landscape. Drawing on principles of participatory landscape management (Antrop, 2005; Beunen and Opdam, 2011; Selman, 2004; Valencia-Sandoval et al., 2010; Velásquez et al., 2009), we argue that effective, intercultural fire management must be based on an understanding of both the social and ecological principles of indigenous fire use.

3. Pemon uses of fire

In Venezuela, the Pemon are known as "Quemones," a pejorative pun that means "those who burn." But to Pemon, fire (*Apök*) fire is seen as a way of "making the land (*Patá*) happy" because it helps to maintain the grasslands healthy and green and serves to prevent larger, more destructive fires. Fire is deeply rooted in the Pemon worldview, central to their identity and indispensable to their cultural survival—which explains, in part, why state institutions have had little success controlling and reducing the use of fire in the Gran Sabana.

Similarly to other indigenous peoples in fire-prone landscapes (Miller and Davidson-Hunt, 2010; Rodríguez et al., 2011), to the Pemon, *Apök*, means much more than the Western conception of "fire:" as with water, wind, rain, birds and animals, fire is alive in the form of spirit. This means that humans can never obtain complete control of *Apök*'s powers. Instead, fire is unpredictable and free: as the elders say, "fire has its own control," and "he knows where to stop." Rather than controlling fire, Pemon believe in developing a meaningful relationship with *Apök* and enlist him as ally in their everyday life. As with many of the spirits in the Gran Sabana, if one respects and understands *Apök's* foibles, he can be a good companion. Practical knowledge of fire use is therefore not enough: it is also necessary to develop a mystical connection with *Apök*.

According to the Pemon worldview, fire helps Pemon fulfill their ancestral obligation to care for the Gran Sabana. Fire is necessary to renew grazing lands for deer and other animals that depend on savanna grasses, to help certain plants flourish and, even more significantly, to permanently shape the landscape. According to the elders, fire not only brings joy to Pemon but also to *Pata*, their land. It is common to hear elders say "if there are no fires, *Pata* is sad." In the words of the elder Valentina Rojas, "I like to clean my paths (with fire) because that makes *Pata* feel happy" (Valentina Rojas, 1999; pers. com.). That is why in the traditional Pemon worldview, fire is commonly defined as "a symbol of life and joy."

This sense of joy is closely associated with the Pemon aesthetic, which sees fire use as essential to preserve the beauty of the landscape. As in the case of other indigenous people such as the Aborigines of Kakadu National Park in Australia (Lewis, 1989), Pemon use fire to "clean" the landscape and make it look "beautiful:"

> Fire is important for us to replace the old grasses. We burn so new plants grow. It's like a man who has not shaved and his hair is long: it looks ugly. If he shaves, he looks handsome. It is the same on the savanna (Leticia Fernandez, 1999; pers. com.).

> We have always used fire to maintain the Gran Sabana, to keep the savanna green. If you do not burn, the bushes and the leaves get old, as if there were no Pemon in the Gran Sabana. So we must continue to burn to keep the Gran Sabana green (Antonio González, 2002; pers. com.).

The Pemon also reap many practical benefits through their relationship with fire. Fire is used in hunting (*rampūn*) and fishing (Yraida Fernandez, 1999; pers. com.), in shifting cultivation, to make walking paths passable, to dry firewood and collect insects such as grasshoppers (*kailau*), and in fishing. Fire is considered a "blanket" to keep warm and to ward off dangerous animals (snakes, scorpions), and its magical powers are used to cure diseases. Fire also serves as a means of communication since differently colored plumes of smoke carry different meanings: depending on the color and frequency of the plumes of smoke, they can indicate signals of a successful hunt, the arrival of a guest, or an emergency. Many elders define fire as "a letter or messenger."

Ultimately, because of its practical and symbolic significance, fire is central to Pemon cultural identity, and maintaining traditional practices of burning is seen vital as for the reproduction of Pemon culture. In the words of the elder César Durán, "the use of fire is an indigenous custom. Our ancestors lived in that way, just as other societies have their customs" (César Durán, 1999; pers. com.). Fire is therefore intrinsic to Pemon self-definition as "savanna people" as opposed to their neighbors, the "forest people" (*Ingarikok*) (Koch-Grunberg, 1917 [1981b]; Butt-Colson, 2009).

3.1. Pemon rules and regulations of fire use

To Pemon, fire use carries great responsibility and the misuse of fire can be devastating: "Fire is like the tongue, if misused (speaking more than one should) it can spread and cause much damage" (Bellarmine Chuantoni Pullo, 1999; pers. com.). This is why each fire must only be started for a specific purpose acceptable to the true "owners" of the land, the *mawariton*, or ancestral spirits, with whom the Pemon have an unwritten pact that gives them permission to use their land. It is the *mawariton* who, according to the Pemon worldview, have determined that some places are sacred and therefore off-limits to burning. If a fire is lit near these places, most typically small forest patches and the dry, sparsely vegetated hilltops, the punishment of the *mawariton* will be immediate and dramatic:

> When a fire is approaching a sacred place, the site responds with rain and lightning to protect itself ... other times the place can be changed and carry itself to the person who burns, who will never be seen again (César Durán, 2002; pers. com.).

