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FIRE IN FOREST RESERVE IN THE CARAÇA SANCTUARY: THE THREAT TO THE CULTURAL AND NATURAL HERITAGE IN MINAS GERAIS, BRAZIL

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ABSTRACT

This paper presents the eminent threat that a forest fire represents for cultural and natural heritage in the State of Minas Gerais, Brazil, in particular the case of a fire which started on September 24th, 2017, in the forest reserve in the Caraça Sanctuary, an important site not only for its natural richness, characterized by a rich biodiversity, but also by the existence of the architectural complex of the Sanctuary, of great cultural value for the country, made up of buildings that house the old school building, a church and the old seminary. In order to do so, a brief history of the place, its cultural and natural importance and the first fire occurred in 1968 will be presented. In the context of the forest fire, the main characteristics of this type of sinister in Brazil will be presented, their possible causes and aspects that differentiate them of fires in other regions of the world. Finally, the last fire *per se* will be discussed.

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INTRODUCTION

The recognition of the interdependence and inseparability of tangible and intangible assets of a given social group reflects the major global trends concerning cultural heritage concepts and shows that the preservation of guarded buildings is important not only for the building itself, but also assists in preserving knowledge, ritual and manifestations of a regional culture or even of a nation. The same can be said about the natural heritage, as cultural assets are not detached from the environment in which they operate, as the landscape and the environment are inseparable parts of the cultural heritage. In addition, the natural heritage is directly linked to the preservation, not only of the fauna and flora of a given location, but as well as the culture of those who, directly or indirectly, are linked to the environment in which they live. When analyzing the risks and consequences of a fire in cultural heritage, in particular in the guarded buildings, some characteristic features of this type of building may potentialize the risks of a fire, make it difficult or even prevent its combat and extinction, and can lead to structural collapse of the building. These aspects can be the constructive characteristics of the buildings, which often have constructive elements (floors, linings, stairs) made of wood; the implementation of buildings in urban areas, which often have no distances between them, or, extensions or irregular occupations in the middle of blocks, leading to a rapid spread of the flames; the lack of proper maintenance of the buildings and their facilities; the type of occupation that sometimes is altered, without the necessary adjustments to adapt to its new use; and facilities: in order to adequate the buildings use, adjustments are made to electrical and liquefied petroleum gas facilities (Serpa, 2009). As for the forest fire in Brazil, it is known that over 90% of outbreaks of fires are caused by: fire in garbage in the yards of houses, fireworks next to dry vegetation sites, camping fires incorrectly or incompletely extinguished, illegal deforestation or cattle pasture areas creation, and land cleaning - the latter case, influenced by a lack of culture of correct forms of land management (Foundation of Municipal Parks, 2017). Another important fact is that, despite annual fire occurrences, they do not cause as many victims due to the fact that such accidents happen mostly in areas of environmental preservation, places with very restricted human occupation, which may, in some cases, explain the criminal nature of the fires, as many of these regions are under pressure due to irregular occupations caused by real estate speculation or illegal agricultural use. Therefore,

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forest fires in the country tend to occur in areas of environmental preservation, many of them protected as natural heritage, consisting of areas that transmit to the population (local, regional, national or international) the importance of the natural environment and, consequently, of its preservation. Thus, this work, based on a bibliographical research in articles, periodicals, training material of forest fire brigades, among other documents, seeks to contribute to the investigation of this type of sinister in order to stimulate the early research for better understanding and deepening the subject. With the continuity of this study, it is expected to raise awareness, information and mobilization of the community, in order to establish a culture of fire prevention in protected environments, supporting a possible restructuring in methodologies, processes and prevention tools, whether on standards, inspection crews, academy or other institutions.

The caraça sanctuary reserve

Site characteristics: Located in the municipalities of Catas Altas and Santa Bárbara, State of Minas Gerais, the Caraça Sanctuary Reserve is a "spirituality and mission, culture and education, environmental conservation, leisure and tourism center" (Action Plan for the Caraça 2007, 2012). It is a private natural heritage reserve, part of the South Environmental Preservation Area (APA Sul) of the Metropolitan Region of Belo Horizonte (RMBH), capital of the State of Minas Gerais; it has federal, state, and municipality perpetual registration as a cultural heritage of Brazil, through the IBAMA document, # 32, of March 20th, 1994 (Almeida, 2017). The Caraça Sanctuary complex comprises a 11,233 hectares area, in which are located the set of Architectural Sanctuary, the Natural Permanent Preservation Region (RPPN), equivalent area to 10,187 hectares, as well as parts identified as management areas. In the architectural complex are the neo-Gothic church, the old school building (now museum and library) and the inn. In the management area are located: Engenho, Buraco da Boiada and Capivari estates (Almeida, 2017). Inserted in a priority conservation area, the RPPN Caraça Sanctuary is contemplated with the recognition of the National Historical and Artistic Heritage Institute (IPHAN), in 1955, when it became part of the list of goods registered by the Union, according to Process # 407-T, Registration #309 in the History Book and Inscription #15-A in the Archaeological, Ethnographic and Landscape Book. This RPPN also integrates the area destined to the Biosphere Reserve of Serra do Espinhaço and and the Atlantic Forest, recognized by UNESCO in 2005, as one of the divisors of the Rio Doce river basin (Almeida, 2017).

