Hum Ecol (2007) 35:331–343
DOI 10.1007/s10745-006-9064-7

Pemon Perspectives of Fire Management in Canaima National Park, Southeastern Venezuela

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Published online: 13 December 2006

Abstract Recent research on the ecology of fire has challenged the view that the use of fire by indigenous peoples is detrimental to ecosystems and wildlife in protected areas. However, in Canaima National Park and World Heritage Site in southeastern Venezuela, since 1981 managers have employed a costly fire control program to eliminate savanna burning by the Pemon indigenous people. Here I present the results of the first study on Pemon perspectives of fire management in the park. I show that savanna burning is an important tool in indigenous land management and plays a key role in preventing large catastrophic fires. Pemon knowledge of fire also raises questions about conventional interpretations of environmental change in the park. Lastly, I recommend a fire management policy that seeks to integrate local ecological knowledge. This will require: (a) greater openness from scientists and resource managers to understanding Pemon rationale for the use of fire, (b) clarification among the Pemon themselves of their own views of fire, and (c) research partnerships among scientists, resource managers and the Pemon in order to encourage understanding of Pemon ecological knowledge of fire, and to assess its true impact in the Canaima National Park.

Key words Savanna · fire · indigenous knowledge · protected area management · Pemon · Canaima National Park · World Heritage Site · Venezuela · Latin America

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Introduction

Since 1872 when Yellowstone, the world's first national park, was created, protected area managers have seen fires as a major threat to ecosystem and wildlife conservation (MacKinnon *et al.*, 1986; Machlis and Tichnell, 1987). However, global research into fire ecology, both from natural and human perspectives, directly challenges this view. For instance, in Indian national parks research has shown that fires play a key role in maintaining particular types of forest ecosystems and their associated wildlife (Puyravaud *et al.*, 1995). Similarly, studies in West Africa show that rather than causing net conversion of forest or shrub vegetation to savanna, indigenous fire practices are often vital for maintaining dynamic forest–savanna and savanna mosaics (Fairhead and Leach, 1996; Mbow *et al.*, 2000; Laris, 2002). In some countries, such as Australia (Press, 1987; Lewis, 1989; Russell-Smith *et al.*, 1997), a more thorough understanding of indigenous burning practices has resulted in their incorporation into mainstream protected area management.

Here I present the first analysis of indigenous views of fire and the perception of alleged fire-induced environmental changes in Canaima National Park in southeastern Venezuela. For more than 30 years, different institutions have striven to change or eliminate the traditional use of fire throughout the area popularly known as the *Gran Sabana*, in the eastern sector of the park. Fire control policies have been based on the assumption that the use of fire, particularly savanna burning, is causing a gradual reduction in forest cover (Galán, 1984; Gómez and Picón, 1994). Despite concerns over the use of fire in the park, land managers have shown little interest in understanding local fire regimes and Pemon views of fire. Instead, fire control has been based largely on preconceived ideas and

unsubstantiated hypotheses of the impacts of fire, resulting in a long conflict between the State and the Pemon over the use of fire in the park.

Many Pemon do not share the view of fire as destructive, and opposition to official fire control policies has taken the form of silent but persistent resistance (Scott, 1990), including: (a) the continuation of traditional burning practices, despite official efforts to change them, and (b) the setting of small fires specifically to irritate park managers and to make the firemen "work and get wet." Additionally, there is a marked difference in the way older and younger Pemon perceive fire, due to the influence of both modern education and direct action by the State to create a new view of nature and fire among the Pemon. These intergenerational differences cause a great deal of confusion among the Pemon, putting them at a disadvantage in debates with outsiders about the use of fire and its impacts. This may explain in part why many Pemon are reluctant to openly discuss their knowledge about fire with non-indigenous people.

By aiming to clarify traditional Pemon reasoning behind the use of fire, this article seeks to provide a starting point for constructive dialogue among the Pemon and to some extent between the Pemon and official land managers in order to improve fire management in the park. I show that the Pemon have important cultural and environmental reasons for using fire which deserve careful attention if fire management policies are to be well-adapted to the area.

Canaima National Park and its Traditional Inhabitants

Canaima National Park is located in Bolívar State, in southeastern Venezuela, close to the borders with Brazil and Guyana (Fig. 1) and covers an area of 30,000 km^2. It protects the northwestern section of the Guayana Shield, an ancient geological formation shared with Brazil, the Guianas, and Colombia (Sharpe and Rodríguez, 1997). Canaima's best-known features are its characteristic flat-topped mountains, known as "*tepuis*." In recognition of its extraordinary scenery and geological and biological value, the park was designated as a World Heritage Site in 1994.

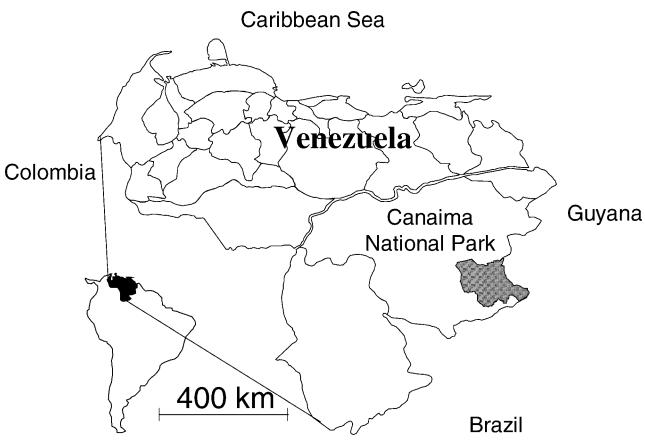

Fig. 1 Location of Canaima national park.

The vegetation of Canaima National Park is strikingly divided between a savanna–forest mosaic in the eastern sector of the park, known as the *Gran Sabana*, and humid evergreen forest in the west. It is still not clear what causes this difference and, in particular, how the savanna originated. Some authors believe the savanna to be a product of a rain shadow caused by the eastern *tepuis* (Huber *et al.*, 2001), or of drastic climatic fluctuations between 4,000 and 2,700 years B.P. (Rull, 1992). Others (e.g., Galán, 1984) consider the formation to be largely anthropogenic, a result of repeated burning by indigenous peoples. This disagreement over the environmental history of the area forms a central part of the analysis below.

