Fire in Paradise: why the Pantanal is burning

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Short Communication

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Abstract: This Communication reports on the fires recently seen in the Pantanal region, in Brazil, the largely continental wetland globally. It outlines the causes of the problem and some of the means which may be deployed to address them.

Keywords: Wetland, Brazilian forests, Vegetation loss, Biodiversity

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1. Introduction

The Pantanal is the largest continental wetland in the world, with a total area varying from around 140,000 square km to 210,000 square km, depending on the season. It is located mostly within the Brazilian state of Mato Grosso do Sul, but it extends into Mato Grosso and portions of Bolivia and Paraguay (Mioto et al., 2012). Today, the population of the Brazilian Pantanal is approximately 1,100,000 people. In Bolivia, it is estimated at 16.800 inhabitants and in Paraguay about 8.400 who live from a combination of agriculture, fishing and tourism. The Pantanal region encompasses the Paraguay River's upper banks and the São Lourenço and the Taquari rivers, which act as its tributaries. The name "Pantanal" comes from the Portuguese word pântano, meaning wetland, bog, swamp, quagmire, or marsh. It derives from the fact that roughly 80% of the Pantanal floodplains are submerged during the rainy seasons, nurturing a rich diversity of aquatic and amphibian plant and animal species.

Like the Brazilian Cerrado, a large portion of the Pantanal region is fire-prone, meaning that fire has major impacts on species distribution and survival, as some species have developed adaptations or rely on fire for reproduction (Hardesty, 2005). However, alterations of the prevailing fire regime, such as fire suppression or higher frequency and intensity, can cause

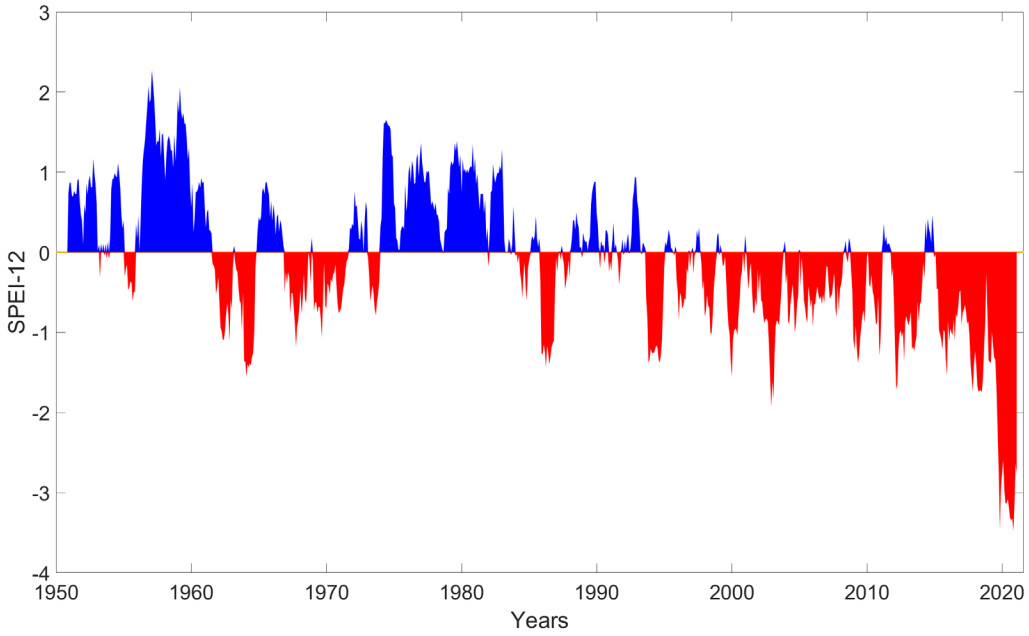
biodiversity losses, replacement of native species and drastic changes in ecological processes. The non-savanna portion of Pantanal is fire-sensitive, i.e., a region with no adaptation to fire and where fire disrupts the native ecosystem (Hardesty, 2005). The Pantanal is home to immense biodiversity: over 2,000 species of plants; 582 species of birds; 132 species of mammals; 113 species of reptiles and 41 species of amphibians are found there (e.g. Alho, 2008; Alho et al., 2011). It faces many environmental problems partly thanks to human influence (Schulz et al 2019), among which mention can be made to deforestation, degradation of land, increased soil erosion, and water resources contamination. These are coupled with cattle breeding for beef production (Bergier et al., 2018) and over-fishing, which poses a threat to local fish stocks. Besides, the region as a whole and, in particular, the floodplain is facing its worst crisis in decades (Chiaravalloti et al., 2017). Under the 2020 severe drought, the biome has been suffering from human-made fires and has had about 26% of its area affected by flames, according to data from the ALARMES warning system (Pinto et al., 2020) from the Laboratory for Environmental Satellite Applications (LASA-UFRJ) (https://lasa.ufrj.br/news/burned-area-pantanal-2020/). Satellite-derived information data shows that the e area affected by fires in 2020 (around 3.9 million hectares) is more than twice the area burnt in 2019. This corresponds approximately to the combined areas of Rio de Janeiro and Sao Paulo, two of Brazil's largest cities. Figure 1 shows the areas affected by fire on 6th September 2020.

