

FIRE IN CERRADO AND PANTANAL - ECOLOGY AND MANAGEMENT

Acknowledgments¹

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Introduction

The Portuguese term Cerrado means closed and designates a vast phytogeographic province dominated by an unambiguous savanna like vegetation, once it can only be found in Central Brazil and some fragments in the Southeast, Northeast and in the Amazonia. The Cerrado occupies more than 1,8 million Km², comprising 22% of the Brazilian territory. The Cerrado holds about 160,000 species of animals and plants, with at least 8.000 species of plants many of them are endemic.

The Pantanal is one of the world's most immense wetlands and rich ecosystems. Extending through Central-West Brazil, eastern Bolivia and northeastern Paraguay, the Pantanal covers some 365,000 km². Plants from the Cerrado, the Amazon, the Chaco and from the South American grasslands constitute its vegetation complex, with rare endemic species belonging exclusively to the Pantanal.

The Pantanal is home to at least 3,500 species of plants, 264 fishes, 652 birds, 102 mammals, 177 reptiles, and 40 amphibians. Levels of endemism are not as pronounced as in the neighboring Cerrado. The fauna of the Pantanal is mostly derived from the Cerrado, with Amazonian influences.

Together with a seasonal dry climate (five months), soil oligotrophy coupled with aluminum toxicity, fire is considered one of the determinants of the existence of the Cerrado. Fire has been part of Cerrado for a long time. Charcoal fragments found in Cerrado soils were dated as 8.600 years. Indigenous population used fire for hunting, for agriculture and for warrior

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purposes long before the Europeans arrive in South America. Natural fire occurrence is related to lightning, which has been noticed in some protected areas.

The existence of several species that tolerate or is dependent on fire in the Cerrado vegetation is further evidence that fire has been a major ecological factor in this biome. Studies about fire ecological impacts on climate, soils, nutrient cycling, fauna and flora are available, and they are important to guide the understanding of the fire regime that could be accepted for a distinct area or region in the future.

Fire regime has been tremendously affected by the rural activities in Cerrado and Pantanal region, mainly in the last 20 years. Like in many other places of the world the principal causes are related to grazing and agriculture, but other reasons are also of cultural importance, as pest control, poisonous snakes control, religious offerings, etc.

The actual fire regimes in these regions are detrimental to air quality, to species conservation, for the economy and public health and needs a better understanding and a correction on its direction.

The Brazilian Protected Areas suffer frequent and important impacts caused by wildfires. Although many information is now available, the use of prescribed burnings is still of little importance in management plans.

This presentation intend to bring the actual fire regimes on these regions to the discussion and to point out ideas that can help to establish clear objectives for to use or not fire for the rural production purposes and for the conservation of biodiversity and fire management for the protected areas.

Fires in the Pantanal

The reasons why fire regime is changed at the Pantanal are not so further away from those at the Cerrado areas. Those fires are now very common, and in many areas they happen at a yearly frequency. Pasture management causes much of them, but accidental fires are also present, although we cannot give the numbers.

Like in many other ecosystems elsewhere, frequent fires are detrimental to tree recruitment and causes strong impacts for the forest habitats in the area. The establishment of cattle farms has dramatically changed the forest cover in the area and frequent fires avoid the regeneration.

At the lower lands of the Pantanal, the forests can be found at the “Cordilheiras”, which can be damaged by fires.

Baía (Bay): temporary or permanent lagoons of variable sizes, which can present many species of emergent, floating or sub aquatic plants.

Baceiro: floating vegetation of grasses and aquatics plants.

Cordilheira: narrow strips of higher non-flooded terrains (one to three meters high), carrying forest, cerrado or cerrado.

The “Cambarazal” is a mono dominant forest, whose dominant specie *Vochysia divergens* seems to colonize the natural open fields, on season flooded areas. They seem to be pioneer species in the recover process, probably running in to the semi-deciduous forest constitution.

Here fire plays a very important regulation, by avoiding the recruitment of the trees in the grass-covered areas. In some places this is probably the cause of fires, to keep the pasture free from those trees.

A distinct pattern of fires in the Pantanal is related to the management of pasture. The autochthonous grass species, which are used for cattle, have different protein contents; they bear distinct patches in a gradient of humidity and also present differences on their production.

The species with higher protein concentration “capim mimoso” and “rabo de burro”, *Axonopus purpusii* and *Andropogon bicornis* respectively, generally stands at sites with more humidity, many times by the edges of the “Baías”. Fire is not desired on these situations.

Nevertheless, there is another specie of grass, the “carona” *Elyonurus muticus*, less palatable, poorer in protein contents. When dried it needs fire to be consumed by the cattle. The cattle only use this grass during fourteen days after burning. Running this time the taste is no more acceptable. This is very important for the prescribed burning plans.