The park is an important source of water for the Guri Dam, which is located approximately 100 km downstream of the northwestern border of the park. In 1992 the dam generated 72% of Venezuela's electricity (Gutman, 2002) which, according to 1995 estimates, represents a total yearly saving for the Venezuelan government of USD 969.29 million in oil for electricity generation (Waugh and Yerena, 1999). Thus, protecting the forests and the watershed functions of the park is of vital strategic importance to Venezuela.

The traditional inhabitants of the park are the Pemon, a sub-family of the Carib linguistic family. Their entire population approaches 20,000 (OCEI, 1992), the largest among Central Guiana Highlands peoples (Thomas, 1982). About half of the Pemon are settled within Canaima National Park, in about 30 villages that vary in size from 100 to 1000 inhabitants, although some Pemon still follow the traditional dispersed settlement pattern of nuclear families (Thomas, 1982) Their subsistence activities include shifting cultivation, gathering, hunting, and fishing, although small-scale mining and tourism are increasingly providing work as well (Sharpe and Rodríguez, 1997). The Pemon use fire in three main activities: shifting agriculture, hunting, and savanna burning. Managers have traditionally believed that these uses are incompatible with two of the conservation objectives of the park: preservation of forest cover and watershed protection (CORPOTURISMO *et al.*, 1974).

Fire as a Social Construct

I discuss Pemon perceptions of fire using a constructivist perspective. Nature means different things to different people, according to their different beliefs, values and interests of nature and its use (Greider and Garkovich, 1994). Thus, nature (including fire) is defined as a social

and cultural construct: burning can be seen by some people as a necessary tool for shaping and maintaining the natural environment, whilst for others it may be regarded as an unacceptable and undesirable practice. The difficulties in building common views over fire management in Canaima National Park are taken to be a result of this clash of views about fire and its use among the Pemon on the one hand, and resource managers and scientists on the other. Rather than presenting a discussion of these different views of fire, I focus here primarily on those of the Pemon. Elsewhere (Rodríguez, 2004a, b), I have provided a detailed discussion of the contrasting views of fire and of environmental change in the park.

Materials and Methods

I studied Pemon views of fire using participatory methods in the village of Kumarakapay (San Francisco de Yuruaní), located in the eastern sector of the park, between February and August 1999. I complemented this with: (a) informal discussions with villagers and leaders from three other villages (Liwo–Riwo, San Rafael de Kamoiran, and Kavanayen), (b) interviews with scientists, resource managers, and park guards, and (c) a literature review of archival records, newspaper articles, historical accounts, reports, and published studies.

The Participatory Research

When first discussing the idea of research on Pemon views of fire with the headman of Kumarakapay, to my surprise his immediate request was that this process be used to help the Pemon clarify and articulate their own views of fire. My original intention had been to reveal to a wider audience what fire means to the Pemon. It had not occurred to me that there could be great differences in views of fire within the Pemon themselves, and that this could be a cause of intra-community conflict. Thus, we agreed to design a research process that would both clarify the reasons for Pemon the use of fire to outsiders, and promote community self-reflection on the same issue. Methods consisted of: (a) community workshops, (b) in depth–interviews, (c) site visits, and (d) a final meeting to discuss interview results with the community.

Community Workshops

Workshops were used to provide a holistic view of Pemon views of fire and perception of environmental change, and to adapt the research to the deliberative, oral-based decision-making structure of Pemon society (Thomas, 1982). Different participatory tools were used in these workshops, including oral testimonies, time lines, territory and community mapping, matrixes, brain storming, group and plenary discussions (Davis, 1992). A group of approximately 30 people (about half elders and half youngsters) participated.

First, a 2-day workshop was organized to give us a historical and physical perspective of the community. This workshop focused on the origin and settlement history of Kumarakapay, changes in the community's well-being over time and the definition of the community's territory (which included areas for hunting, agriculture, fishing, gathering, and previous settlements).

A 1-day workshop on Pemon views of environmental changes followed, which focused on the perceived importance of the different components of the community's territory (forests, savannas, rivers, *tepuis*, game, minerals, *Mauritia* palm swamps) and their changes over time. During this workshop, it became clear that there were marked differences in the way Pemon youth and elders viewed environmental change, particularly the role that fire played in these changes. It was agreed that a more detailed study was necessary to explain these differences. This was carried out through a series of in-depth interviews with elders and youth (see below).

In-depth Interviews

A working group, consisting of two Pemon (the headman and his wife) and myself, was formed to conduct research on Pemon views of fire. The former conducted interviews with Pemon elders and translated the material into Spanish, while I focused on interviewing young Pemon, all of whom speak fluent Spanish. The checklist of enquiry we agreed to use included: (a) meanings of fire, (b) Pemon uses for fire, (c) advantages and disadvantages to the use of fire, (d) season of the year for using fire, (e) methods used by the Pemon to prevent large fires, (f) past and present frequency of fire use, and g) history and origin of large catastrophic fires. A total of 29 interviews were carried out (14 young Pemon and 15 elders). In order to avoid recording views that had been influenced by our previous discussions with the community, most of these interviews were carried out with Pemon who had not participated in the workshops.

Site Visits

Site visits with some community members were also carried out in agricultural areas and in places where erosion and savannization were apparently increasing. With the support of EDELCA, a helicopter overview of Kumarakapay's territory and adjoining areas was carried out by a community elder, Kumarakapay's headman, and myself in order to visualize and discuss possible changes in the forest cover of the area. Photographs were taken during the site

visits and in the helicopter overflight and used in the interviews as material for discussion.

Feedback

The results of the 29 fire interviews were presented at a community meeting at Kumarakapay. All the people who had participated in the workshops or interviewed were invited. The resulting discussion was useful for clarifying differences in views about fire and for validating information.

