



Traditional burning by the indigenous Pemón people in conucos (shifting cultivation areas). Photo: Ruth Salazar-Gascón

An intercultural vision for integrated fire management in Venezuela

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“Fire management planning and implementation must consider the benefits and learn from the indigenous use of controlled fire.”

*Very sadly, Bernardo Ancidey passed away from Covid-19 prior to publication of this article. He will be greatly missed. Condolences to his family and friends.

Introduction

Climate change and governance conditions have made wildfires a critical issue that transcends academic and technical issues and enters socio-political arenas. In Latin America, indigenous peoples, peasant communities, peri-urban populations, firefighters, biodiversity and ecosystems are all vulnerable and threatened. This situation represents a paradox in Latin America, as fire has historically been an essential sustaining element in the survival and domestication of the territory, and in the cultural heritage of the original Amerindian peoples (Bilbao et al. 2019). However, changes in fire regimes introduced by European settlers, and policies of newly independent states, have made the situation worse (Box 1), leading to justified demands for a paradigm shift.

Fire control demands increased budgets and efforts, especially in conservation programmes (Mistry et al. 2016). However, policies that

exclude virtually all types of fire have had limited impact, and in fact, appear to increase the risk of large and severe wildfires. In Venezuela, for example, the Environmental Criminal Law enacted in 1992 and reformed in 2012 contains measures that prohibit fire and punish those who use fire in protected areas, and limit the management by or inclusion of traditional practices of local populations (Government of Venezuela 2012).

Given the scenarios that will likely lead to a continued increase in the size and severity of wildfires, programmes with a holistic vision are urgently required; they must be oriented to fire prevention rather than fire suppression. Furthermore, due to the role of fire in maintaining

ecosystem diversity and function, and the richness of traditional fire-use practices by local populations, it is necessary to consider the socio-environmental aspects of fire, and to promote interaction and dialogue between a range of actors to establish more inclusive, intersectoral, participatory and intercultural governance.

This article describes the advances, challenges, limitations and progress in the development of a new paradigm of Integrated Fire Management (IFM) with an intercultural vision in Venezuela, from its beginnings in Canaima National Park to its later convergence with government actions and those of firefighters.

Box 1. Changing fire regimes in Latin America

The fire was a key element in early agriculture in the tropical forests of Latin America, mainly characterized by unfertile, low pH and weathered soils that are exposed to high temperatures and heavy rainfall. Unlike in temperate regions, nutrients are found in the vegetation rather than in the soil, and fire catalyzes the release of nutrients, making agriculture possible and facilitating regeneration after the end of the crop cycle. Indigenous peoples have also used fire for hunting and fishing, to induce the fruiting of wild plants, and to reduce fuel levels in savannas to prevent the spread of wildfires to adjacent forests. Fire also plays important roles in the cultural and religious dynamics of communities, being a central element around which ancestral traditions and cosmovision are maintained.

There is clear evidence of the sustainability of these Amerindian practices, which historically were compatible with the diversity and maintenance of forests, even in Amazon rainforests that have not evolved with a high exposure to fire (Piperno et al. 2019). Perhaps the greatest evidence of this coexistence is revealed in the extensive forest mass on the continent that was home to hundreds of thousands of indigenous peoples before the arrival of Europeans. However, pre-Columbian indigenous practices, maintained for millennia, suffered after European colonization, under the imposition of socioeconomic concepts of land use that were drastically opposed to those of the original inhabitants.

Large tracts of South America were transformed into agricultural and livestock production systems based on monocultures and pastures, following deforestation and the indiscriminate use of fire by the new settlers. Settlers

disregarded indigenous practices, leading to a marked deterioration in natural and sociocultural systems. The most important change in fire regimes was the repeated setting of high-intensity wildfires at the end of the dry season in an attempt to eliminate native vegetation from the forests (Vieira et al. 2019). Thus, instead of fire management based on controlled burns used by the indigenous peoples, uncontrolled fire as wildfire was introduced. Consequently, this cultural and political approach to the use of fire, introduced by Europeans in the 1600s, produced a dramatic change in tropical American landscapes.

