FIRE HAS SHORT-TERM NEGATIVE EFFECTS ON A SUPER-DOMINANT NATIVE FERN, *PTERIDIUM ARACHNOIDEUM* (DENNSTAEDTIACEAE), IN A BRAZILIAN SAVANNA

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Although fire occurrence plays a central role in the dominance of the super-dominant bracken fern *Pteridium arachnoideum* in Neotropical forests, it is unclear whether this applies to the Brazilian savanna (Cerrado), which vegetation is naturally adapted to fire. We assessed fire effects on the aboveground biomass of *P. arachnoideum* in the Cerrado Ecological Reserve in Central Brazil. We measured frond height, density, standing biomass, and litter biomass before and for two years following a prescribed fire, and also sampled a control site to control for other mortality events and for seasonal variation. The average *P. arachnoideum* frond height and aboveground biomass decreased over three times in the burnt site 18 months after the fire. The frond density decreased both in the burnt and control site, indicating that this may have been caused in another way than by fire. Conversely, litter biomass decreased shortly after the fire in the burnt site, but returned to pre-fire levels in one year. Possible explanations for the lasting negative effects of fire on the height and biomass of *P. arachnoideum* include the implementation of the prescribed fire early in the dry season, which likely limited immediate clonal regrowth, and the herbivory by leaf-cutting ants. Nevertheless, the effective clonal growth of *P. arachnoideum* apparently precluded the fire from having stronger effects and hence this species was not excluded from the site. We conclude that direct and indirect fire effects may cause the decline of *P. arachnoideum* in Cerrado, so that prescribed fires may be applied as a management strategy in Cerrado sites where this species is super-dominant, ideally in combination with other control measures.

Key words: Cerrado, clonal growth, disturbance, Neotropical bracken, prescribed fire

Introduction

A disturbance regime often plays a key role in the structure and composition of plant communities (Bond & Keeley, 2005; Simon et al., 2009; Ding et al., 2012) and has been highly modified by human interference in many ecosystems. For example, increased fire frequency and species introduction in certain ecosystems have excluded native species and favoured species that are resistant or tolerant to fire (D'Antonio & Vitousek, 1992; Brooks et al., 2004). In addition, there have also been reported cases of very high dominance by clonal native species in the Neotropical region, especially bamboos (Campanello et al., 2007; Smith & Nelson, 2011) and *Pteridium* spp. bracken ferns (Hartig & Beck, 2003; Pivello et al., 2018), as a result of deforestation and frequent fires, hampering succession and negatively impacting local biodiversity. These native clonal species are generally referred to as super-dominant species, which are defined as species, the rapid proliferation of which and the negative impacts that they cause within their native range are similar to those caused by invasive alien species (Pivello et al., 2018).

Species of the genus *Pteridium*, such as the Northern *Pteridium aquilinum* (L.) Kuhn and the Neotropical *Pteridium arachnoideum* (Kaulf.) Maxon, occur natively on all continents except for Antarctica (Marrs & Watt, 2006). They are often dominant in degraded temperate (Marrs & Watt, 2006; Stevens et al., 2016), Mediterranean (Amouzgar et al., 2020) and tropical (Alonso-Amelot & Rodulfo-Baechler, 1996; Hartig & Beck, 2003; Silva Matos & Belinato, 2010; Silva Matos et al., 2014) ecosystems, often forming dense stands with a continuous canopy and a deep litter layer (den Ouden, 2000; Ghorbani et al., 2006; Silva Matos et al., 2014). Indeed, *P. arachnoideum* has been classified as a super-dominant native species in Brazil (Pivello et al., 2018).