Results and Discussion

Framing the Fire Narrative in Canaima National Park

The dominant view of fire in Canaima National Park as well as the fire control polices are the products of more than a century of misinterpretation of the Pemon use of fire by non-indigenous people, starting with the early explorers in the nineteenth century. In most of the accounts of European explorers, naturalists, and missionaries that first visited the area, Pemon uses of fire were described as careless and ignorant (e.g., Schomburgk, 1840; Boddam-Whetham, 1879; Im Thurn, 1885 (1934); Appun, 1893; Clementi, 1920; Tate, 1930). As early as 1920, fire was regarded as an external factor rather than an integral component of the landscape (Clementi, 1920), and was blamed as a cause of the systematic reduction in the forests of the *Gran Sabana* and a widespread savannization process (Tate, 1930; Christoffel, 1939).

When the Venezuelan government began to take an interest in exploring and "developing" the *Gran Sabana*, it consulted these early published accounts (e.g., Aguerrevere *et al.*, 1939). Thus, the view of fire as an external component of the *Gran Sabana* landscape was incorporated in the official discourse, to the extent that in the first management plan for the park the use of fire by the Pemon was described as a "pyromaniac vice" (CORPOTURISMO *et al.*, 1974). By the 1970s, Pemon burning practices were widely viewed by resource managers, planners, scientists, and the military as irrational and highly destructive of *Gran Sabana* ecology. The Pemon themselves became popularly referred to by non-indigenoues people in Venezuela as "*los Quemones*" (the burners).

Underlying this view of traditional burning practices was the perception that the Pemon lack the necessary knowledge and skills to use fire or manage the land. Such a perception, together with the strategic importance of the *Gran Sabana* for hydroelectric power, was used by the State to justify external intervention to manage fire in the park. This gave rise in 1981 to EDELCA's fire control program, which seeks to (Gómez, 1995):

- reduce the degree of fire damage to vegetation in priority sectors, by *rapid intervention* of the fire brigade.
- *reduce or minimize the start of fires* through an intensive program of fire prevention
- ensure *adequate fire management* by the Pemon (all emphases is mine).

Pemon involvement has been restricted to direct employment as manual laborers (firemen) 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. Research on fire ecology has paid scant attention to the study of local fire regimes and to the Pemon knowledge about fire management. In sum, there has been little effort to understand traditional Pemon use of fire and the ecological knowledge that underlies it.

Furthermore, research on fire ecology carried out in the park has favored studies that provide only a short-term view of savanna–forest dynamics such as fire behavior, savanna combustibility, and ecological dynamics of fire in order to determine the factors that generate instability in the *Gran Sabana* forests (Galán, 1984; Fölster, 1986; Fölster and Dezzeo, 1994; Hernández, 1999). Little attention has been paid to gathering sets of data to study processes of landscape change more directly and to document historical changes, though the characteristics of the soil, vegetation, and burning practices vary considerably from area to area (Otto Huber, botanist, IVIC, personal communication). Even though existing research provides only partial working explanations of forest–savanna dynamics and environmental change (Fölster, 1992; Rull, 1992), scientists have been highly vocal in supporting the view of fire as a detrimental component of the park. All this has contributed to perpetuating a monolithic view of fire among managers in the park, and has created a strong clash between two different knowledge systems about fire.

Rather than an isolated example, fire policy in Canaima National Park has to be understood against the background of a global discourse on fire and savannization responsible for creating distorted images of local knowledge systems of fire management throughout the world. The way in which the dominant view of fire became established in policy and scientific circles in Canaima shows striking parallels with similar processes documented in other parts of the world (Pyne, 1997). For instance, Leach and Mearns (1996) describe how colonial views were responsible for influencing the way that scientists and policymakers interpreted processes of landscape change in Kissidougou's forest–savanna mosaic in Guinea during the last century.

A more detailed understanding of Pemon views of fire and their knowledge of fire ecology in Canaima National Park may add to the important developments that have been made over the last decades in challenging this global narrative (Lewis, 1989; Leach and Mearns, 1996; Pyne,

1997; Laris, 2002). Such understanding would contribute significantly to preparing the ground for a fire management system that is better adapted, both culturally and environmentally, to the park.

In order for management practices to progress in this direction in the case of the *Gran Sabana*, it will be necessary to gather more detailed information on how the savanna mosaic is formed. This should include (amongst other elements) learning how the landscape becomes fragmented into savanna patches in different stages of succession through the use of early and late dry season fires in relation to climatic forces, biological succession, ecosystem and topographic characteristics, and the seasons used for different livelihood practices (Lewis, 1989; Laris, 2002).

Pemon Views of Fire

The Pemon appear to use fire for a wide variety of reasons (Table I), which overlap considerably with results presented in other studies on indigenous fire practices (Hough, 1993; Mbow *et al.*, 2000; Laris, 2002). Without fire, most of the traditional Pemon livelihood practices, including agriculture, fishing, hunting, and gathering, would simply not be possible. Hence, it is not surprising that young Pemon and elders most often define fire as "essential to life," as a "help in their lives," or as a "companion wherever we go." In the words of one elder "fire works for you, fire works for all of us." Although youngsters and elders agree on this general definition of fire, this does not imply that their perception of fire is the same. Elders provide additional views of fire, which reflect the close interrelation that exists with fire in the traditional Pemon world-view.

Table I Uses Given to Fire by the Pemon

Different uses of fire
To clean and maintain the savannas: large, catastrophic fire prevention
For communication
To clean paths when going fishing, hunting, to agricultural plots, on visits, etc.
To make the savannas look pretty and green
For cooking
To rejuvenate savanna grass for the wild animals or cattle
In fire hunting (*rampüm*)
To prepare agricultural crops (shifting cultivation)
To keep themselves warm
To frighten and keep dangerous animals away
To cure illness (fire has magical properties)
To make the grasshoppers come out with the smoke (for gathering)
To dry firewood
To make the fish come out when going fishing
To irritate EDELCA and make the fire-fighters "work and get wet"

Fire as a Symbol of Life and a Source of Happiness

Pemon elders commonly define fire as "a symbol of life and source of happiness." According to them, fire not only brings joy to the Pemon but also to *Pata* (their place, their land). They frequently say that if they do not start fires, "*Pata* is sad." This association of fire with happiness is much weaker in young Pemon; 5 of 15 elders mentioned happiness, while only one young Pemon of 14 did.