The RPPN CaraçaSanctuary holds a peculiar historical past to be in possession of only two owners, Brother Lourenço de Nossa Senhora and the Congregation of the Mission, for more than 240 years. Due to its historical context, the RPPN received the name of Caraça Sanctuary, granted by the Archbishop of Mariana, through the Decree of March 4th, in 2005 (Almeida, 2017).In this context, the Caraça Sanctuary Reserve is also a tourist center, responsible for generating direct employment for about 70 residents of the region in which it operates, and promotes an annual tourist flow greater than the sum of the populations of the two cities in which it is located. Because it is a Catholic institution of the Vincentian family, it has several social purposes, among them the missionary and the attention to the poor, still a center of pilgrimage, culture, environmental education and production of scientific knowledge and academic research (Almeida, 2017).

Historical Context: Around 1770, the lot of Caraça was bought by Brother Lourenço de Nossa Senhora, who soon began to build a hospice (guest house) for pilgrims and a Baroque church dedicated to Nossa Senhora Mãe dos Homens(Holy Mary Mother of Men), a typically Portuguese devotion. With the development of the Sanctuary, Brother Lourenço founded the Brotherhood of Nossa Senhora Mãe dos Homens (Holy Mary Mother of Men) in 1791-1885 and, with the help of his members and the alms obtained from pilgrimages throughout the province, improved the Caraça facilities, enriching the church and its inn. Due to its growth, this brotherhood reached more than 23,000 members throughout the century of its creation (Almeida, 2017). In 1775, the construction of the hermitage of the church begun, a small baroque church for hermits and pilgrims use until 1876, Figure 1a, when it was dismantled for the construction of the present church in neo-Gothic style, Figure 1b (Almeida, 2017). In 1820, the first students of the incipient Caraça school arrived, who, after being transferred to another municipality, returned to its place of origin in 1856. Several prominent personalities have studied in this school, including two presidents of the Republic of Brazil (Almeida, 2017).

Figure 1a. Old church

Figure 1b. Present church

Fire in the Caraça School: On May 28th, 1968, a major fire destroyed much of the Caraça school library collection. A forgotten stove lit in one of the binding rooms caused the accident and, thanks to the work of the institution's students, about 15,000 of the 50,000 books were saved (IEPHA/MG, 2013). The fire lasted about eight hours, with the initial focus occurred at 3:00 am, extinguished by about 100 men and six vehicles from the State Fire Brigade of Minas Gerais (CBMMG). In addition to the damages in the library, other injuries were caused by the destruction of laboratories, dormitories and classrooms. Only the parsonage, the refectory

and the church were not reached (Werneck, 2013). There were no injuries, even though students and priests were asleep at the time the accident began. The abandonment of the building where the school was located was immediate and, even though it was partially taken by the flames, the access stairs to the escape floor allowed the evacuation of all occupants, who were on the second and third floors. Fire consumed most of the library collection, including literature treasures from France, Italy, as well as a collection in latin, one of the remaining unique in the world, priceless and that was lost irretrievably. The impact of this fire on the daily life of the place was so devastating that it caused the end of the apostolic school that settled there in 1885 (Werneck, 2013).

Forest fire: Forest fire is any uncontrolled fire that affects any form of vegetation, whether it is man-made (intentional or negligent) or by natural causes(lightning). On the other hand, controlled burning is characterized by an agricultural or forestry practice in which fire is used rationally, that is, by controlling its intensity and limited to a predetermined area, acting as a production factor. There is also the possibility of being used in the management of protected areas to prevent fuel accumulation, thus, preventing the occurrence of fires with violent behavior and difficult to be controlled (IMCBio, 2017). The spread of fire is characterized by heat that can be transferred through the air or through contact between fuels and flames. Regardless of its intensity, this heat spread, in forest fires, occurs through four processes often combined: irradiation, which is the heat expansion in all directions; conduction, which is the expansion of heat through contact; convection, which is the displacement of hot air upwards; and sparks, launched from incandescent parts (Brigade 1, 2014). Forest fires are categorized into three distinct types: underground fires, which occur below the surface and have roots as fuel, peat and other materials that are found underground; surface fires, which occur above ground in shrub vegetation and grasses, spreading rapidly, but easily extinguished; and aerial fires, which occur on the treetops, generating large amounts of heat and a difficult combat.