The *mawariton* also proscribe sanctions against extensive burning of savanna lands. In the month of August the *Masak-Pre*, a grass with sharp thorns, flourishes in the southern grasslands in the Gran Sabana. It is necessary to burn these grasses because they make walking uncomfortable, and they provide habitat for mosquitos. But, according to the Pemon, if they burn too much of the *Masak-Pre* in August, "this will provoke thunder and heavy rains" (Maria Felina Delgado, 1999; pers. com.). In other words, the spiritual norms that govern the use of fire follow a logic of ecological sustainability and undergird a system of prescriptive fire management: fires must be small and contained, avoid sensitive vegetation, and used to prevent accumulation of dead grasses.

3.2. Pemon system of prescribed burning

According to the Pemon, proper management of the risks associated with fire use hinges on one, fundamental principle: to prevent the accumulation of fuel, the grass on savanna should not be allowed to accumulate. Grasses should be burned frequently and regularly, fires should be small, and they should be lit the right time of day and the right day of the month. If not, dead grasses will accumulate and lead to fast-burning, very hot fires with high flames. If the wind is strong, the fire can jump natural and man-made fire breaks and destroy entire human settlements. The Pemon call this type of fire *tüpüyi tade*: a fire that burns even "against the wind." Such fires might enter forests and become

atabuta, fires that can burn underground for weeks. As Leticia Fernandez explains, "we burn through the air, part by part, the grasses that are on top of the ground ... if we let the grass accumulate, everything might burn, even the forests" (Leticia Fernandez, 2002; pers. com.).

From a Western ecological perspective, all this translates into the following: the Pemon maintain a system of controlled burning to prevent accumulation of combustible plant material that, if left alone, may fuel major fires. This prescriptive burning is premised on the use of "small fires" (*Apök manarön*) to produce fire breaks:

> In order to prevent a large area from one must light fire where you see piles straw so it extinguishes itself, on its own. When that is lit, it burns and then goes out. When someone returns he does the same thing where the previous fire stopped (Francisco Fernandez, 1999; pers. com.)

This system of fire breaks is particularly important in forest-grasslands boundaries. For Pemon, the "savanna edge" (*Tureta kata*), i.e. the last few meters of grass vegetation that border the forest-savanna ecotone, is an important fire management unit that must be managed through fire. Ecotones in the Gran Sabana commonly consist of ferns or perennial grasslands that catch tree seeds, forming regeneration zones where forest expansion takes place. In Pemon tradition, the "savanna edge" is constituted by the strip of grass that grows between this ecotone and the open savanna. Thus the savanna edge can be defined through its functionality, in the sense that a savanna edge can prevent a grasslands fire from entering the forest, or—if fuels have accumulated—can strengthen grasslands fires so that they encroach on the forest.

Unlike the drier areas of the open savanna, these low-lying areas often have more fertile soils with higher organic matter and are often covered by dense, fast-growing grasses. The Pemon distinguish these low-lying areas from other parts of the savanna because of their lush grasses, referring to them as *ramontarödau aurotasen* [in Taurepan]: "flat areas with tall grass." Because of their fertility, these low-lying areas near savanna gallery forests can produce a large amount of combustible material if they are not burned every one or two years. Although gallery forests in the Gran Sabana do not catch fire easily (Kellman and Tackaberry, 1993; Biddulph and Kellman, 1998), the presence of high fuel loads along forest edges can increase the fire risk.

Because of the risk posed by fuel accumulation in savanna edges, therefore, Pemon regularly burn these areas "so fire does not enter the forest" (*Apök womünamai Tureta tak*) (Fig. 1). This burning is commonly conducted at the end of the rainy season (between August and January) so that grasses along forest edges are green during the dry season, when the risk of fire is greatest. In Pemon (Taurepan), this burning period is known as *teyanösen wanak tureta depipon*; literally, "when you can burn the edge of the forest." This is the time of year when rainfall is frequent and forests (both vegetation and soils) are wet and unlikely to catch fire (Kellman and Tackaberry, 1993; Biddulph and Kellman, 1998). If necessary, a second burn is done six months later during dry season, but only following a heavy rain (Fig. 2).