Faced with the increase in large forest fires and damage to vulnerable ecosystems, administrative and legal actions were undertaken by several governments in Latin America in the 1900s. These efforts created protected areas such as national parks, and “zero fire” (or “zero burning”) policies that focused on the exclusion and prohibition of fire and even criminalized those who used fire (Bilbao et al. 2010; Eloy et al. 2019).

Under a business-as-usual scenario, there is an increased likelihood of more frequent and severe wildfires, due to higher temperatures and droughts associated with climate change, altered fire regimes with accumulating combustible material under “zero fire” policies, changes in settlement patterns that lead to both land clearing and land abandonment, and changes in land use from local practices to agro-industrial exploitation. Expansion of the agricultural frontier in forested areas is of particular concern, with fires used as an economic and practical means of eliminating vegetation, alongside the absence of state protection of forests or lack of enforcement, and only an incipient interest in fire risk prevention and integrated fire management.

Canaima National Park

On the border between Venezuela and Brazil in the northern Amazon basin, the three-million-ha park is the third largest in Venezuela and the sixth largest in Latin America. Evergreen tropical rainforests cover 60% of the park, alternating with savannas and other ecosystems

in a characteristic mosaic landscape (Figure 1). It is emblematic for conservation due to its high biodiversity and unique species, and was declared a UNESCO Natural World Heritage Site in 1994. The park also includes the headwaters of the dammed Caroní River, which provides 80% of the country's energy.

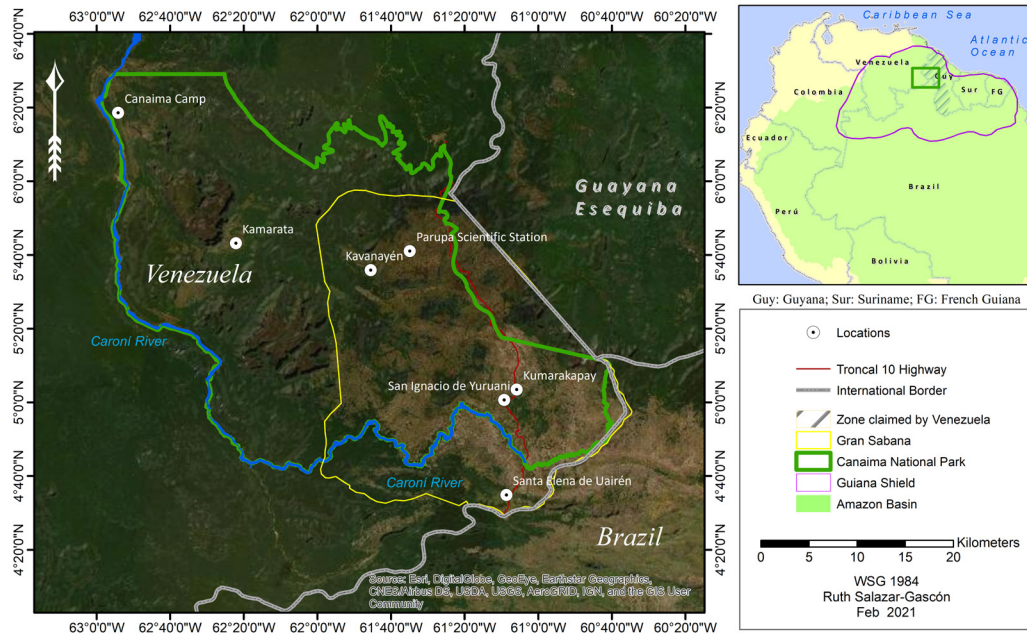


Figure 1. Location of Canaima National Park. Dark green indicates areas with forest cover, and light brown indicates savannas. Source: Ruth Salazar Gascón, published in Bilbao et al. (2021)



Diverse landscapes and vegetation in Canaima National Park threatened by high-intensity wildfires.