Fire is a symbol of life for many because it is used to transmit messages about the well–being of relatives and friends during the daily routine. Sometimes used deliberately (as a smoke signal) and other times as a by-product of other activities, the different densities, shapes, and colors of smoke have different meanings for the Pemon. According to the characteristic of the smoke, they can distinguish a signal of emergency from one of return after a successful hunt. They can also differentiate a savanna fire from a forest or shrubland fire. The absence of smoke in the landscape can also be a warning, indicating that something is amiss. Six of 15 elders stressed the important role of fire as "a letter, a messenger:"

> Fire makes us feel well. If we see smoke at a distance we know that a certain person is around and that he or she is well. That lifts our spirit. But if we notice that the person who always sets the fire has not set it, we get worried (Teresa Perez de Mayor, Pemon elder. Interview, August 6, 1999).

In the traditional Pemon world-view, fire is seen as an integral part of the landscape. This is partly because the Pemon consider themselves "savanna people," in contrast to their indigenous neighbors from British Guyana, the *Ingarikok*, who are known as "forest people" (Koch-Grünberg, 1917 (1981c)). Being able to see the horizon, their land, and smoke gives elders a sense of tranquility.

The Cultural Significance of Fire

The perception of fire as an integral component of the landscape is linked to the view of fire as an inseparable part of the Pemon culture. According to 7 of 15 of the elders interviewed, the use of fire is deeply rooted in the Pemon through tradition. Consequently, the perpetuation of burning practices is viewed as an important part of the maintenance of the Pemon culture itself:

> It is a custom of indigenous people to use fire. Our ancestors lived that way, just as other societies have their customs, (César Durán, Pemon elder. Interview, May 11, 1999).

Thus, the use of fire is a means of cultural reaffirmation, and also of legitimizing the Pemon sense of ownership over

their lands, which EDELCA's fire control program, among other contributing factors, is perceived to be threatening. This explains why a frequent Pemon reply when asked about the reasons for burning is: "I burn because this is my land, and in my land I do whatever I want to."

The Aesthetic Value of Fire

Fire makes savannas turn green, making them aesthetically attractive to the Pemon:

> Fire for us is important to replace the old weeds. We burn so that new plants come out. It is like a man when he has not shaven and his hair has grown: he looks ugly. If he shaves, he looks handsome. It is the same with the savanna (Leticia Fernández, Pemon elder. Interview, May 11, 1999).

In this respect, Pemon motivations for using fire resonate with those of others indigenous peoples, where burning is seen as "tidy" (Hough, 1993) and a corrective tool for "cleaning the country and making it right" (Lewis, 1989). As for the aborigines in Kakadu National Park, Australia, where one of their strongest motivations for using of fire is "taking care of their country" (Lewis, 1989), in the case of the Pemon, the use of fire is seen as part of the duty they have towards their land:

> I like to walk on clean paths, because that makes *Pata* feel happy (Valentina Rojas, Pemon elder. Interview extract, August 4, 1999).

The Environmental Importance of Fire

The use of fire to maintain the savanna looking "pretty" and green is intimately linked with one of the most important reasons given by Pemon elders for using fire, which has been entirely overlooked by EDELCA: each of the 15 Pemon elders interviewed stressed the crucial role that savanna burning has in preventing large, destructive, and occasionally catastrophic conflagrations. One of them explained:

> Fire is used to do maintenance work to our lands. To let the grass grow is much more dangerous because it can cause a large fire. To avoid that, we have to burn part by part (Juan Miguel Sosa, Pemon elder. Interview, May 11, 1999).

It is because of this that Pemon elders find it difficult to conceive of putting out fires. They advocate repeated burns of small portions of the savanna, which then act as natural firebreaks. Their approach is to fight fire with fire, not with the water, beaters or—least of all—with the helicopters that EDELCA employs. This process is carried out in a cooperative way, each person spontaneously resuming where another left off:

> You set the savanna on fire, it burns and then it dies down on its own. When somebody else goes by the same place [he or she] starts the fire where the previous one died out (Francisco Fernandez, Pemon elder. Interview, August 5, 1999).

In the traditional Pemon view, then, large fires are prevented by collaboratively burning a mosaic of small portions of savanna of different height (in different stages of succession). In such a mosaic, fires die out naturally when they reach the border of a previous fire. This leads the Pemon to believe that "fires have their own inherent control," a view that contrasts sharply with that of EDELCA (Gómez, 1995). As an elder commented:

> The Pemon do not worry too much about causing a conflagration. We say that fires burn until they die out on their own. Now we see that the people from EDELCA are working to put out fires. I was laughing at them a little the other day when I went hunting because I set the fire to make the deer come out, and the firemen came and tried to put out my fire. That does not solve the burning problem, because the fire will burn until it reaches its natural limit (Julio Enrique Lambos, Pemon elder. Interview, August 13, 1999).

The rain also plays a part in this process. There are only two periods in which the rain is essentially absent from the Gran Sabana: *pamak-wiyu* (September) and *toronkan* (January–February). *Toronkan* is the driest period of the year, with no rain and is named after the constant, strong winds. This is the most risky period to burn, according to some of the elders (3 of 15). The rest of the year, even during the dry season, rain is present and so is fire. This is why savanna burning during the dry season is not a problem if combined with approaching rains.

One of the elders explains the sense of responsibility that lies behind the maintenance of the savanna mosaic and their burning practices:

> We burn as caretakers of the savanna and the forests, closely examining where to burn and how far the fire is going to expand. That is how we live (Francisco Fernández, Pemon elder. Interview extract, August 5, 1999).

Putting out fires is even regarded as a detrimental practice by the Pemon elders:

> What the people of EDELCA are doing is provoking greater destruction, because in some areas you can easily observe that the savanna is too high. If by accident that gets ignited, it will cause a large fire

(Julio Enrique Lambos, Pemon elder. Interview, August 13, 1999).

Nevertheless, most of the young Pemon interviewed (12 of 14), like resource managers and scientists, were unaware of the logic behind this fire management system. In fact, many (5 of 14) disapproved of the apparent lack of control. In their view, it is irresponsible to leave fires burning:

[The elders] set the fires and if a number of hectares get burned, well, they will get burned... I think it does not affect them to see all the landscape getting burned (Bibiana Delfonso, young Pemon. Interview, August 5, 1999).