The relation between fire and *P. arachnoideum* has been explored in tropical forests, such as the Atlantic forest of Brazil, a biodiversity hotspot where *P. arachnoideum* is often dominant on disturbed sites, particularly those created by wildfires (Silva Matos et al., 2002; Gallegos et al., 2015; Menezes et al., 2019). It can also dominate the soil seed bank on these sites (Silva & Silva-Matos, 2006). As tropical rainforests are not naturally adapted to fire, *P. arachnoideum* may exacerbate fire effects in these environments (Silva & Silva Matos, 2006) or, alternatively, facilitate regeneration by improving the microclimate of disturbed sites (Gallegos et al., 2015).

However, this may not apply to the Brazilian Cerrado, a fire-prone vegetation, where natural fires are frequent (Ramos-Neto & Pivello, 2000) and where native plant species are generally able either to withstand fire events or resprout after them (Hoffmann, 1998; Hoffmann & Solbrig, 2003; Silva et al., 2009; Dodonov et al., 2014). *Pteridium arachnoideum* has been considered as one of the most important invasive plants in the Brazilian Cerrado (Pivello et al., 1999), where it may lead to a low density and diversity of native woody plants (Miatto et al., 2011) and a high abundance of alien grasses in the soil seed bank (Xavier et al., 2016), with possibly negative consequences for Cerrado regeneration. Although many Cerrado sites have been subjected to frequent anthropogenic fires, these ecosystems are naturally prone to fires (e.g. Ramos-Neto & Pivello, 2000), so that prescribed fires have been considered important tools to maintain their biodiversity and functioning (Durigan & Ratter, 2016). Thus, assessing the relationship between fires and dominance of *P. arachnoideum* in this environment is highly relevant.

Population dynamics studies have shown that Cerrado woody plants may withstand fire return intervals as small as three years (Hoffmann, 1999). Even so, fires may favour the dominance by invasive African grasses in the Cerrado, as these species may modify the fire dynamics by changing the type and quantity of fuel available (Hoffmann et al., 2012; Gorgone-Barbosa et al., 2015) and also by resprouting or germinating quickly after fire (Williams & Baruch, 2000; D'Antonio et al., 2001). Similar relations have been observed between *P. arachnoideum* and fire in the Atlantic Forest, where this species leads to a fire cycle by causing high dry biomass accumulation, quickly resprouting after fire and then becoming dominant (Silva Matos et al., 2002). Thus, considering that *P. arachnoideum* has been shown to dominate other Neotropical savannas after repeated fires (Alonso-Amelot & Rodulfo-Baechler, 1996) and that a previous study showed decreasing impacts of *P. arachnoideum* in Cerrado sites in the absence of large disturbances (Guerin & Durigan, 2015), it is possible that a fire feedback loop also will be observed in the Cerrado. Such feedback would depend on whether *P. arachnoideum* recovers rapidly after fire events. This has not yet been assessed in the Cerrado but could lead to altered fire dynamics and additional impacts. Alternatively, if *P. arachnoideum* is sensitive to fire in this environment, this would indicate that prescribed fires could putatively be used to control this species.

We performed a two-year study of the fire effects on *P. arachnoideum* in a Brazilian Cerrado Protected Area in Central Brazil. We sampled a typical cerrado (*sensu* Ribeiro & Walter, 1998) site with partial *P. arachnoideum* cover, which we burnt for the experiment in order to assess whether its recovery is similar to what has been observed in other vegetation types, and a control (unburnt) site. With this, we aimed to answer whether *P. arachnoideum* abundance and productivity increase or decrease after a fire event in the Cerrado. A rapid re-growth of the species would indicate a positive fire feedback loop (as observed elsewhere), whereas a decrease followed by a slow recovery could indicate difficulties for re-establishment of *P. arachnoideum* after fire, for example, due to the seasonally dry climate typical of the Cerrado in Central Brazil (Furley & Ratter, 1988). This information may indicate whether prescribed and/or natural fires could aid in controlling this species in the Cerrado.