The general pattern is that the burnings are not well planned and are badly conducted, causing enormous wildfires of high intensity. These fires impact the ecosystems and also contribute for the global climate change.

Fires in the Cerrado

Temperature regime on soils – The pattern of soil temperatures in the Cerrado is not different from other savannas ecosystems, where about 97% of burnt matter belongs to the ground layer vegetation, mainly grasses.

At those conditions, the maximum air temperatures at 60 cm high can get to 800 °C for two minutes. The observed soil temperatures during the burning got to 53°C, 27°C and 22°C at 1, 5 and 10 cm deep. The removal of vegetation, and the insulation characteristic, resulted in an increase in the amplitudes of soil temperatures to 26.2°C, 9.8°C and 4.1°C at 1, 5 and 10 cm, respectively. Before the fire the amplitude was 13.6°C and 4.5°C at 1 and 10 cm.

Dynamic of nutrients – Fire promotes nutrient transferences to soil surface in the ash deposits and exporting great volumes to the atmosphere. The effects on soil parameters like pH and the sum of bases are important and last for more or less three months. The nutrient volume exported to the atmosphere is amazing but returns back by precipitation processes in tree or a little more years. This is a good point to think when establishing fire regimes.

Vegetation physiognomy and structure – It is known that Cerrado fires don't cause direct deaths for the established woody plants. However, it causes the destruction for the thinner aerial stems of established woody plants (lower than 1.30 cm and thinner than 9 cm of diameter at 30 cm from the ground), and causes structural damage to the wood plants between 1.3 to 5.0 meters high and 9.0 centimeters thick at 30 cm from the ground.

Re-sprouting, flower bloom, seed dispersion and germination – It is known that fire in the cerrado promotes many species to flower, fruit ripen and seed dispersion by cleaning the area. However, the woody plants re-sprouting and vegetative reproduction strategies seems to be the most important event in terms maintenance of this vegetation structure.

Fire regime and fire management

Rural fires - The actual fire regime for rural areas in the Cerrado and Pantanal regions are at annual basis. In general they are not prescribed but uncontrolled fires where the landowners set on fires and just let them go. Hundreds of thousands of hot spots are detected by satellites every year in these regions. Impacts on air pollution, economy, public healthy and over ecosystems are dramatic. Besides this, lots of fires are accidental, which needs different approach.

Different strategies have to be applied to establish an appropriate fire regime in the region. The government and non-governmental institutions are doing an amazing effort in order to change the situation.

In general, the landowners are getting to the conclusion that is not smart to burn their cultivated grasses, and in the near future this figure will probably be much better. But, many poorer farmers will keep using the fire to manage native grasslands.

The “caronal” fields in the Pantanal and in many parts of the cerrado region, where native grasslands are used for cattle, the importance of prescribed burnings will last for a good time. So, those are the cases we have to take a very good look and try to develop the best use of fire.

How to do?

- Fire regime;
- Size and rotation of burnings;
- Early or late burnings;
- Burning techniques;

These are the main questions; accumulated knowledge and good sense are the tools in each case!

Protected areas – Much of the origin of fires at the protected areas are outside of its boundaries, and in many cases they came from miles away. Their causes are mainly related to the uses of fire for agriculture and cattle breeding, along the boundaries of the protected areas. Others causes can be related to pest control, snakes, balloon, fireworks, accidental, etc.

A present fire regime at the conservation unities is variable and depends on the stage of implementation of the area; many don't have enough people and resources to develop any good work; some have problems with land ownership and so on. However, some have enough resources to do a good job, and are trying hard.

We have cases where fires once have started they hardly will be extinct without a good rain. But in many cases the fire brigades do very well their jobs and fires are maintained in desirable limits.

Our capabilities to control fires in the cerrado protected areas have been improved and we have avoided hazardous fires. On the other hand, this protection is providing biomass accumulation, creating scenarios for potential big fires in the future.

The general adopted strategy is to extinguish any fire that gets in to those areas. No fire management is been used to prevent wildfires. Fire management is a very recent program in Brazil, and needs to establish clear objectives.

For now, we have only a general objective, which is to avoid catastrophic fires.

Although we have now a reasonable understanding about fire ecology for the cerrado we didn't get to a

point to use prescribed burnings, apart those we usually make to build fire breaks in our protected areas.

The exception is the fire management program for Emas National Park, where we have some distinct objectives. There we have at a yearly basis 380 kilometers of fire brakes, varying from 25 to 60 meters wide, creating big zones where lightning fires are monitored. We only combat those fires if they escape from one zone to another with greater risks. Fires originated by human causes are combated to extinction.

As can be observed, in Brazil we just have begun with the fire management. So we have plenty of opportunities for research and applied programs on fire ecology and management.

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