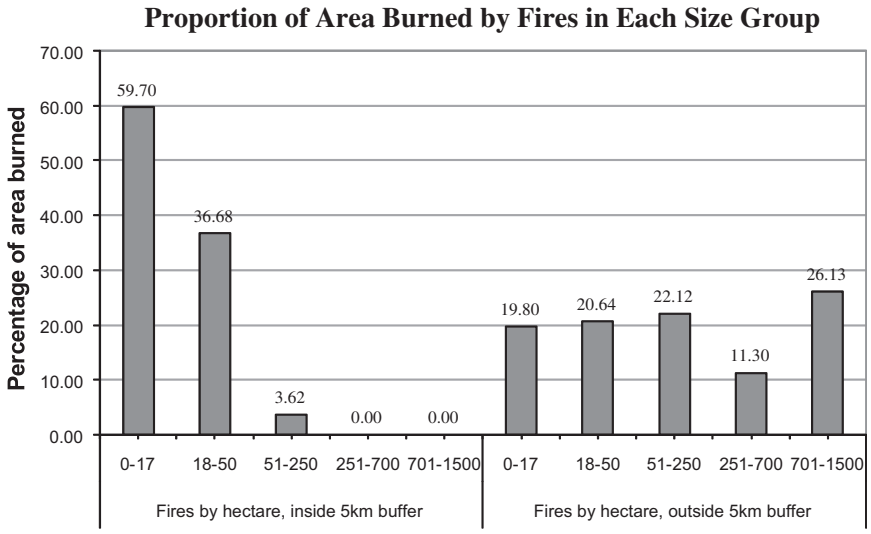
3.3. Ecological considerations of Pemon prescribed burning

Anecdotal evidence suggests that in areas that have remained unburned for more than two or three years, grasslands fires spread rapidly and out of control. The Pemon—including those who work as fire fighters in the fire control EDELCA program—often speak of areas located far from communities that are no longer fire-managed by Pemon, which eventually are exposed to fire, either intentionally or accidentally, and become sites of large, destructive fires. These observations appear to be supported by EDELCA fire fighting statistics, which indicate an increase in size and intensity of fires in relation to the distance of communities: between 1993 and 2003, 60% of the acreage that burned within a radius of fire kilometers of Pemon communities was the result of small fires (less than 17 ha). There were no fires greater than 250 acres within these areas. However, in areas located more than 5 km from the communities, one third of the total area was burned by fires greater than 250 ha in size (Fig. 3).

Fig. 1. Lighting a prescriptive fire in savanna edge with damp vegetation near Vista Alegre, the Gran Sabana. Photo: Bjorn Sletto.

Recent studies also appear to provide support for Pemon prescribed burning as an appropriate technique for biodiversity conservation. Between 1999 and 2009, Bilbao et al. carried out a long-term controlled experiment of fire behavior and its impacts on the production of biomass and biodiversity in the Gran Sabana (Bilbao et al., 2009, 2010). Selective burns in 27 plots were carried out during the dry season over a period of 7 years, revealing great variability in fire behavior in terms of fire extent, temperature, and flame height. The variability in fire behavior, in turn, creates a mosaic of grasslands patches with different fire histories, where the recently burned patches act as fire breaks in the propagation of fires started in neighboring patches. Based on this research, the

Fig. 2. A recently burned savanna edge near Kumarakapay, the Gran Sabana, Venezuela. Photo: Bjorn Sletto.



Chi-square: P=0. (The relative proportion of area burned by large fires is significantly higher in the groups of fires outside the 5 km buffer, compared to the groups of fires inside the 5km buffer.)
T-test, P<0.005, P=1.00435E

Fig. 3. Fires fought in the management area of the EDELCA Upper Basin of the Rio Caroni, in terms of burned areas (hectares), within or outside a buffer zone of 5 km, between 1993 and 2003. Source: EDELCA Geographic Information System, 2003.

authors suggest that the Pemon prescribed burning system reduces the occurrence of dangerous fires and also furthers spatial and temporal vegetation heterogeneity (Bilbao et al., 2010).

An investigation of fuel loads in forest–grasslands boundaries also suggests that fuel loads are elevated in areas less frequently burned by Pemon fire managers. A sampling of fuel density was carried out between 2003 and 2004 (Sletto, 2006) to assess whether more frequent, prescribed burning leads to lower accumulations of combustible plant material (in kg/m) in savanna edges, and whether fuel accumulations are higher in the land-use zones of communities that experience rapid cultural change (Kumarakapay) compared to communities experiencing slower rates of change (Monte Bello).

The sampling was carried out at the beginning of the dry season and followed the fuel-analysis methodology of Keane et al. (2001) and Sandberg et al. (2001), and employed vegetation sampling methods of Bonham (1989), Brown (1981), Canfield (1941), and Floyd and Anderson (1987). A total of 158 samples were taken between December 2003 and February 2004. All plant material was collected from square-meter quadrants, separated by intervals of 20 m in 79 transects located four feet away from and parallel to the ecotone. Samples were taken from sites that exhibited similar characteristics: low plains, flat and wet (*ramontarödau aurotasen*), dominated by *Trachypogon* grasses, often in the arch of a U-shaped curve in a river or stream (*intaka*) with muddy soil, unlike the sandy soils and often rocky slopes of the highlands.[6]

The results suggest that in frequently-burned areas (defined as areas within 15 km from the communities), fuel loads in savanna edges are lower. In areas burned frequently in the two land-use zones, the dry weight (i.e. the density of combustible material) of grasses and other vegetation in savanna edges was 0.26 kg/m^2 compared to 0.70 kg/m^2 in infrequently burned areas (Fig. 4). It is also important to note the differences between the two communities in terms of dry weight: In Kumarakapay, the community subject to more rapid social change, and where burning traditions are disappearing, the average dry weight in infrequently burned areas was 0.81 kg/m^2. In Monte Bello, the corresponding figure was 0.46 kg/m^2. There was no significant difference between the two communities in terms of dry weight in frequently burned areas, but the samples with the highest fuel loads in infrequently burned areas were found in the land-use zone of Kumarakapay.