Material and Methods

Study site

The study was performed in the Ecological Reserve of the Instituto Brasileiro de Geografia e Estatística, a 13.9-km^2 Protected Area located in Brasilia, Central Brazil (15.93° S, 47.87° W). The altitude ranges from 1048 m a.s.l. to 1100 m a.s.l. The climate is tropically wet and dry, with a dry season from May to September and a wet season from October to April (Pereira et al., 2004). The annual average temperature is 22°C and the average annual precipitation 1450 mm (Pereira et al., 2004); see Fig. 1 for variation during the study period. The predominant soil is a yellow-red oxisol and vegetation comprises several Cerrado phytophysiognomies, the occurrence of which depends on soil characteristics such as depth, fertility, and drainage capacity (Pivello & Coutinho, 1996).

Sampling design

We performed a controlled fire experiment on a site that had been protected from fire for 11 years and that had patches with high abundance of *P. arachnoideum* in a typical Cerrado, a savanna vegetation showing a discontinuous tree layer and a continuous layer of shrubs and grasses (Ribeiro & Walter, 1998). Although we could not sample a control site dominated by *P. arachnoideum* with abiotic conditions and fire history similar to this Cerrado site, we used as a control the closest site dominated by *P. arachnoideum*, located in a wetter site adjacent to a riparian forest. Notwithstanding this difference, we believe that this site can be used to control for the possibility of large-scale mortality events during the study period and for the natural seasonal (phenological) variation in the cover of *P. arachnoideum*.

Both in the burnt and unburnt sites, we randomly established six 25 m^2 (5 × 5 m) plots divided into 25 subplots (1 × 1 m), corresponding to a 150 m^2 total sampling area, or 150 subplots available for sampling. In March 2008, two months before the prescribed fire, we randomly selected 20 subplots at each site, distributed among the six plots. In each subplot, we counted and measured the length of *P. arachnoideum* ramets (hereinafter – fronds) and collected *P. arachnoideum* aboveground biomass (including live fronds and standing dead fronds) and the plant litter. We did not separate *P. arachnoideum* litter from litter produced by other species because this proved to be challenging for multiple samples, as fine litter produced by *P. arachnoideum* was often indistinguishable from fine litter produced by other species. We dried all biomass and litter samples at 75°C for 48 h and weighted each sample using a digital scale.