Others say that they are unaware of any traditional methods used to prevent the expansion of fires (4 of 14). Like most non-indigenous people, they do not perceive repeated burning as a way of controlling fires. In fact, some young Pemon have adopted EDELCA's fire management perspective to such an extent that they only associate fire control with modern methods:

To improve fire management, when somebody wants to burn the savanna and there are some *morichales* [*Mauritia flexuosa* palm swamps] near, they should dig a fire break or put out the fire with beaters (Marcelino González, young Pemon. Interview, August 6, 1999).

This lack of knowledge of traditional fire control methods among the younger Pemon population is often accompanied by a deep sense of cultural embarrassment over the ubiquitous use of fire:

I am sick and tired of fire. Sometimes I feel embarrassed when people ask me why there are so many fires and I have no answer to give them, so I shut my ears. I always tell them, Ahhh! that is done for pure pleasure. I tell them that when the elders are gone there will be no more fires I think it will be better that way. (Name withheld, young Pemon. Interview, August 19, 1999).

Pemon Perceptions of Environmental Change

In order to understand the origins of the very different opinions, of scientists and rescue managers on the one hand and many Pemon (particularly elders) on the role of fire in the gradual decrease in *Gran Sabana* forest cover, this section examines and discusses local views of environmental change using the following indicators: (a) the environmental history of the *Gran Sabana* landscape, (b) frequency of fires, (c) the inferred causes of large catastrophic fires, (d) the impact of fire on savanna–forest borders, (e) agriculturally induced deforestation, and (f) the siltation of the rivers.

Environmental History of the Gran Sabana

The central debate over the origin of the contemporary landscape of the *Gran Sabana* is whether or not the region was covered by continuous forest in historical times and, if so, whether the reduction in forest cover was caused by humans (Fölster, 1986; Huber *et al.*, 2001). The presence of a human population that is highly dependent on the use of fire encourages the idea that the *Gran Sabana* is a man-made environment produced by the gradual, fire-assisted conversion of forest to savanna. The contemporary climate of the area also partially supports this view, since the humid tropical climate that exists in the Upper Caroní River Basin typically supports forest cover elsewhere (Fölster, 1986; Rull, 1992).

Some of the early projections of the environmental history of the region claimed categorically that forests were the dominant vegetation in historical times (e.g., Christoffel, 1939). Even today this view is predominant amongst EDELCA personnel. One of its senior personnel comments:

The Pemon are making the forest disappear. All the savannas that you see today were forests before (Name withheld. Informal Conversation, December 7, 1998).

According to the Pemon, however, savannas rather than forests have historically been the dominant feature of the *Gran Sabana* landscape. The Pemon creation myth, the *Makuanima*, tells that the *Gran Sabana* landscape as we see it today was formed by the *Makunaima* brothers, their supreme cultural heroes, sons of the sun and a woman made out of jasper. The following is a condensed version of the myth, summarized from Armellada (1989) and Koch-Grünberg 1917 (1981b). Long before the *Makunaima* farmed their agricultural plots, they used to chase after animals to find out what they were eating. The younger of the two brothers had the bad habit of cutting down the trees where animals fed in order to eat as much fruit as he could. One day he persuaded his older brother to cut down a very big tree called *Wadakayek*, and the latter reluctantly accepted. It was a difficult tree to cut, as the wood was very hard and the tree was completely covered with vines and bees. Some of the vines turned into snakes when cut. Because of this, it fell towards what is now Guyana, or "the other side". Only very few of the branches fell towards "this side". The places where those branches fell, called *Tuai Waden* and *Muik*, are the forest patches where edible wild plants are now found. These are also the places preferred by the Pemon for cultivation and are now known to be areas of relatively fertile, less acid soils over diabase.

After the tree was felled, a vast quantity of water burst from inside the tree together with it all sorts of large fish. Before the *Makunaima* could do anything to halt the flood, all the fruit (pineapples, sugar cane, papayas, etc.) and the big fish that the tree bore were carried away downstream. This is how the Pemon explain that all the forested and fertile areas (*Ingareta*) are found towards the west, east and north of their territory and that only small portions of fertile land, and few patches of forest and small fish can be found in their land. According to the Pemon, the stump of *Wadakakek* can be seen today in the shape of one of the table mountains: *Wadakapiapü*. Another mountain, *Roraima*, corresponds to the trunk of the felled tree.

The view that the forests have been the dominant feature of the *Gran Sabana* is a product of some scientists and resource managers basing their interpretations of the landscape on short-term, snapshot observations (Fairhead and Leach, 1996). If we focus on long-term observations instead, a different conclusion is reached, which interestingly enough has important points in common with the Pemon explanation of the landscape history. For instance, historical accounts by early explorers suggest that the landscape has not changed significantly over the last 160 years. The dominance of savannas over forests stands out very clearly in many accounts (Schomburgk, 1840; Boddam-Whetham, 1879; Im Thurn, 1885 (1934)).

The historical presence of savannas in the area is further corroborated by palynological studies (Rull, 1992; Schubert, 1995). The conclusion of these studies is that the area was not covered exclusively by forests in the recent past: rather forests and savannas have coexisted for more than 4,000 years (Rull, 1992). Furthermore, results from paleoecological research suggest that a humid environment did not start to develop in the area until 8,000 to 10,000 years ago in the early Holocene (Schubert, 1995), which means that savannas have existed in the area for much longer than forests. This is supported in scientific terms by the presence of at least 109 endemic savanna plant species (Picón, 1995) the existence of which would be difficult to explain in the absence of a considerable area of savanna habitat over recent evolutionary time. Thus, both scientific and Pemon knowledge suggest that savannas rather than the forests have been the dominant feature of the landscape for a very long period of time—certainly throughout historical times. This is an important conclusion for any future attempts at building areas of agreement for a joint fire management plan for the area. What is yet to be ascertained, however, is whether the process of savannization is accelerating in recent times and to what extent the Pemon are responsible for any changes. Surprisingly, despite the concern that scientists and resource managers have about the apparently accelerated process of forest retraction in the area, no attempt has yet been made to determine the rate and intensity of deforestation in the area over the last century or more. Attention to the process of forest recovery over time has also been lacking. Future research on fire and savanna ecology in the area should aim to fill this important gap.