Photos: (a) Maiquel Torcatt, (b) Adriana Millán, (c) Humberto Chani, (d) PCIV-CORPOELEC



An experimental burn initiated by indigenous Pemón members of PCIV brigades. Photo: Bibiana Bilbao

The park is part of the ancestral territory of the Pemón people, the fourth largest indigenous group in the country, but there are also other interests in the park and its surroundings. These include the national hydroelectric company (CORPOELEC), the national park authority (INPARQUES), the national armed forces, and the local government, among others. These diverse actors have different and even conflicting interests, leading to a complex context. For example, biodiversity in the park is not only an aim of conservation, but also has cultural, spiritual and subsistence value for the Pemón.

Pemón communities use fire widely: for domestic purposes, in hunting to ambush prey and to stimulate production of tender grass shoots (which transform savannas into feeding and hunting grounds, and to make insects jump into the water and attract fish), for clearing roads, for protection against snakes and scorpions, and for communication with smoke signals. Fire provides an important link to the spiritual world, used in ceremonies and ritual practices to ward off evil spirits, in celebrations around bonfires, and for healing. Fire and its uses are strongly linked to education, transmission of knowledge, and maintenance of culture (Bilbao et al. 2019).

In farming, fire has an essential role in improving soil quality, allowing the planting of crops in small forest clearings (*conucos*) that are cultivated for two to three years, then left to regenerate for five to twenty years. Burning is carried out upwind (backfiring) in the early morning, while flammable material is damp to prevent the fire from spreading, and to allow a full day to contain and control the fire. Fire is also used to prevent savanna wildfires from spreading into the forests that are crucial to livelihoods.

Fire suppression policies in the park

In 1981, the national hydroelectric company and the *Corporación Venezolana de Guayana* began a vegetation fire control programme (PCIV) to protect and conserve the forests of the Caroní basin, including Canaima National Park. A fire exclusion policy was implemented, in response to the long history of forest fires, especially those of 1979 and 1980, which affected extensive areas of forest, scrubland and savanna, shocking the public and the media. The Carlos Todd Initial Attack Brigade also began its work at this time. It was responsible for preventing, detecting, investigating and fighting forest fires, including to minimize burning and ensure proper fire management by indigenous Pemón communities (Gómez et al. 2000; Millán 2015).

Despite enormous organizational efforts and huge investments in infrastructure, equipment, aircraft, and hiring and training of personnel, an average of only 13% of the 1,000–3,000 annually reported fires were effectively controlled. Also, according to some inhabitants and park officials, wildfires actually became larger and more difficult to control, in particularly in drought years. The programme also ignited a historical conflict with the Pemón, whom CORPOELEC called “burners” and the cause of the “fire problem” in the park as a result of their burning practices. However, the Pemón perceived that the conservation policies and programmes of the various public bodies in the park not only prohibited their traditional use of fire, but also extinguished their cultural values and their capacity for self-management in their ancestral territory (Bilbao et al. 2019).

Not all fires are wildfires

Although scientific articles supported fire suppression policies in the park, there were no studies that provided evidence of the direct impact of fire on vegetation and soil, the role of climatic variables and fuel material on fire behaviour, or effects on ecosystems. CORPOELEC requested support for a study to quantify these variables and reinforce their fire control and management practices. In 1999, a series of long-term fire experiments were initiated, led by researchers from Simón Bolívar University, to evaluate fire behaviour and its effects under different burning frequencies and treatments during the dry season. This formed part of the multidisciplinary project, Atmosphere-Biosphere Interactions in the Gran Sabana, Canaima National Park, financed by the Ministry of Science and Technology.