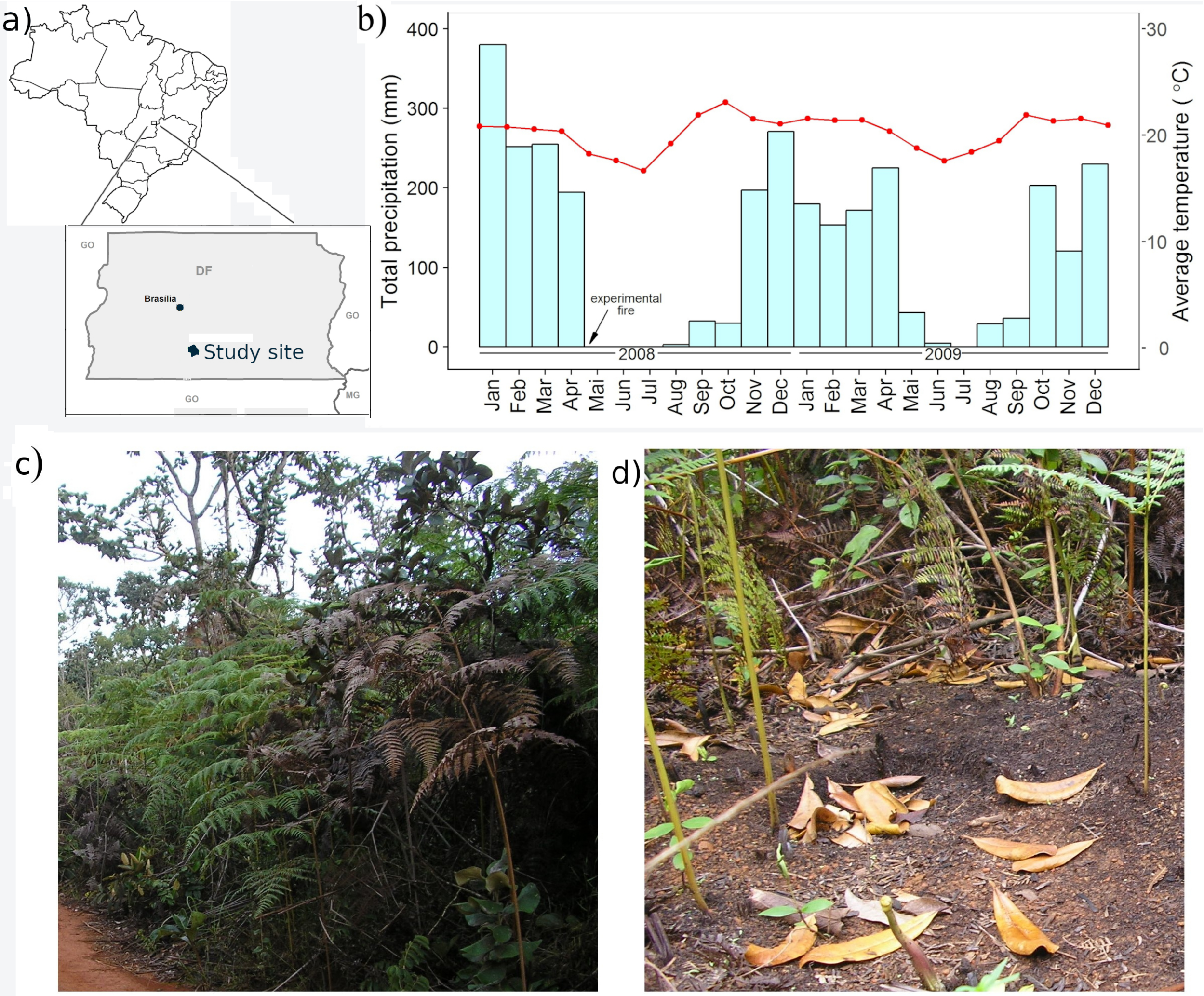

Fig. 1. Characterisation of the study site, located in a Brazilian savanna area in the Ecological Reserve of the Instituto Brasileiro de Geografia e Estatística, in Brasília, Central Brazil. Designations: a) Location of the study site in Brazil. b) Monthly variation in average temperature and total precipitation in the study site during the study period; bars indicate total precipitation, and the dotted line represents average temperature. Data were obtained from the Brazilian Meteorological Institute (INMET, 2018). c) Study site before the fire. d) Detail of an experimental plot six months after the fire.

Under controlled conditions, in May 2008, we set fire to the experimental site, with the support of the fire brigade of the Ecological Reserve of the Instituto Brasileiro de Geografia e Estatística. Fires in the Cerrado are expected to be much more intense during the dry season peak (Miranda et al., 1993). Therefore, local managers required that the prescribed fire would take place early in the dry season, i.e. when the vegetation moisture content is still relatively high and fire control tends to be easier (Govender et al., 2006). After the fire, we followed the same sampling procedure described above three more times (in November 2008, May 2009, and November 2009), sampling frond density and length, aboveground biomass of *P. arachnoideum* and litter in both sites to assess the fire effects. For each sampling period, we randomly selected a new set of 20 subplots to avoid sampling the same subplot more than once during the study. No fires occurred in the control site during the study.

Data analysis

We assessed the temporal variation in four response variables: mean frond length (m), number of fronds (fronds/m^2), standing biomass (g/m^2) and total litter biomass (g/m^2). We used permutation analysis of variance (ANOVA) followed by permutation t-tests to assess the significance of the results, with 4999 randomisations and including the original data as a possible randomisation result (Manly, 2007), separately for the burnt and the unburnt sites.