Scientific data about the Pemon settlement history in the area that could help determine the degree of the Pemon responsibility in the historical patterns of forest change in the area are imprecise. Based on erroneous interpretations (e.g., Schubert and Huber, 1985, Dezzeo *et al.*, 2004) of anthropological studies (e.g., Butt Colson, 1985), it is often held that the Pemon occupation of this area dates to the late seventeenth Century. This has fuelled the popular-scientific hypothesis that the Pemon lack environmental knowledge to use fire due to their alleged relatively recent arrival in the area and therefore unfamiliarity with it (Rodríguez, 2004a, b). In fact there are no published data available on the date of arrival of the Pemon in this area. Only reliable archaeological studies that can determine the precise settlement history of the Pemon will help ascertain the possible link between the historical process of landscape change in the Gran Sabana and Pemon fire practices.

Fire Frequency

Despite the lack of reliable data, there is a common perception among scientists that the use of fire has accelerated savannization process in the park during the last century (Hernández, 1987a; Galán, 1984; Fölster, 1986; Dezzeo, 1994). An increase in the frequency of fires is generally blamed for this (Galán, 1984; Fölster, 1986; Fölster and Dezzeo, 1994; Huber *et al.*, 2001). Underlying this explanation we find the assumption that more people naturally lead to more degradation:

> It is fair to affirm that the impact of fire has increased during recent years due to the increase and concentration of the population together with the development of processes of acculturation, transculturation and *mestizaje*. A change in lifestyle increases the demand for goods, and consequently, there is a greater exploitation of the scarce natural resources (Hernández, 1987b).

The Pemon elders from Kumarakapay maintaining changes in livelihood practices, particularly a reduction in fishing and hunting, have actually led to a reduction in the use of fire in the area:

> Nowadays there is less burning than before. Before it was not possible to buy meat, chicken, sardines and people had to go and get their own food. They would grab their *kumache* [hot pepper sauce] and their *casabe* [manioc bread] and they would go fishing. They used fire to communicate. But now there is less burning, because some people can obtain their meat in

the shops (Nodrid Delgado, Pemon elder. Interview, August 17, 1999).

Kingsbury (1999) recently corroborated this view. By analysing EDELCA's fire statistics through a period of 15 years (1981–1994) she found that, contrary to what is commonly believed, "the incidence of hunting fires has not increased as a result of the reported declines in game, but rather decreased." There is no hard evidence to suggest that processes of social and economic change have led to an increase in the use of fire, particularly in savanna areas. The view that fires frequency has increased seems to be simply the product of personal perceptions and is certainly not based upon research on environmental change over long periods of time.

In fact, rather than an increase in fire frequency over time, there could be a problem with a more localized and less extensive use of fire, due to shift to a permanent settlement pattern among the Pemon. A more permanent settlement pattern could actually discourage Pemon people reaching remote areas and carrying out burns as extensively and regularly as before. Testimonies from the Pemon elders suggest that this is indeed the case. This appears to cause the savanna to go unburned in some areas, which allows organic matter to accumulate to more hazardous levels. This is turn, could be causing an alteration of the burning seasons and an increase in the severity of burns. Although *Toronkan* (January–February) is not the most appropriate time of the year to use fire, oral testimonies of the elders indicate that intentional savanna burns in this period are frequent. It was not possible to ascertain whether this was a new practice or not. However, it is not hard to imagine that if visits to remote areas have decreased, and savannas are allowed to develop and produce much more organic matter, there is now a greater potential for large fires. Letting the savanna go unburned for another year could be even more hazardous; thus, the Pemon would feel the urgency to burn such well-grown savannas. In other words, the problem might not be *Toronkan* fires, but insufficient fires in the rest of the dry season. On the other hand, a permanent settlement pattern can also increase the chances of having repeated and intense fires in the same place, which might favor savannization. All this, however, would have to be corroborated in the field.

The Cause of Large Catastrophic Fires

The most clearly visible and frequently cited evidence of the retraction of forests due to the impacts of fire are the scorched tree trunks that remain from the three large fires that took place in the *Gran Sabana* during the twentieth century (Galán, 1984; Fölster and Dezzeo, 1994; Gómez and Picón, 1994). The year 1926 was one of the twentieth Century's driest in Venezuela. It is popularly known as the year of the "*Gran Humareda*" (Great Smoke), due to a dense cloud of smoke that covered the whole of Bolívar State for 3 months. The *Gran Humareda* has been attributed to large forest fires originally set by the Pemon to burn savannas (Galán, 1984), even though that year the regional press documented extensive savanna and forest fires throughout Bolivar State, Venezuela, and even in neighboring countries (*El Luchador*, Ciudad Bolívar, April–June, 1926), where no Pemon were present. The idea of indigenous culpability seems to have been propagated by the first published account about the origin of that year's only individually documented fire, which happened on the slopes of *Roraima tepui*:

> The lowlands about Roraima are scantily peopled by the Arekuna (Jarekuna of Brazil) Indians who inhabit the basins of the Cotinga, Kukenam, and Caroní rivers. They have a deplorable custom of setting fire to the grasslands of their territory. The fires sweep over hundreds of acres of savanna annually and, entering the forests, destroy or greatly alter the component vegetation of large tracts. Great regret was felt on finding that two years before the arrival of the expedition, during a period of extreme drought, the greater part of the forests of diabase slopes of Roraima had been completely destroyed (Tate, 1930).