The extinction of fires are the counterpoint of the elements necessary to the existence of fire, and can be categorized by three methods: smothering, with the removal of the oxidizer (the fire is extinguished by suffocation); cooling, with the removal of heat; and the withdrawal of fuel, through the manufacture of firebreaks (opening in the vegetation, using combustible material, which acts as a barrier to delay or prevent the progress of forest fire). Each situation requires the use of a certain strategy, which is defined by the most experienced firefighters during the planning of the action. They can be divided into three methods: direct, which combines cooling and muffling (it is used when the heat intensity allows the approach of the firefighters); indirect, used when the intensity of the flames does not allow the approach of the combatants, using, therefore, the firemen to stop the advance of the flames; and the parallel, which is characterized by the simultaneous combination of direct and indirect methods (Brigade, 2014). Forest fires develop as the elements responsible for their behavior vary. Three sets of factors can act simultaneously and are decisive in any combat situation: climate, topography and vegetation. The determining factors that the weather can influence in firefighting are: temperature, relative humidity, wind and atmospheric precipitation. The topography can influence as well, due to: solar exposition of the area, the degree of slope of the place, the fire position, as natural barriers (rocks, canyons, etc.) and elevation of the region. Finally, the vegetation influences due to the humidity, the continuity (no gap that allows the natural firebreak), volume (density) and size (size of plant species). In Brazil, the incidence of forest fires is increasing due to changes in rainfall regimes that start late, as well as other factors such as deforestation and criminal fires, thus aggravating their intensity and quantities. Natural forest fire occurrences have shaped the current landscape through occurrences at appropriate times. Through the fire, there is the renewal of the vegetation with the adaptation of the biomes, as shown in Figure 2a. However, by breaking the natural cycle of rain and drought periods, fires gain intensity on warmer and lower air humidity days. Even species that adapted to fire do not withstand high temperatures as a consequence of the crossing of multiple factors, favorable to the occurrence of fire, Figure 2b. When natural, forest fires are concentrated in dry seasons - winter in the southern hemisphere and summer in the northern hemisphere - and are closely linked to low relative humidity (<30%) and high ambient temperature (> 30 ° C).

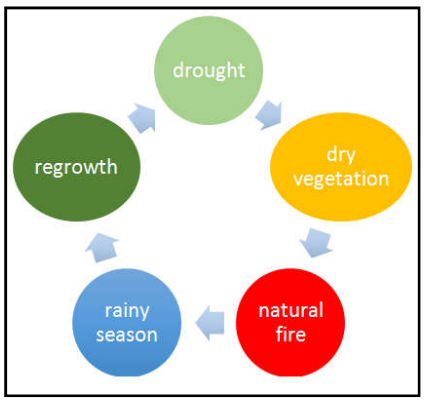
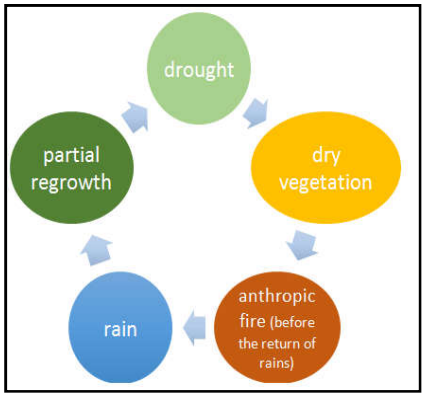