This study demonstrates the importance of taking into account how often the Pemon burn, instead of only considering "how much" they burn. Also, social change and EDELCA environmental education aimed to reduce burning is having unexpected consequences. In communities subject to greater cultural change due to their proximity to the Pan American Highway and greater access to

	Average dry weight (kg/m^2)	Average no. of months since burning
Monte Bello frequent	0.23	2.5
Monte Bello infrequent	0.46	9.1
Kumarakapay frequent	0.27	5.1
Kumarakapay infrequent	0.81	18.1

Fig. 4. Summary of results from the collection of surface fuels in the savanna edges in the land use zones of Kumarakapay and Monte Bello (average weight in kg/m^2). "Frequently burned areas" are defined as the area within a radius of 15 km from the center of the community. "Infrequently burned areas" extend from a radius of 15 km from the community to the boundaries of the land-use zone of each community. The table shows the average weight of fuel that is freshly cut and dried, respectively, each from one square meter in areas frequently and infrequently burned of each land-use zone.

[6] It should be noted that no systematic evaluation of soils was conducted from these sites (chemical or structural). Although the morphology of the landscape was similar between the sites, the soils may be different between the sites, just as the composition and structure may vary. The dominant grass species in each sampling were documented, but due to the limitations of the study it was not possible to record data on the mixture of species or structure of the vegetation structure at each site. This study focused on documenting the weight of the plant biomass (the weight in the field and then the dry weight after two days) as an indicator of the flammability of organic matter in each quadrant, as measured by the density of organic matter (kg/m^2).

public services, prescribed burning of savanna edges is less frequent than in communities with lower rates of acculturation. Fire managers in communities that experience a higher rate of cultural change are less likely to venture into remote areas because their livelihood is less dependent on hunting, fishing and shifting cultivation. Similarly, the concentration of these populations has reduced the number of visits to family members located in more remote areas, and as a consequence, to a reduction in the frequency of prescribed burns.

Thus, although the decline in fire use in communities subjected to more intense social change is interpreted as positive by EDELCA managers, this development actually obscures the negative implications of socio-cultural change for forest conservation in the Gran Sabana. Communities like Kumarakapay that have reduced their fire use in remote areas can present a greater risk to forests in the Gran Sabana than traditional communities where fire management traditions are maintained, such as Monte Bello. This suggests a need to rethink fire management in the Gran Sabana, specifically to shift away from focusing on suppressing frequent fire use (which tends to be the current focus of fire managers; see e.g. Ablan et al., 2007) to concentrating on efforts to re-establish indigenous prescribed burning practices.

4. Factors limiting intercultural fire management

However, significant obstacles must be overcome to arrive at such a reconceptualization of fire management in the Gran Sabana. This includes pervasive resistance to dialogue and contrasting views of fire and the "fire problem," not only between Pemon and EDELCA fire managers, but also within Pemon communities and state agencies.

4.1. *Conflicting views of fire* in Pemon communities

Just as social change is leading to a decline in prescribed burning, these changes are also contributing to differences in perceptions of fire among the Pemon, especially between Pemon youth and elders. There are also noticeable differences between groups of youths, depending on whether or not they participate in the market economy or grow up in more or less acculturated communities.

In Kumarakapay, elders tend to emphasize feelings of happiness, joy and tranquility when talking about fire and its use. Youth, on the other hand, tend to highlight the possibility of destruction and damage to the landscape, and they often suggest that fire is used "without control" by the elders (Rodríguez, 2007). Interestingly, this attitude is particularly noticeable in young people who work as teachers or in public administration, and those who have had access to higher education. As expected, the decreased connection to fire on a day-to-day basis decreases their knowledge of its use: "We young people hardly know anything about fire. For example, I'm not growing cassava. I'm not going to *conuco* (gardens), I do not practice indigenous customs. I'm eating Western food. I've lost everything" (Bibiana Delfonso, 1999; pers. com.).

Or, as one elder said:

> The young people have forgotten everything. They only think about studying, more than anything, to work in schools and make money and live that way. This is how they live now. This means they are not thinking about the old ways of living, the indigenous culture. Therefore, they do not know how to use fire. If the children had stayed with their parents, they would have learned, but they cannot learn now (Antonio González, 2002; pers. com.).

Did you know that forest fires are prevented "little by little" through small fires?					
Kumarakapay elders			Kumarakapay youth		
15/15	100%		2/14	14%	
Is it good or is it bad to burn at the edge of the savanna?					
Kumarakapay youth			Monte Bello youth		
Good	8	30.8%	Good	10	100%
Bad	18	69.2%	Bad	0	0 %
Total	26	100%	Total	10	100%

Fig. 5. Comparison of youth knowledge about prescribed burning and fire control mechanisms among the Pemón in Monte Bello and Kumarakapay.