Figure 1. Fires in the Pantanal on 6th September 2020 (Source: NASA, Earth Observatory 2020)

The summer season in the Pantanal lasts from December to March, with average daily temperatures above 27 °C. The highest average temperature is 29 °C, but can go as far as 32 °C.

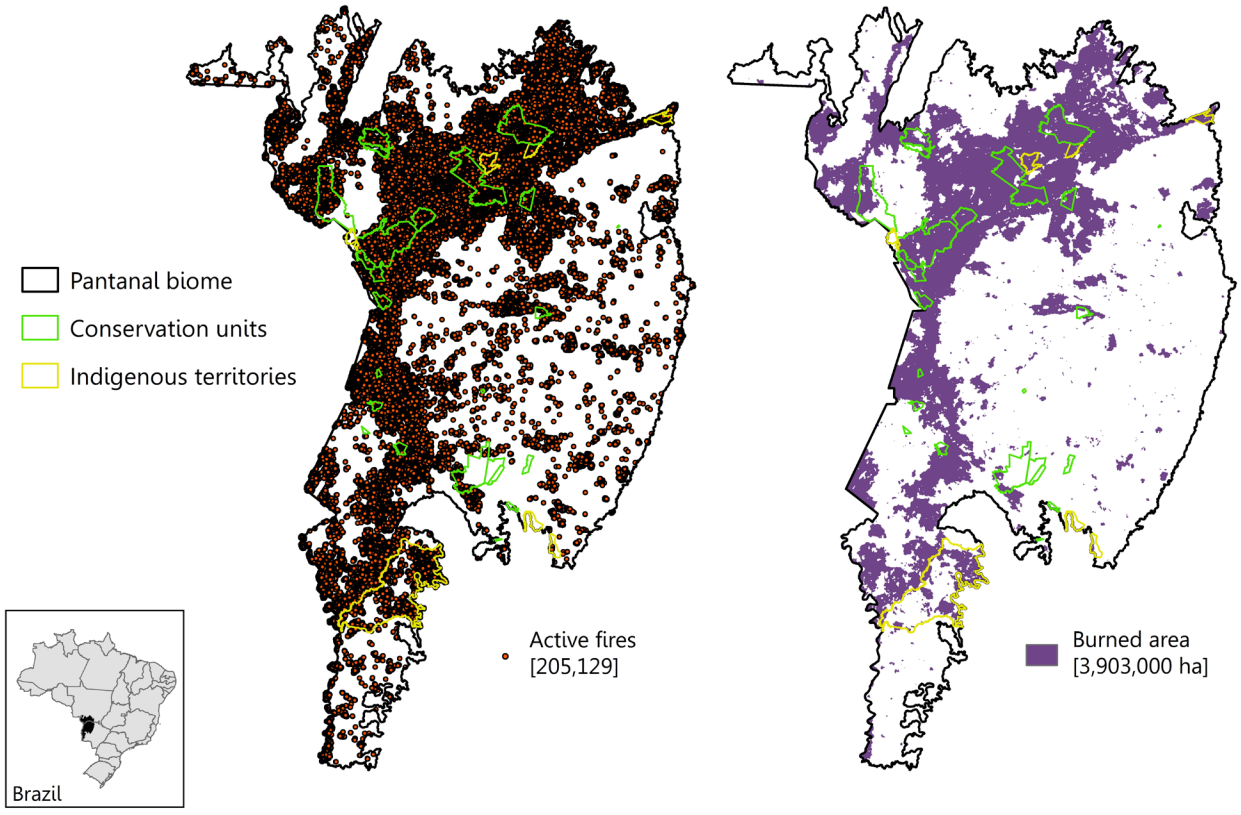
The cold season is usually from June to September, with an average daily high temperature below 21 °C. The Pantanal is affected by teleconnection mechanisms linked to oscillations in sea surface temperature (SST) of the Pacific and Atlantic oceans responsible for most of the rainfall variability over the region (Marengo et al., 2016). During 2020, the region has experienced the most severe drought of the last decades and near-record-high temperatures (Figure 2) (Libonati et al., 2020; Marengo et al., 2021).. Drought modulation by SST warming over the Pacific and Atlantic oceans is expected to continue impacting the Pantanal (Thielen et al., 2020), which will contribute to amplify the susceptibility of the biome to fires.