We first used permutation ANOVA to test whether the burnt and control sites were similar before the prescribed fire, separately for each response variable. If they were similar before the fire but different after, this would indicate fire effects. However, three of the four response variables were significantly different between the two sites in the first sampling period (see the section of Results), precluding this sort of interpretation.

We then tested whether there was, for each response variable, a statistically significant interaction between sampling period and site. The existence of an interaction would indicate possible fire effects. If the fire had no effects on the response variable, we would expect the difference between the two sites to remain the same throughout the study and, similarly, the differences between the sampling periods to be the same for both sites. Conversely, if the fire affected the response variables, we would expect greater differences between the sampling periods in the burnt than in the unburnt site and greater differences between the two sites after the fire than before, which would be indicated by a statistically significant interaction between sampling period and site. To test for the interaction, we first calculated the residuals of a reduced ANOVA containing the main effects but not the interaction (Manly, 2007). We then performed a full ANOVA, including the interaction, on these residuals and extracted the F-value. Finally, we randomised the residuals and, for each randomisation, repeated the ANOVA and extracted its F-value, and calculated significance by comparing the observed F values with the randomised ones (Manly, 2007).

When the interaction was significant, we compared between the sampling periods separately for the burnt and control sites. For each site, we first tested for differences between the sampling periods (March 2008, November 2008, May 2009, and November 2009) by randomising the sampling plots between the four sampling periods and using the F-values as test statistics (Manly, 2007). When the effect of sampling period was significant, we performed a series of permutation t-tests (Manly, 2007) to assess which sampling periods were different from one another, using the absolute difference in mean values between the two sites as test statistics. In the pairwise tests, we used a significance level of p = 0.01 to account for multiple testing. All analyses were performed in R 4.1.0 (R Development Core Team, 2021) with the aid of the «yarrr» package (Phillips, 2017) to create the figures. The data and code are available at https://github.com/pdodonov/publications (accessed on 27.04.2022).

Results

There were significant differences between the two sites before the fire for frond density (p = 0.0002), average frond height (p = 0.0002) and litter biomass (p = 0.0004). Only standing biomass did not differ between the sites (p = 0.31). There were statistically significant interactions between sampling period and site for all response variables (p = 0.048 for frond density, p = 0.0002 for average frond height and litter biomass, and p = 0.0004 for standing biomass).

Except for the number of fronds, the temporal variation was very different between the burnt and unburnt sites, indicating that changes in the burnt site were probably caused by the fire and not by other factors (Table). At the burnt site, there were highly significant differences between the sampling periods for density, height, standing biomass (p = 0.0002), and litter biomass (p = 0.006). We did not observe a trend towards recovery to pre-burn levels in either density, height or biomass of *P. arachnoideum,* as these variables decreased after the fire and remained low (Fig. 2). The average density observed before the fire was two to seven times higher than in the subsequent sampling periods, whereas the average height was 1.5 to 4.5 times higher and the average biomass was 2.8 to 3.7 times higher (Fig. 2). The litter biomass also decreased in the first sampling period after the fire but returned to the pre-burn values shortly thereafter (Fig. 2).

At the unburnt (control) site, there were differences between the sampling periods for frond density ($p = 0.0004$), average frond height ($p = 0.0016$), and litter biomass ($p = 0.0002$), but not for standing biomass ($p = 0.1118$) A two-fold decrease in average frond density was observed after the first sampling ($p < 0.005$ in the pairwise tests; Fig. 2). Conversely, frond height and litter biomass increased after the first sampling period ($p < 0.005$ in the pairwise tests) (Fig. 2). The original data are available in Table 1S, and summary statistics in Table 2S.

Discussion

In this study, we assessed the effect of an experimental fire on the standing biomass and on total litter biomass of *P. arachnoideum* in a Cerrado site in Central Brazil. We found that fire reduced the aboveground biomass production of *P. arachnoideum* but had only short-lasting effects on the total amount of litter, which is an unexpected result given the literature regarding the effects of fire on *Pteridium* in other environments (Silva Matos et al., 2002; Gallegos et al., 2015; Menezes et al., 2019). We discuss how these findings are related to local factors and to the typical environmental conditions in the Cerrado, as well as their implications for the management of *P. arachnoideum* in this ecosystem.