The loss of local knowledge about fire use among young people has been tested in two recent studies. In a series of 29 in-depth interviews conducted with youth in Kumarakapay in 1999 (Rodríguez, 2002), only two (14%) knew that according to traditional Pemon fire practice, forest fires are prevented through prescribed burning. In contrast, all the 15 elders interviewed explained that this is the traditional way to control fire (Fig. 4). This relationship between social change and loss of knowledge about fire use among young people is illustrated even more clearly when Kumarakapay is compared with the more traditional community of Monte Bello. In a survey conducted in 2002, youth in both communities were asked, "Is it good or bad to burn the savanna at the edge of the forest?[7] While in Kumarakapay 18 of 36 young people (69.2%) responded that this was "bad," in Monte Bello, 10/10 (100% of the youth) saw this as positive (Sletto, 2006) (Fig. 5).

On the other hand, young people in Kumarakapay worried much less about fuel accumulations: just a little over half said that if it is dangerous let the grass accumulate, while youth in Monte Bello all responded to the contrary. When they were asked the question, "Why shouldn't the edge of the forest be burned during the dry season?" youth in Kumarakapay provided a variety of responses: some (12%) responded that it was not dangerous to burn the savanna in the dry season at all (contradicting the traditional principles), many (31%) responded with a general statement "you can end up burning everything," while a few (8%) responded that burning the edge of the savanna in the dry season can harm "the flora and fauna." In Monte Bello, in contrast, nine out of ten young people interviewed answered that burning the edge in the dry season can cause the fire to burn the forest (Sletto, 2006).

In rapidly changing communities like Kumarakapay, these differences in attitudes toward fire use have also become a source of intra-community conflicts. Youth tend to reproduce a narrative against fire use which, in turn, has led to a form of "ethnic shame" (Rodríguez, 2002):

> I'm sick of the fire. Sometimes I get embarrassed when people ask me why there are many fires and I have no answer them; then I close my ears. I always tell them, 'Ahh! They do it for pleasure.' I tell them that when the elders go there will be no more fires. I think it best that way (Young Pemon, 1999; pers. com.).

Elders, for their part, tend to increasingly blame youth for abusing the power of *Apök* by "burning for the sake of burning" or "burning against EDELCA" that is, burning to irritate EDELCA officials and "make the fire fighters work" (Rodríguez, 2004, 2007; Sletto, 2006). The elders consider such fire use illegitimate,

[7] Elders Antonio Perez and Julio Enrique Lambos (in Kumarakapay) and the chief Leobaldo Pinzón (Monte Bello) helped with the survey design and questions. Yirolaisa Pérez and Erica Duran, Kumarakapay, translated the survey from Spanish to Taurepan. The survey was conducted by Yirolaisa Pérez y Erica Duran in Kumarakapay and Alicia Contasti and Leobaldo Pinzón in Monte Bello.

dangerous, and contrary to the spiritual ties that govern the human relationship with Apök, and also as evidence of disrespect of elders. Ultimately, this tension between young people and elders has led to a lack of communication and internal consensus regarding fire use within acculturated Pemon communities. Especially elders in acculturated communities tend to avoid discussing fire use, whereas in more remote communities that are less affected by Western culture, the issue of fire is not nearly as complicated or contentious. Also, the differences in knowledge and practices of burning between acculturated and more traditional settlements have complicated dialogue between Pemon communities regarding fire management.

4.2. Institutional inconsistencies regarding fire management

If there is no monolithic view of fire and its use among the Pemon, there is also a lack of consensus about indigenous fire use within and among state institutions, including in EDELCA (Rodríguez, 2002; Sletto, 2006, 2008; Sanchez-Rose and Vessuri, 2008). Differences of opinion between fire managers depend on their area of expertise, their educational and technical background, and on their longevity within the organization. Fire managers working in the Gran Sabana have traditionally been more supportive of the idea of prescribed burning and participatory approaches than staff and administrators in the agency headquarters in Puerto Ordáz. For example, in the 1980s and 1990s, EDELCA managers explored the possibility of working with the Pemon to develop a joint fire management program. According to fire managers, however, these attempts were repeatedly resisted by senior management. John Júnior, the first coordinator of the fire brigade in the Gran Sabana explains:

> In those days [in the '80s] we went to the communities, we had meetings with them, we talked about prescribed burning, and we integrated ourselves in their work and they into ours. We helped them clean up their roads, community areas, and they saw our interest in helping. When they had to burn a *conuco*, we went with them to help them burn and even harvest. Why not? It is important to integrate with the community...our initiative was working well. You see? In those days we were much more autonomous, people who worked here made decisions autonomously. But in 1986 the institutional structure of EDELCA changed... and that was when the change began. Our project with the communities did not receive any more support from EDELCA and we had to devote more time to fire control, but we did hardly anything, which I think is a mistake, because fire control does not solve the problem (quoted in Rodríguez, 2002).