Figure 2. Time series from 1050 to 2020 of the Standardised Precipitation-Evapotranspiration Index (SPEI) for the Pantanal region. This is a multiscalar drought index used for determining the onset, duration and magnitude of drought conditions with respect to normal conditions. Positive (negative) values of SPEI indicate wet (dry) conditions. Dataset from https://spei.csic.es/index.html



Consolidated data from the National Institute of Space Research (INPE) released in September 2020 show that fires in the Pantanal region grew by 215% in 2020 compared to the same period last year (INPE, 2020). The region has registered over 15.000 fire spots this year, against 4.940 in 2019, which can be used as a baseline. Figure 3 shows active fires and burned area in the Pantanal region in 2020 (from 1 January to 31 December 2020), reported by (https://lasa.ufrj.br/news/burned-area-pantanal-2020/). The Brazilian Institute for Space Research (INPE) has reported that considering all Brazilian forests and biomes, the increase in fire spots detected so far compared to 2019 is up by 12% (INPE, 2020).

Figure 3. Active fires and burned area in the Pantanal region (1 January to 31 December 2020)



The fires increased in the Pantanal from July onwards, when the drought became even more intense. Whereas small fires are historically not rare in the region, usually for land clearing for subsistence purposes, the unusually long drought encouraged many people to set arson fires for ranging and land expansion. Several thousand were recorded in 2019, and this trend has become even more intensive in August and September 2020. One of the most affected areas in the fires, the Encontro das Águas National Park, had 82% of the total 88,500 hectares burned, according to the ALARMES system (https://lasa.ufrj.br/news/burned-area-pantanal-2020/). The site is known worldwide for housing one of the largest populations of jaguars in the world (Tortato and Izzo, 2017). The region is located at the Mato Grosso state portion of the Pantanal, which experienced a huge increase in the burned area compared to 2019 (https://lasa.ufrj.br/news/burned-area-pantanal-2020/), endangering the one of the main refuges of hyacinth macaw *Anodorhynchus hyacinthinus* (arara-azul) (Scherer-Neto et al., 2019).

The current fire problems seen in the Pantanal are a combination climate factors and human activities on the plateau and plains, which exacerbate them. Many canals, commonly called "mouths", have been artificially blocked by farmers to avoid the flooding of fields used for grazing. The fact that the water cannot easily spread, means that the fields are not duly irrigated, which, in turn, increases exposure to droughts. Furthermore, inadequate agriculture practices have been influencing the water supply to rivers like Cuiabá and Paraguay, reducing their sizes. This fact also increases the vulnerability to droughts.

The alternation of consecutive years of flood and drought in the Pantanal (cycles), constitutes one of the most important actors in the socio-economics and biodiversity of the region. Fires put such a balance at risk. Whereas life history, morphology and behaviour allow

some fauna groups to be more or less susceptible to the consequences of fires, they can lead to severe reductions of populations, which may critically affect their sizes.

The lack of respect for the Permanent Preservation Areas increases the load of sediment that falls into the rivers, making them shallower, and the small and large hydroelectric dams change the pulse of the waters. All these factors have negatively influenced the hydrological cycle of the Pantanal. Combined with fires, they may undermine the local ecosystems' ability to respond and to recover.