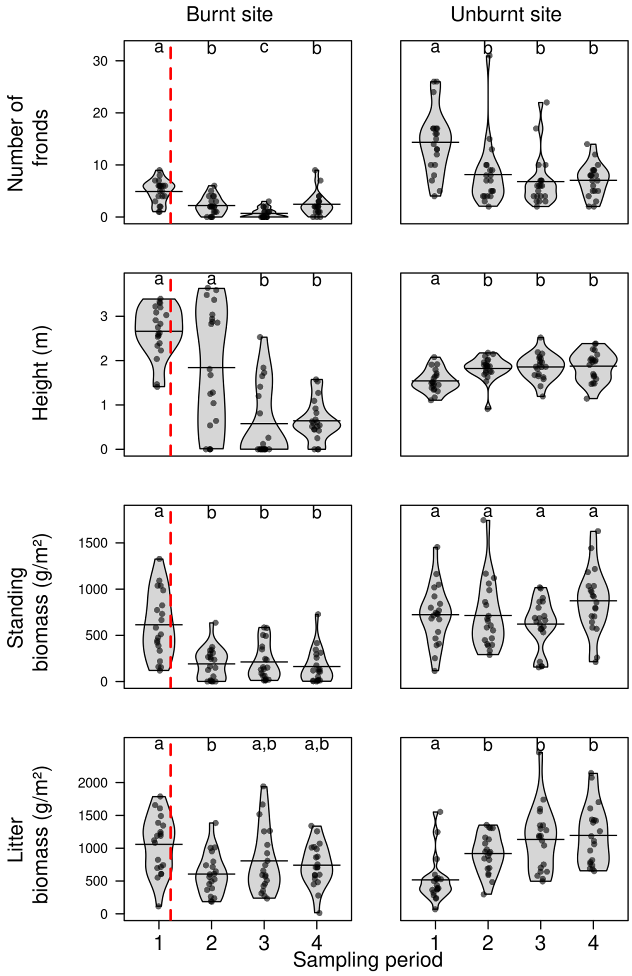

Fig. 2. Violin plots showing the variation in the number of fronds, height, standing biomass and litter biomass of *Pteridium arachnoideum* in two sites of a typical Cerrado (burnt and unburnt), obtained in four sampling periods. Designations: 1 – two months before the fire; 2 – six months after the fire; 3 – 12 months after the fire; 4 – 18 months after the fire. For each variable, different letters indicate significant differences between sampling periods ($p < 0.01$) based on permutation t-tests with 5000 randomisations each. In the plot, each point represents a sampling unit; the horizontal line represents the sample mean; the curves represent the empirical density functions. The red lines show the approximate time of the prescribed fire. The study was performed in two Brazilian savanna sites in the Ecological Reserve of the Instituto Brasileiro de Geografia e Estatística, in Brasília, central Brazil.

Table. Summary of the temporal variation in the number of fronds, frond height, standing biomass and litter biomass of *Pteridium arachnoideum* in two Brazilian savanna sites in the Ecological Reserve of the Instituto Brasileiro de Geografia e Estatística, in Brasília, Central Brazil. The two sites were first sampled in March 2008 and the burn site underwent a prescribed fire in May 2008, and both sites were sampled 6, 12, and 18 months after this fire

Parameter	Site type	Change after the first sampling period	Time for the change to be detectable	Time to return to the initial level
Number of fronds	Burnt site	Decrease	6 months	6 months
	Unburnt site	Decrease	6 months	6 months
Frond height	Burnt site	Decrease	12 months	Did not return
	Unburnt site	Increase	6 months	Did not return
Standing biomass	Burnt site	Decrease	6 months	Did not return
	Unburnt site	No change	–	–
Litter biomass	Burnt site	Decrease	6 months	12 months
	Unburnt site	Increase	6 months	Did not return