However, the Pemon elders have a very different explanation of how this fire originated. In the oral testimonies of six elders there is a consensus that the fire: (a) originated at the foot of Mount Roraima, (b) was not set by the Pemon, (c) occurred during a period of extreme drought, (d) originated not from savanna burning, but from a fire set inside the forest, and (e) expanded because the surrounding savanna was overgrown. Furthermore, two Pemon oral testimonies agree that the fire in fact took place during one of the many foreign expeditions to Mount Roraima at the beginning of the twentieth century:

> One day when the English came, they brought with them our relatives the *Ingarikok* [Patamona indians], from Kuatin [then British Guiana], as their helpers. They are from the forests. They camped by a creek at the base of Roraima, in the forest...They went up while the base of Roraima was still forested. When they camped in that place, they collected a lot of firewood and set the fire to keep them warm during the night. They woke up in the company of the fire. It was their custom to put out their fire when leaving. But there was a strong draught and they did not notice that there was fire underneath the root mat. They only put out the fire that was above the roots. Then, they set off to Roraima. When they were almost at the top they saw

> that the place where they had been camping was on fire... That is how the base of Roraima was turned into how we see it today. That was burned not too long ago, in the times of my father. It was the fire that the *Ingarikok* set (Julio Enrique Lambos, Pemon elder. Interview, August 13, 1999).[1]

The account of Desmond Holdridge, a North American explorer who visited Mount Roraima in 1926 in search of diamonds is strikingly similar (Holdridge, 1933). Holdridge commenced his expedition in British Guiana (present day Guyana) and explicitly mentions that they hired a group of *Patamona* Indians, called *Ingarikok* by some Pemon groups (Koch-Grünberg, 1917 (1981a)), including a man named Isaac as their guide for their ascent of Roraima. Furthermore, it is evident that the forest in the base of the mountain was still intact before the expedition took place: "A belt of forest ran around the mountain and it was far from easy to tell where the ascent might be made though, of course we knew it existed..."(Holdridge, 1933). The rest of his account speaks for itself:

> On the third day we started for the top... By noon we were well up. The shelf was so broad and so thickly covered with trees and lianas that we could never tell how high we had climbed... Abruptly the forest ended and Isaac and I—well in advance of the others—arrived at a point where only grass and rubble and a steep climb of some two hundred feet separated us from the summit. We had stopped to get our breath when a burst of howls from below told that something was amiss for the howls were of the kind that people reserve for the announcement of major disasters. Isaac registered apoplexy. My inquiry was met with a torrent of hopelessly unintelligible Arekuna. Finally, he puffed his cheeks and bellowed, "*Apok! Apok!*"—Fire!, Fire!—and I deduced that there was a forest fire below us... Below us a column of thick white smoke rose from the place where we had been encamped. Even fifteen hundred feet above it, the dull roar rose to our ears; we were in imminent danger of being marooned on the top of Roraima until the fire burned out and that looked like a ten day job, at least. No choice, we had to go down and at once (Holdridge, 1933).

These testimonies importantly contradict Tate's (1930) conclusion that the fire was caused by the Pemon since the fire appears to have originated inside the forest. The fact that the fire was started as part of one of early twentieth century expeditions to Roraima also deserves careful attention. Land managers, scientists and young Pemon have not considered the intervention of outsiders, and more specifically of non-indigenous people, as a possible origin of these large fires. More through investigations into the causes of the other large fires of the twentieth century could help further understand the Pemon reluctance to accept responsibly for these events.

[1] A very similar account was obtained from the daughter (nowadays an elder) of a man named *Achic* (Isaac in English); who was at that time the local Pemon guide for the expedition up to Mount Roraima.

Fires and Forest–savanna Ecotones

The other indicator commonly used as evidence of deforestation and savannization is the impact of fires on forest–savanna borders:

> ...many of the forests, or the majority of them, show evidence of having been burned on the edges, and the recovery process of a forest is very slow due to the characteristics of the soil. The latter is very poor and thus every fire that is generated has an impact. That explains why the forest retracts and the savanna expands every year. That is why we talk about a savannization process (Yony Rivas, EDELCA resource manager. Interview, May 7, 1999).

An alternative view given by the Pemon is that forests burned only on their edges tend to naturally recover from fire, and only repeated burns of the same forest border—which they believe to be an unusual occurrence—can lead to eventual permanent deforestation. They also argue that the danger of fires hitting the edges of the forests lies in potential damage to the root mat and that this risk increases during the dry periods. Some Pemon explain that the risk of repeated, localized fires at forest borders increases if the savanna adjoining the forest is left unburned for a long time, as the fire is likely to enter with more intensity into the forest. By keeping these savannas low by controlled burning, the real threat is reduced. In essence, they justify regular burning of the savannas in close proximity to forests in order to periodically remove the dry biomass and therefore reduce the risk of intense fires, which would then enter the neighboring forest.

However, the real impact of fires on the forest–savanna borders can only be assessed by systematically establishing the frequency and intensity of historic burns on forest borders with accompanying data on plant regeneration. This remains to be examined in future research, which should be carried out in conjunction with the Pemon.

Shifting Cultivation and Landscape Change

The impact of shifting cultivation on the forests is another indicator commonly used to illustrate the influence of fire and Pemon livelihood practices on environmental change. There is a consensus among the Pemon (particularly among those settled in large and permanent settlements) that forests used for agriculture close to the communities show a marked decline

and in that in many places they have been replaced by savanna vegetation (Rodríguez, 1998; Kingsbury, 1999). The decline in fertile land has forced some communities to accept the need to fallow present agricultural land and start looking for new farming areas further away (Valeriano Constati, former Pemon Headman of Kavanayen, personal communication).

However, the Pemon never cite fire as the specific explanation for the reduction in forests useful for agriculture. They attribute the conversion of forests to savanna vegetation near settlements to the concentration of population centers and their "multiplication," which has led to the intensification of a formerly extensive agricultural system, which in turn has brought about a reduction in the fallow period and decreased forest regrowth.

Further discussion with the Pemon will require clarification as to whether traditional fire management knowledge and practices are maladaptive in this altered socioeconomic situation. Scientific research indeed suggests that this is the case. Kingsbury (1999) for instance has shown that in the context of settlement nucleation the destructive use of fire in agricultural activities increases. This poses a major challenge for the Pemon to find well-adapted and sustainable agricultural practices, an area in which scientific and technical knowledge could perhaps offer them know-how and thus develop opportunities for joint land management.