Sometime later, Eduardo Gómez, coordinator of the fire control program between 1990 and 1996, proposed to develop a prescribed burning program in conjunction with the Pemon. Although this program acknowledged the environmental benefits of the indigenous practice, senior management rejected the proposal because they thought it "would not be effective." According to Gómez:

> This *would* be an effective solution. We can deal with the Pemon fires very well, because they already use this technique (prescribed burning). They have a management vision and that vision is one of prescribed fires: reduce combustible material so that when a big fire comes, there is not much that can burn. If they do not burn the Gran Sabana, the fires would be spectacular. Of course when there are accumulations of fuel it must be burned (quoted in Sletto, 2008).

Some EDELCA managers today are discussing the idea of integrating participatory fire management into a comprehensive, integrated conservation model for the Caroni Basin (Sanchez et al., 2007). Such a conservation model would be based on an explicit recognition of the importance of "prioritizing the values, cultural practices and forms of land use that promote conservation" (ibid.), including indigenous use of fire. These managers have even voiced the need to recover and implement traditional fire practices for long-term, comprehensive conservation. However, there is still little evidence of any effort to recover local knowledge of fire use in EDELCA. Instead, the agency still follows the same intervention philosophy developed two decades ago; that is, fire suppression combined with environmental education to teach the Pemon how to properly use fire (Rivas et al., 2007).

Recently, the National Parks Institute—which has remained relatively distant from the issue of fire use in the Canaima National Park since EDELCA assumed institutional responsibility for fire management in the early 1980's—has taken a more active role. However, the approach favored by INPARQUES is very similar to that of EDELCA's traditional model, i.e. focusing on fire suppression and fire fighting instead of promoting a vision of joint fire management (INPARQUES, 2007). Also, according to EDELCA informants interviewed in 2008, INPARQUES' involvement has become a primary obstacle to develop a new institutional framework for a more democratic and effective fire management strategy in the Gran Sabana. Some EDELCA managers argue that INPARQUES might impede intercultural fire management in the Gran Sabana, in part because agency managers are less connected with everyday indigenous fire management and have traditionally pursued top-down instead of participatory strategies in protected area management (Navera, 2003; pers. com.). In an interview in 2003, INPARQUES official Jorge Navera said, "We are not very much loved in the Gran Sabana" because of these heavy-handed conservation strategies. Or as Aciclo Gómez, an elder and former Cacique in Kumarakapay, puts it, succinctly: "INPARQUES was our enemy early on" (Aciclo Gómez, 2003; pers. com.).

5. Strategies for advancing intercultural fire management in the Gran Sabana

The complex socio-cultural and institutional landscape discussed above present serious challenges to intercultural fire management strategy in the Gran Sabana, as in other protected areas. The development of productive dialogue and communication based on respect of indigenous knowledge is widely recognized as one of the major challenges to sustainable development and environmental management (Perez and Argueta, 2011; Galopin and Vessuri, 2006; Leff, 2003; ICSU-UNESCO, 1999). We therefore propose the following strategies to develop a more democratic, participatory, and effective intercultural model of fire management in the Gran Sabana; also see Table 2 for major principles for intercultural fire management.

5.1. Support indigenous dialogue on the meaning and impacts of fire

Our research suggests there has been a significant loss of Pemon knowledge of fire use as a result of social change during the past 50 years. Also, Pemon have shown little interest in discussing fire management with other parties, in part because it is an issue that has rarely been discussed on their terms and using their language, and in part because the Pemon have no single and consistent view on the subject. Before they can discuss the topic with other stakeholders, it is necessary for the Pemon to be able to express and clarify their own visions of fire and its impact, with the understanding that there is never going to be a singular Pemon vision of fire. This has to be done through a participatory, communicative process led by Pemon authorities, both traditional (elders) and

Table 2
Major principles of intercultural fire management.

Type	Principle
Research	Achieve an understanding of indigenous fire management that takes into account social constructions and spiritual attachments to the landscape.
	Find common ground between indigenous and scientific knowledge systems regarding the use of fire and its impacts.
Reflective deliberation	Create opportunities for indigenous peoples to assess the environmental health of their territories and about their future management.
	Create opportunities for indigenous peoples to reflect about their cultural changes and their desired future.
	Strengthen indigenous fire management knowledge systems through internal deliberations about traditional and current uses.
	Create opportunities for deliberation among different stakeholders regarding the use of fire and its impacts.
Implementation	Guarantee autonomous decision-making among holders of traditional knowledge in the development of intercultural fire management.
	Ensure a willingness to participate in the development of an intercultural process by both indigenous peoples and resource managers.
	Ensure financial resources for the design, implementation and assessment of the intercultural fire management process.

modern (elected leaders and teachers). In addition, this communicative process must be conducted within a broader context of indigenous rights and development strategies, perhaps within the framework of a "Plan de Vida" ("life plan"). A Plan de Vida has been repeatedly mentioned by the Pemon as a potential tool to strengthen their heritage and to initiate dialogue with the outside world about their history and identity, visions for development, land use planning, and resource use and management (García, 2009; Pizarro, 2006).