2. Lack of monitoring and control

The Brazilian Institute for Space Research (INPE) has reported that, considering all Brazilian forests and biomes, the increase in fire spots compared to 2019 is at a high of 10%. Here, the role of climate variability in fire activity is important and especially conspicuous during extreme droughts, which exacerbated fire incidence and added to the severity of the problem in the region. Compounding the effects of climate, recurrent spikes in vegetation burning in the Pantanal region is related to anthropogenic activities such as large-scale agriculture and cattle growth (Libonati et al., 2020; Li et al., 2020).

Even though fires are illegal during the dry season, they still take place. Apart from commercial interests, there is a lack of monitoring due to a limited number of inspectors. The number of notices of infraction is an important fact that can translate the government's effort to punish those who commit environmental crimes. The smaller the frequency of government inspectors in the field, the greater the feeling of impunity is to hold offenders accountable. Consistent with this reality, it has been verified that, from January to September 2020, the Brazilian environmental protection agency (IBAMA) imposed 50 fines against violators in Mato

Grosso do Sul, for violations involving “damages to vegetation” as setting fires are often called. In the same period of 2019, 64 infraction notices were registered.

Most of the Brazilian portion of the Pantanal biome (approximately 65%) lies in the territory of Mato Grosso do Sul. The rest (about 35%) is in the neighboring state of Mato Grosso. There, the drop in fines was even more remarkable: in 2020, there were 173 recorded offences, compared with 361 in 2019 – a reduction of 52%. Adding up the infractions data in the two states that shelter the Pantanal, the fall is around 48%.

Apart from the fact that its operational budget is rather small, IBAMA has lost half of its enforcement staff in recent years. There are currently less than 600 inspectors to act throughout the national territory, including the Blue Amazon (Brazil's exclusive economic zone in the Atlantic Ocean). To get an idea of how small a number this is, the Military Police of the State of Rio de Janeiro alone has today almost 45.000 police officers on duty.

Another factor that has greatly hampered progress in preventing and fighting wildfires in the country was the government's decision to appoint and occupy the management positions of IBAMA by people without any experience in the field. Fire as a disturbance needs to be faced by making use of appropriate monitoring technologies (Libonati et al., 2020), fire ecology knowledge and “integrated fire management” (Berlinck et al., 2020) for biodiversity conservation.

3. Conclusions

As this paper has shown, the Pantanal region is under severe pressure due to the many economic interests surrounding it. This is partly due to Brazil's political crisis (Magnusson et al.,

2018, Karam-Gemael et al., 2018), which has been negatively impacting biodiversity. The indirect effects of fire are usually wider, later and more diverse than the immediate ones. These impacts can alter animal communities' structure due to changes in habitats and in the landscape (Arruda et al., 2016). Such changes are related to variations in food availability and quality, and changes in habitat structure, such as destruction of breeding, protection and resting places (da Silva Jr et al., 2020).

It is not yet possible to have an exact number of animals killed by fire, but it is known that the loss of wildlife is quite significant (Libonati et al., 2020; Li et al., 2020). Fire Brigades report having found dead tuiuiús, armadillos, sucuris and anteaters, many of them charred. Besides, there are reports of animals running over on highways as they tried to escape the fire, such as quatis, anteaters, alligators and snakes.

Whereas the long-term damages to the local fauna and ecosystems are yet unknown, it is clear that the currently inefficient system of fines needs to change. Also, greater national and international partnerships are necessary, especially in respect of research, to improve the current knowledge and the quality of information about the Pantanal fires. In particular, apart from ground monitoring and more robust governance, along with the education of land owners, more reliable remote sensing techniques and satellite monitoring of land use and occupation are much needed, especially the monitoring of wildfires, to better support the efforts to handle their impacts.

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Competing interests

Authors declare no competing interests.

References

Alho, C. J. R. (2008). Biodiversity of the Pantanal: response to seasonal flooding regime and to environmental degradation. Brazilian Journal of Biology, 68(4), 957-966.

Alho, C. J., Camargo, G., & Fischer, E. (2011). Terrestrial and aquatic mammals of the Pantanal. Brazilian Journal of Biology, 71(1), 297-310.