Fire, Soil Erosion and the Siltation of Rivers

One of the greatest concerns over the use of fire in the park is its possible impact on the hydrological cycle of the Caroní River Basin and the life-span of the Guri Dam. Such concern is supported by the perception of resource managers and scientists alike that erosion in the area is increasing due to the use of fire:

> There are qualitative observations which show the existence of an accelerated process of erosion. This process is caused primarily by the high rainfall, the extension of savanna vegetation and by the frequent human alterations associated primarily with the frequent fires (Dezzeo, n. d.).

As a result, EDELCA has put considerable effort into environmental education activities aimed at convincing the Pemon that the use of fire will eventually cause rivers and creeks to dry out. However, young Pemon and elders alike, openly challenge this view:

> The rivers will not dry out because of the use of fire; we have said that before. That is what my grandparents have told me. They say that they have been living in this way for years and never has any river gone dry as a consequence of the use of fire—never (Jorge Norberto Pérez, young Pemon. Interview, August 5, 1999).

When discussing local perceptions of environmental change in greater detail, the Pemon do recognize that increased siltation has occurred in some rivers and creeks, but, they blame deforestation caused by the building of the main road through the area in the 1980s, and subsequent erosion. There is certainly no disagreement among managers that the road has increased erosion locally along its route as its effects are obvious (Schubert and Huber, 1985). Since the road was built by the Venezuelan Guayana Corporation (CVG), the Pemon view this as another example of environmental change caused by non-indigenous people. In the future, a systematic monitoring of the water quality of some of the main rivers of the *Gran Sabana*, carried out in conjunction with the Pemon, could perhaps help clarify this debate.

Conclusion

This paper is a first step towards explaining the Pemon resistance to fire control in the park. I have argued that, contrary to conventional belief, the use of fire by the Pemon is not a product of ignorance or negligence. There are important cultural and environmental factors that explain its extensive use in the area, which land managers must understand to be able to develop a fire management program that is well-adapted to the area. Most significantly, the use fire is for many Pemon (particularly elders) an integral part of their culture, deeply rooted in their traditional practices. Thus, any attempt to eliminate or restrict the use of fire will inevitably be seen as a threat to their cultural identity and their sense of ownership over their lands, and is likely to meet with resistance.

Also, like other indigenous peoples living in similar environments (Lewis, 1989; Fairhead and Leach, 1996; Mbow *et al.*, 2000; Laris, 2002), Pemon elders claim to have developed a prescribed burning system that involves the selective and cooperative setting of savanna fires at various times of the year in order to avoid large destructive forest fires. Ignoring this aspect of the Pemon logic behind the use of fire may explain an important part of the failure of EDELCA's fire control in the park in terms of changing the use of fire by the Pemon and reducing the numbers of fires set every year.

Finally, Pemon ecological knowledge of fire suggests that concerns about the use of fire in the park are not shared locally, and that conventional interpretations of environmental change in the park need revision. A clear example lies in explanations for the environmental history of the *Gran Sabana* and its large catastrophic fires, which assign the Pemon more responsibility than they believe they deserve. In other cases, such as the debate over the impact of fire on the forest–savanna borders, resource managers are seen as making overly broad generalizations about the impact of fire out of a lack of understanding of Pemon ecological knowledge of fire.

However, the information presented here is by no means exhaustive. Many questions remain to be answered in order

to have a complete understanding of Pemon ecological knowledge of fire and to assess its impact in the park. For example, temporal information about the frequency, seasonality, and physical location of fires and their relationship with topography, types of vegetation and Pemon livelihood practices are all indispensable in order to gain a greater understanding of the way the forest–savanna mosaic is formed and maintained. Also, further research should be carried out on the frequency and intensity of burns on forest borders and historical land cover changes. Systematic water quality monitoring in the *Gran Sabana* rivers would also help assess whether siltation of the rivers is occurring, and if it is linked to the use of fire.

In order to avoid reproducing present conflicts over the use of fire in the park, future research should be carried out through partnerships among the Pemon, ecologists, and resource managers. At the same time, however, the Pemon will have to continue to clarify their own views of fire, since possible partnerships with ecologists and resource managers could be impaired by Pemon reluctance to communicate openly about fire with non-indigenous people. Such a process of self-reflection could fruitfully incorporate the model of participatory research used in the present study. According to participants, the most important contributions of the participatory research in Kumarakapay were:

- It made younger Pemon reconsider their own views of fire and give more importance to the knowledge of elders.
- It made elders acknowledge their share of responsibility in the gradual loss of knowledge of fire among younger Pemon, through decreased teaching about how to relate to the natural world.
- Young Pemon and elders expressed their commitment to learn and teach each other about the use of fire.
- Some participants expressed having a clearer view about the use of fire in the park, and feeling better able to discuss it with government officials.

Replicating this experience in other communities and in encounters among elders, young Pemon, scientists, and resource managers could help increase the understanding of Pemon ecological knowledge of fire, as well as open avenues for partnerships for future fire management in the park.

Acknowledgements Juvencio Gómez (Headman General of the Pemon from Sector 5) and his wife Iraida Fernandez were my research partners in the study of Pemon views of fire. Without them, and the interest and participation of the elders and youngsters of Kumarakapay, this article would not have been possible. This article presents some of the results of my doctoral thesis, which I was able to carry out at the Institute of Development Studies, University of Sussex, England, thanks to the support of the Venezuelan Science Council (FONACIT) and the British Council. My supervisors Ian Scoones and Jutta Blauert were of great guidance in carrying out the research on which this article is based. The International Development Research Center (IDRC) of the Government of Canada supported the production of this publication. Miguel Lentino, from Fundación Phelps and Colección Ornitológica Phelps, and Ana Maria Fernandez, from the Venezuelan National Library, kindly provided access to invaluable historical documents. Gabriel Picón, from Parupa Biological Station, provided access to important documents in the station's library. Dominic Hamilton put in my hands the evidence that I needed to help substantiate a reinterpretation of the cause of the 1926 fire. And Jon Paul Rodríguez, Kathryn Rodríguez-Clark, Chris Sharpe and two anonymous referees provided very valuable critical insights, which improved significantly earlier versions of this manuscript.

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