Figure 2a. Natural cycle of the Brazilian environment



Figuea 2b. Altered cycle of the Brazilian environment

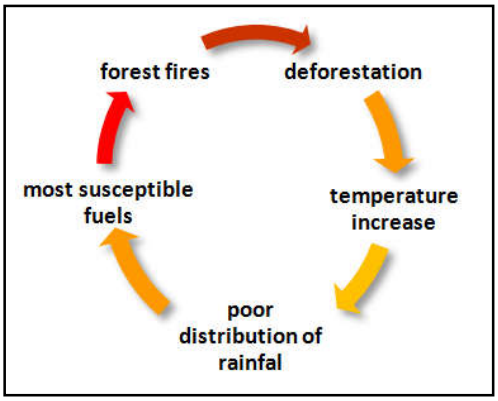


Figure 3. Cycle of fires due to deforestation

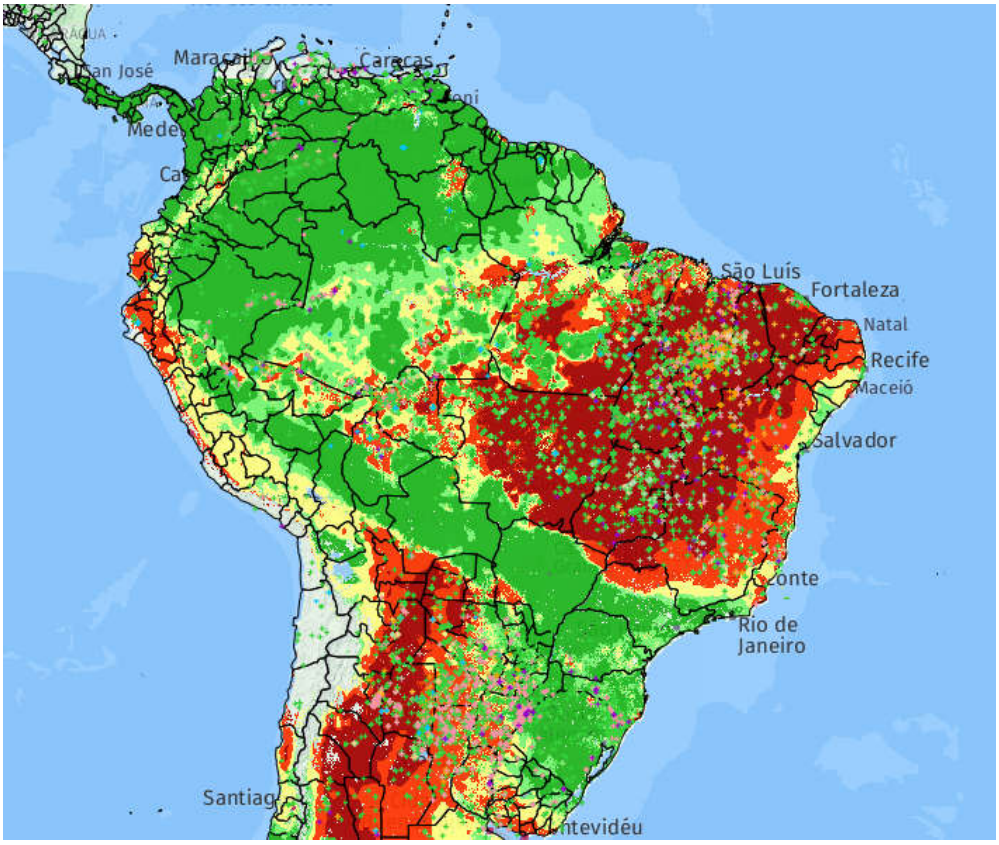


Figure 4. Riskoffire in Brazil

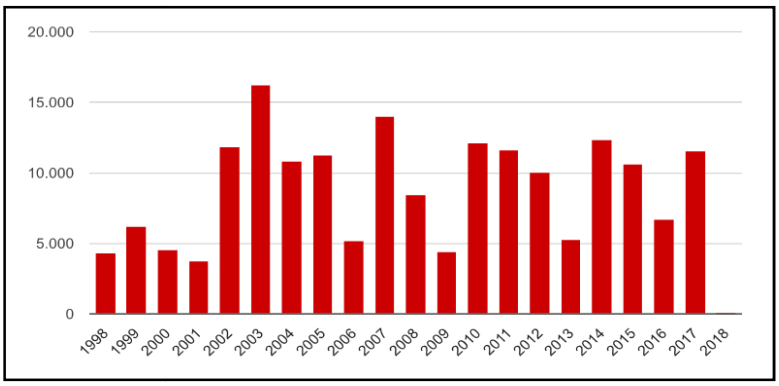


Figure 5. Time series of total fires detected by a satellite, in the period between 1998 and 2018 in the state of Minas Gerais (INPE, 2017).

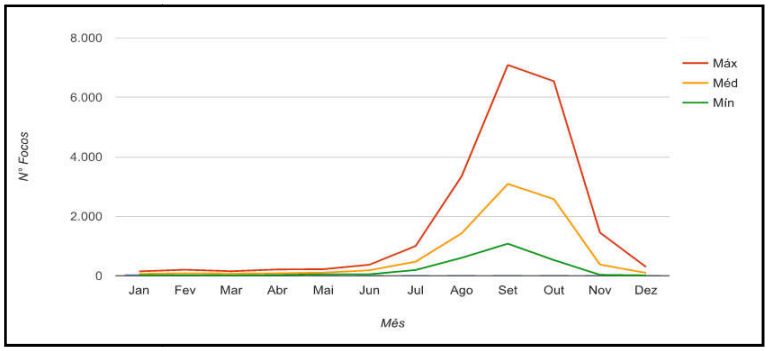


Figure 6. Comparison of the data of 2017 with the maximum, average and minimum values, in Minas Gerais (INPE, 2017)

Figure 3 shows the cycle caused by the inadequate management of natural resources in Brazil, instigated by uncontrolled deforestation and climate change, weakening the ecosystem and causing an increase in the quantity and intensity of fires, further impacting environmental losses.