Arruda, W. S., Oldeland, J., Paranhos Filho, A.C., Pott, A., Cunha, N.L., Ishii, I.H., Damasceno-Junio, G.A. (2016). Inundation and Fire Shape the Structure of Riparian Forests in the Pantanal, Brazil. PLoS ONE 11(6): e0156825. https://doi.org/10.1371/journal.pone.0156825

Berlinck, C. N., & Batista, E. K. (2020). Good fire, bad fire: it depends on who burns. Flora, Volume 268, July 2020, 151610. https://doi.org/10.1016/j.flora.2020.151610

Bergier, I., Assine, M.L., McGlue, M.M., Alho, C.J.R., Silva, A., Guerreiro, R.L., Carvalho, J.C. (2018). Amazon rainforest modulation of water security in the Pantanal wetland. Science of the Total Environment. 619, 1116-1125. doi: 10.1016/j.scitotenv.2017.11.163.

Cemaden (2020) Monitoramento de Secas e Impactos no Brasil. Centro Nacional de Monitoramento e Alertas de Desastres Naturais. Available at: http://www.cemaden.gov.br/monitoramento-de-secas-e-impactos-no-brasil-setembro2020/ (last accessed 27/10/2020)

Chiaravalloti, R. M., Homewood, K., Erikson, K. (2017). Sustainability and land tenure: Who owns the floodplain in the Pantanal, Brazil? Land Use Policy, 64, 511–524

da Silva Junior, C.A., Teodoro, P.E., Delgado, R.C. et al. (2020) Persistent fire foci in all biomes undermine the Paris Agreement in Brazil. Scientific Reports 10, 16246. https://doi.org/10.1038/s41598-020-72571-w

Hardesty, J., Myers, R., Fulks, W. (2005). Fire, ecosystems, and people: a preliminary assessment of fire as a global conservation issue. The George Wright Forum, 22(4), 78-87.

INPE Instituto Nacional de Pesquisas Espaciais (2020). Portal do Monitoramento de Queimadas e Incêndios Florestais. Available at: http://www.inpe.br/queimadas (last accessed: 18/09/2020)

Karam-Gemael, M., Loyola, R., Penha, J., Izzo, T. J. (2018). Poor alignment of priorities between scientists and policymakers highlights the need for evidence-informed conservation in Brazil. Perspectives in Ecology and Conservation, 16, 125–132.

Li, X., Song, K., Liu, G. (2020). Wetland Fire Scar Monitoring and Its Response to Changes of the Pantanal Wetland. Sensors, 20(15), 4268.

Magnusson, W. E., Grelle, C. E. V., Marques, M. C. M., Rocha, C. F. D., Dias, B., Fontana, C. S., Fernandes, G. W. (2018). Effects of Brazil's political crisis on the science needed for biodiversity conservation. Frontiers in Ecology and Evolution, 6, 163. doi:10.3389/fevo.2018.00163

Marengo, J.A., Alves, L.M., Torres, R.R. (2016). Regional climate change scenarios in the Brazilian Pantanal watershed. Climate Research, 68, 201-213. doi: 10.3354/cr01324

Mioto, C. L., Paranhos Filho, A. C., & do Amaral Albrez, E. (2012). Contribuição à caracterização das sub-regiões do Pantanal. Entre-Lugar, 3(6), 165-180.

NASA Earth Observatory. Fires Char the Pantanal (2020). Available at: https://earthobservatory.nasa.gov/images/147269/fires-char-the-pantanal (last accessed: 28/10/2020)

Pinto, M. M., Libonati, R., Trigo, R. M., Trigo, I. F., & DaCamara, C. C. (2020). A deep learning approach for mapping and dating burned areas using temporal sequences of satellite images. ISPRS Journal of Photogrammetry and Remote Sensing, 160, 260-274.

Scherer-Neto, P., Guedes, N. M. R., & Toledo, M. C. B. (2019). Long-term monitoring of a hyacinth macaw Anodorhynchus hyacinthinus (Psittacidae) roost in the Pantanal, Brazil. Endangered Species Research, 39, 25-34.

Schulz, C., Whitney, B., Rossetto, O., Neves, D., Crabb, L., Oliveira, E., Lima, P., Afzal, M., Laing, A., Fernandes, L., Silva, C., Steinke, V., Steinke, E., Saito, C. (2019) Physical, ecological and human dimensions of environmental change in Brazil's Pantanal wetland: Synthesis and research agenda. Science of The Total Environment, 687, 1011-1027. https://doi.org/10.1016/j.scitotenv.2019.06.023

Tortato, F. R., & Izzo, T. J. (2017). Advances and barriers to the development of jaguar-tourism in the Brazilian Pantanal. Perspectives in Ecology and Conservation, 15(1), 61-63.