The Pemon's desire to articulate their own views of development as a precondition for dialogue with other actors is shared by many other indigenous peoples in Latin America (Avensur et al., 2007). The concept was originally conceived in Colombia (Jansasoy and Pérez, 2005), where Life Plans are already used as articulating mechanisms between indigenous peoples and external advisers in land-use planning processes (Perez and Argueta, 2011; Vásquez et al., 2005). Indigenous peoples in the Andean region are furthering their own perspectives of development through the concept of "El Buen Vivir" (To Live Well; *Suma Qamaña* in Aymara and *Sukak Kawsay* in Quechua), which seeks to place local culture and priorities at the core of interactions with external academic, political and economic actors (Huancuni, 2010; Leon, 2010).

In our experience, a Plan de Vida process must emerge from within the community to generate local interest and commitment, and to effectively reveal local environmental knowledge and perspectives. This became evident during a seven-month series of workshops carried out in 1999 with a group of 30 residents in Kumarakapay, half of whom were elders and half youth (Rodríguez, 2002, 2007). Through this participatory process, Pemon for the first time discussed socio-environmental changes and fire use as a group. However, such critical reflections on the role of fire for culture, subsistence, and environmental management should not only include members of modern communities, but also elders and youth in more isolated communities. While there is a rapid loss of traditional environmental knowledge in acculturated communities such as Kumarakapay, these practices continue in more remote communities. Residents in communities like Kumarakapay respect the knowledge of their cousins from distant communities: as the Pemon of Kumarakapay and Kavanayen say, those who live far away "know more" about the practice of prescribed burning since burning is still a central part of their daily lives. In workshops with members of modern communities, people listen with great respect to the perspectives of community members from such traditional communities as Monte Bello, Vista Alegre, and Tuau Ken.

5.2. *Inform local leaders about the topic*

Our research in the Gran Sabana during the past 10 years indicates that traditional ecological knowledge is maintained by elders. Often, younger, modern leaders as well as other formal authority figures (particularly teachers and those engaged in the tourism industry) are less familiar with subsistence practices, including fire management. This knowledge gap between traditional and modern leaders generates conflicts and makes it difficult to reach consensus on issues related to environmental management. In order to develop a participatory model of fire management, elders and traditional leaders need to educate young people about the traditional knowledge of fire. It is therefore important to secure the participation of elders in public discussions on local perspectives of fire management.

5.3. *Document elders' knowledge before it is too late*

As discussed above, the traditional knowledge of fire management is disappearing, and it is essential that this knowledge be documented before even more is lost. However, even in the more acculturated communities such as Kumarakapay, this knowledge is more present than is commonly assumed by EDELCA and other state agencies and researchers. This knowledge is "hidden" in part because families who practice a traditional way of life tend to be reluctant to interact with outsiders, and also because they spend less time in the communities. Instead of getting involved in the tourism industry, these families spend much of their time hunting or working in their gardens, which are several hours or even days away. Their work makes them less likely to participate in meetings, especially those involving state officials. To successfully integrate these fire managers in an intercultural approach to fire management, these people must be invited by the traditional authorities, especially by the elders, and meetings should be scheduled to accommodate their schedules.

To increase the value of this documentation of indigenous knowledge, it should be accompanied by dialogue and sharing of traditional and modern perspectives on fire management. Young Pemon, including students and teachers, can play an important role in building a common understanding about the current and future role of fire for Pemon culture and environmental management. In addition to facilitate dialogue, youth can play an active role in recording, systematizing and seeking long-term strategies to integrate traditional knowledge into their daily lives and education system. This is especially important since the issue of fire use, like many other Pemon environmental practices and knowledge systems, are still totally absent from the current, bilingual intercultural education system in Venezuela.

5.4. *Pursue further studies on the ecological dimensions of Pemon fire use*

Additional fuel load research should be conducted in the Gran Sabana, especially since the study discussed above was a pilot project completed during a short period with a limited number of sampling sites. Despite strong indications that fuel accumulations are uneven across the Gran Sabana and that there is a link between frequency of burning and accumulation of combustible materials,

more research is needed to test these initial findings. It is particularly important to note that the study was conducted to verify Pemon claims, specifically the claim by elders that less frequent burning leads to the accumulation of more fuel and, therefore, more extensive and destructive fires. By continuing such reflective and participatory fire management research, other local knowledge and assumptions can also be tested using scientific methods.

We also recommend the use of remote sensing analysis to map and model the greenness factor as a proxy for fuel loads in different areas of the Gran Sabana. This analysis should be based on a time series of imagery to model the spatial patterns and rhythms of prescribed burning in different areas with different proximities to communities. By comparing such remote sensing analysis with EDELCA data, a fire management model can be developed that integrates scientific and Pemon knowledge.