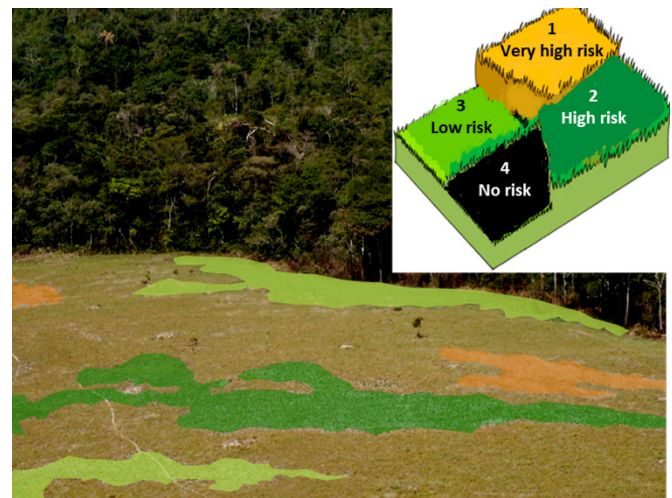
Participatory experimental burns were conducted in a savanna-forest gradient (where 70% of fires usually start), simulating indigenous practices. Members of the Pemón and PCIV-CORPOELEC fire brigades participated (Bilbao et al. 2010). The main results were these: fire can occur in a variety of climatic conditions and with different combustible materials; burns are highly variable in intensity and fire behaviour, but generally have low combustion efficiency; controlled burns are possible only every three to four years due to limited regeneration after burning; and savanna areas left for more than four years without burning have a biomass of $>0.6 \text{ kg/m}^2$ and a green/dry ratio >1 and so have a higher risk of high-intensity and uncontrollable wildfires.

These results indicated, contrary to general belief, that not all fires are wildfires. Burns showed different behaviour and rates of spread and fire intensity, and were affected by the interactions of environmental factors such as wind, temperature and humidity, and by vegetation characteristics defined by the accumulation and arrangement of biomass. None of the 31 experimental burns was the same, indicating the high diversity of fire types even in the same vegetation type. This also countered the myth that wildfire, when it occurs, is always catastrophic.

The results also showed that intentional burning of savanna vegetation at different times creates patches with different burning histories, forming a mosaic. Characterizing the ecological basis of what was termed the patch mosaic burning (PMB) technique was a significant result of the study. More important was the finding that this technique is used by the Pemón to make firebreaks to slow the advance of fire when entering a

recently burned area; this prevents catastrophic wildfires in the forested areas that they depend on for hunting, shifting cultivation, fruit and wood gathering, etc.

Another revealing result was that prolonged exclusion of burning led to a significant accumulation of dry combustible material, leading to high-intensity fires. This proved that the fire exclusion policy in the park may have actually increased the fire problem, and suggested the need to shift from fire suppression to fire management. This shift would incorporate indigenous practices that manage fire in a way that favours a diversity of vegetation (pyrodiversity) and that reduces the spread of large fires (Bilbao et al. 2010).



Areas with different risks of fire (according to the time since the previous burn), resulting from patch mosaic burning practices carried out by Pemón indigenous peoples in savanna-forest transitions. Photo: Ruth Salazar-Gascón

Making impacts

Lessons were learned about fire ecology, impacts and management, and also about the importance and enormous potential of integrating different sources of knowledge. Project scientists learned much through contact and exchange with the Pemón and indigenous CORPOELEC brigades, and this interaction changed the perspective of the research. The need to implement newly learned knowledge became evident, but it wasn't clear how to integrate more information from actors with such different perspectives. To answer this, the Proyecto Riesgo (Risk Project) and Proyecto Apök (fire in the Pemón language) were created, followed by others, supported by local and international funding.

All these projects were interdisciplinary and intercultural and were centred around safe meeting spaces that allowed dialogue between indigenous communities,



Workshop on integrating indigenous perspectives with academia and institutions in the Instituto Venezolano de Investigaciones Científicas (IVIC), Altos de Pipe, Caracas, Venezuela, January 2017.

(a) Closing speech by the president of the Kavanayén Council of Elders, (b) Pemón community member presenting the results of a fire management working group, (c) Exchange of knowledge between firefighters, INPARQUES officials, academics, and members of indigenous communities, and (d) workshop participants. Photo: Maiquel Torcatt

academics and government institutions. They aimed at developing a truly inclusive approach to fire management in the park. Indigenous youth were trained as community researchers, and were responsible for interviewing elders and collecting ancestral knowledge and practices related to fire use, shifting agriculture and hunting (Bilbao et al. 2021). Training workshops contributed to building capacities in using photography and video to document traditions and good practices. A new fire management paradigm began to be collectively conceptualized. This approach integrated indigenous Pemón knowledge on the use of fire, information on fire ecology from academics, and technical knowledge from fire control authorities.