Figure 4 presents the map, generated on August18th, 2017, with the data related to the fire risks due to the relative humidity of the air, with the green color showing the minimum risk of fire and the red color in places with the highest risk of incidence of this type of sinister. Minas Gerais State, where Caraça is located, is highlighted. It can be verified, therefore,

that this state is in an area of high risks of forest fires (INPE, 2017).

Fire in the caraça sanctuary

On September 24th, 2017, a major fire began in the vicinity of the RPPN of the Caraça Sanctuary, next to the municipality of Catas Altas. With the strong wind, the fire spread, headingPico do Sol, on the border with the Caraça Sanctuary, extinguished only in the late afternoon of Monday, September 25th, after intense work, supported by CBMMG strong apparatus, by the volunteers of the Forest Fire Prevention and Control Program of the State of Minas Gerais (Previncêndio), by firefighters of companies in the region, public servants and residents, totaling more than 30 people, besides the logistic support of the municipality of Catas Altas through the distribution of food and water. However, this is not the first occurrence of this type of accident in RPPN. In 2011, it took 14 days to control a fire considered the largest fire in the region. Estimated at 200 hectares of affected area, this event mobilized 36 firefighters and 44 volunteer firefighters, and had the support of a helicopter from CBMMG and two airplanes from Previncêndio. The fire reached Pico do Sol, next to Conceiçãodo Rio Acima, and Pico da Conceição (Soares, 2011). Figure 5 shows the time series of total fires detected by a satellite, in the period between 1998 and 2018 in the state of Minas Gerais. By observing the graph, it can be seen that the years of 2011 (111,652 fire outbreaks) and 2017 (11,564 fire outbreaks), upon the occurrence of fires mentioned before, do not match the year of highest number of outbreaks, 2003 with 16,331 events. However, when analyzing the average number of fire outbreaks between 1998 and 2018, which is 9,017; the number of this type of event, in 2011 and 2017, exceeds between 28% and 29% of this value (INPE, 2017). In Figure 6, it can be observed that the period of the highest number of outbreaks (with its peak in September), corresponds to the dry season rains in the state of Minas Gerais. It can be verified, therefore, that the fires in Caraça occurred during the period of greatest number of fires in the state, as expected (INPE, 2017). However, according to data provided by the National Institute of Space Research INPE (2017), in the municipalities of Catas Altas and Santa Bárbara, only on September 11th, 2017, fire risk increased more than 770 times in Catas Altas; the same occurred in Santa Bárbara, only two days later. In 2011, however, there were no significant increases in fire risk in these municipalities (INPE, 2017).

Conclusion

In Brazil, there is an extreme lack of research in the field of fire in natural and cultural heritage and, consequently, there is a lack of development for teaching, preventing the formation of skilled labor to work in this specific area. The figures presented demonstrate the large number of forest fires in the State of Minas Gerais, in addition to the potential occurrence of this type of disaster throughout the country. Although the number of fire outbreaks increased greatly during the dry season in the state studied, as shown in Figure 6, this occurs in every year period in the analyzed period, which reinforces the assertion that other factors are added to the environmental characteristics in order to increase the risk of starting a forest fire because, despite of the significant increase in the number of outbreaks in 2011 and 2017 in relation to the historical average, it was not in the years that more outbreaks took place. Therefore, it is urgent to study forest fires, as issues of utmost importance to increasing fire safety, such as minimum intervention to prevent the decharacterization of the property, the possibility of reversibility to enable that a particular intervention can be further removed, the provision of appropriate preventive procedures, risk levels and increase of outbreaks monitoring, and awareness of the local population and visitors about fire safety, may prevent or minimize damages caused by this type of accident. Moreover, it is verified that the occurrence of fires in the RPPN of the Caraça Sanctuary has an even greater weight, by the sum of the threat to the cultural heritage, characterized by the existing buildings and their history, with the threat to the natural heritage, signaled by the forest reserve constituted by three Brazilian biomes (the Atlantic Forest, the Cerrado and the Campos de Altitude), not counting the risk of loss of human life, local fauna and flora.

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