Ultimately, a reflective and deliberative dialogue on the practices and meanings of fire will reveal that issues of most concern to Pemon are not entirely different from those of EDELCA. The identification of these common concerns is critical to defining a participatory research agenda.

5.5. *Create opportunities for reflection and public deliberation about fire management as perceived by different disciplines and knowledge systems*

Participatory research on fire use in the Gran Sabana should be based on principles of trans-disciplinarity. In particular, as suggested in the participatory landscape literature (Beunen and Opdam, 2011; Selman, 2004; Valencia-Sandoval et al., 2010; Velásquez et al., 2009), it is important that researchers within science disciplines such soil science, ecology and biology engage productively with the socio-environmental reality of the Gran Sabana and consider the ecological value of Pemon knowledge. Despite the criticism of the Pemon and attempts to halt their fire use, they will continue burning because it is an integral part of their world-view. Also, fire remains an integral part of the daily lives of Pemon in many parts of the Gran Sabana. Therefore, future research on the subject must recognize this social reality, and thoroughly investigate Pemon practices and examine their applicability and validity under different conditions and in different areas. The same applies to the prevailing fire control policy in the Gran Sabana as carried out by EDELCA, which will require a serious reconceptualization.

On the other hand, Pemon elders and youth know very well that their current knowledge and practices are not perfect. Furthermore, social and environmental conditions in the Gran Sabana are not the same as 25 or 50 years ago, when elders learned their fire management practices from their grandfathers. Because of this, a more effective and culturally legitimate fire-management system must be built on the integration of traditional knowledge of fire use with modern technology and scientific knowledge. Therefore it is essential to create venues for public deliberation and reflection among Pemon, researchers and environmental managers of the Gran Sabana (especially representatives of EDELCA and INPARQUES), to exchange views and perspectives on the problem of fire and its long-term management.

6. Conclusion and recommendations

There appears to be a slowly growing acceptance within EDELCA of the need for a more participatory approach to fire "management" as opposed to a continuing emphasis on fire suppression (Galán, 1984; Rivas et al., 2007). This is based on a growing recognition that current strategies are inadequate to preserve biodiversity in the Gran Sabana, and that instead, indigenous knowledge may contribute to more sustainable protected area management in the Gran Sabana. However, despite recent signals from some CVG-EDELCA professionals that they might support a communicative and participatory approach to fire management, this process is barely beginning and EDELCA and other state agencies are still divided on this issue.

In the meantime, the Pemon continue to burn despite the attempts of EDELCA and other agencies to reduce their fire use, and despite state strategies of acculturation and education that have led to a change from subsistence culture to tourism-oriented economic development. In all likelihood, indigenous fire use will continue, not only because it constitutes a central element of Pemon identity, but also because of its ecological value in preventing larger fires. However, our research suggests that indigenous practices are, and will continue to be, pursued to differing degrees in different parts of the Gran Sabana because of uneven patterns of social change. This could result in increasingly contradictory patterns of burning and substantial landscape change, which in turn may lead to increasingly destructive fires, particularly in more remote areas. Ultimately, rather than attempting to eliminate or reducing indigenous burning, both environmental conservation and Pemon cultural survival depend on the maintenance of traditional burning practices.

Building a shared vision for sustainable fire management in the Gran Sabana is not easy. The tensions regarding fire in the Gran Sabana are the result of a clash between different knowledge and symbolic systems relating to fire, which in turn arise from fundamentally contrasting relationships with fire and nature. Furthermore, these differences cannot simply be ascribed to a simple state/indigenous dualism. EDELCA managers disagree about the feasibility of an intercultural approach to fire management, and among the Pemon, there are marked differences in the way youth and elders view fire and its impact, just as there are differences in the perception of fire between communities close to the highway and those in remote areas.

However, this does not mean that an intercultural dialogue about fire is not feasible or possible. Rather, we suggest that in order to arrive at shared visions—that are not only culturally legitimate, but also sustainable over time—we must take into account the social and cultural complexities that surround social constructions regarding fire, landscape, and culture. The Pemon themselves must initiate such an intercultural model of fire management, but to do so, they require the support of scholars and institutions committed to the protection of the Gran Sabana.

Ultimately, the conflict surrounding fire management in the Gran Sabana suggests that participatory landscape management in indigenous lands must be premised not only on knowledge of indigenous land-use practices, but also on a fuller understanding of indigenous social constructions and spiritual attachments to landscape. This is because landscapes are socio-ecological phenomena, incorporating ecological realities as well as memories and meanings, and thus produced through material as well as social practices. Ultimately, this perspective suggests the need for a shift from a focus on merely "incorporating" current, indigenous environmental practices into participatory management plans, to a conceptualization of indigenous environmental knowledge as fundamentally dynamic, socially and spatially differentiated, and grounded in social constructions and narratives of landscapes and landscape ecologies. This, in turn, necessitates an approach to participatory landscape management that is based on critical and open dialogue not only between indigenous people and conservation agencies but also *within* indigenous communities, which as often as not are grappling with rapid and uneven changes in their traditional, socio-ecological landscape management systems.

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