This work was consolidated in a 2015 workshop involving representatives from Pemón and Yekuana communities, and indigenous Makushi, Wapishana and Kayapo peoples from Brazil and Guyana. In 2017 and 2018, national workshops included indigenous communities and 25 national public and private organizations. They promoted participatory and sustainable fire management, and called for unity between academics, governmental bodies and indigenous peoples to support

joint actions and respectful inclusion of indigenous knowledge. In 2018, as a result of the agreements reached, implementation began of an intercultural mechanism for IFM in the east of the park (Gran Sabana). These pioneering activities involved two-way training, with the Pemón providing training in patch mosaic burning and other indigenous fire prevention techniques to park authorities and forest firefighters, while also receiving technical training.

In 2019, following a presidential initiative, forest fire brigades throughout the country were expanded to 10,000 personnel, with training for 3,400 male and female firefighters; 1,800 of them are currently progressing toward university degrees as higher technicians and graduates in fire science and fire safety. This in-service education and training includes elements of IFM in a new operational philosophy for firefighters. They do not just intervene in fire control, but also work as local managers who facilitate intercultural dialogue and replace the fire exclusion model with community fire management.

A permanent working group for integrated fire management in Venezuela was formed in 2021,

including researchers and academics, and officials from environmental, territorial management, public safety and emergency response agencies. They are committed to promoting the methodological development of IFM with an intercultural vision and disseminating this approach at the national level through webinars and workshops. The park's forest fire firefighters have now incorporated lessons learned throughout this process in their training programmes, applying IFM techniques in protected areas throughout the country and exchanging experiences in integrated and participatory fire management with national and international experts.

These experiences are now being included in a new national system of IFM. It is promoted by an intersectoral team that includes public officials representing the INPARQUES forest fire firefighters, the Forest Fire Protection Directorate of the Ministry of Ecosocialism, the Vice-Chair of IPCC Working Group II on impacts, adaptation and vulnerability, and academics who have promoted these actions.

Work also continues at the regional level, building on the Participatory and Intercultural Fire Management Network established in 2015. A joint declaration expresses the commitment of actors in Venezuela, Brazil and Guyana to legitimize and strengthen indigenous fire management in regional fire policies. For example, the Cobra Collective and Simón Bolívar University are sharing lessons to provide a basis for developing scenarios for use in all of tropical America. Given that fire has historically been seen as a driver of deforestation and a emitter of greenhouse gases, experiences in Canaima National Park represent an innovative alternative in managing fire to mitigate climate change.

Conclusions

This research revealed a sophisticated indigenous knowledge system on the use of fire in livelihood activities, and collaborative burning practices at savanna-forest boundaries to protect forests from catastrophic wildfires. In contrast, studies showed that fire exclusion increases the risk of more severe fires due to fuel accumulation, a situation worsened by drier and warmer climatic conditions.

Inclusion of indigenous peoples, firefighters, public officials and academics in field research and dialogue on socioecological aspects led to a paradigm shift that values Pemón knowledge and culture in sustainable resource management and adaptation to climate change. This led to the adoption of integrated and

participatory fire management principles by the INPARQUES forest fire firefighters. Management plans also increased indigenous peoples' trust and involvement.

Further efforts are still needed to support the participatory development of viable plans and implementation of integrated fire management with indigenous communities throughout the region and the country. The immediate needs are to build organizational platforms with the necessary technical and financial resources, with institutional support structures that transcend sectoral approaches.

The use and value of fire as a land management tool and the reintroduction of traditional indigenous practices must be incorporated into a national integrated fire management plan with an intercultural vision. This must also be complemented by technical and professional training, research on fire dynamics and use of fire as a tool for climate change mitigation, alongside a system to effectively monitor and evaluate fire occurrence in real time to optimize planning and intervention efforts and assess the impacts of past, ongoing and future programmes.

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