One year after the fire, the frond height and standing biomass of *P. arachnoideum* on the burnt site were approximately four times lower than before the fire. As similar patterns were not observed in the unburnt (control) site, it is likely that the observed decrease is indeed related to the burning, and not to other factors. These findings are unexpected considering the positive feedback of fire occurrence on the dominance by *P. arachnoideum* in the Atlantic Forest and other Neotropical ecosystems (Hartig & Beck, 2003; Silva & Silva Matos, 2006).

It is also possible that the initial post-burn environment with full exposition to sunlight and high evapotranspiration was unsuitable for the growth and survival of emerging *P. arachnoideum* fronds. This is a likely explanation because the site was burnt at the beginning of the dry season and followed by three months with no precipitation (INMET, 2018; Fig. 1), as commonly found in Cerrado sites in Central Brazil (Oliveira & Marquis, 2002). Although ferns in the *Pteridium* genus exhibit true xylem vessel and hence have a high tolerance to water deficit compared to most species of ferns (Pittermann et al., 2011), they still have limited hydraulic mechanisms to withstand severe drought compared to angiosperms (Baer et al., 2020). Indeed, the performance of *Pteridium* species is typically limited by soil desiccation (Alonso-Amelot & Rodulfo-Baechler, 1996; Marrs & Watt, 2006), highlighting that water deficit possibly played a central role for the slow after-fire re-growth of *P. arachnoideum* in our study.

The fire had weaker effects on the density of *P. arachnoideum* fronds than on its biomass and height, as the density remained approximately 50% lower than pre-burn levels two years after the fire. In addition, a decrease in *P. arachnoideum* density was also observed on the unburnt site, indicating that this may be related to other mortality factors or to seasonal or phenological variation. Even if the fire does decrease the frond density, *P. arachnoideum* has an extensive rhizome system with many pre-developed buds and stored resources, which typically is not affected by the fire and supports the emergence and initial growth of new ramets (Marrs & Watt, 2006). Such re-growth may be accelerated by extensive physiological integration between the fronds (Pennings & Callaway, 2000; Herben, 2004) if some photosynthesising fronds survived the fire. Therefore, notwithstanding the decrease in biomass and height, we did not observe a complete post-burn *P. arachnoideum* mortality on the burnt site. This is similar to what is observed for Cerrado woody species that resprout after fire (Hoffmann & Solbrig, 2003; Dodonov et al., 2014). Therefore, the clonal growth of *P. arachnoideum* could allow its persistence at the site and further expansion under suitable conditions in the future (Marrs & Watt, 2006), highlighting that attempting to eradicate the species in a given site may not be a cost-effective management strategy.

Although there was an apparent decrease in overall litter biomass after the fire, one year was sufficient for it to return to pre-burn levels. This finding is unexpected considering that dry *Pteridium* litter is highly flammable (Marrs & Watt, 2006; Adie et al., 2011), and, so, we expected it to be largely consumed by fire and to recover more slowly, especially considering that *P. arachnoideum* biomass remained low two years after the fire. The fire was set very early in the dry season, when plant and litter moisture generally is still moderately high and hence the overall fire intensity tends to be lower (Miranda et al., 1993). In effect, there was considerable precipitation late in April and some precipitation just two days before the burning (08 May) (Fig. 1), so that the relatively high moisture likely affected fire behaviour and hence led to relatively low litter combustion. In fact, we observed a persistent litter layer after fire. In addition, litter production in the Cerrado has a seasonal pattern (Valenti et al., 2008) and varies greatly in space, even at short distances (Dodonov et al., 2017), complicating the detection of general patterns.

Although the climatic seasonality and low soil fertility typical of the Cerrado may have played a role in this post-fire decline, *P. arachnoideum* is also observed as a super-dominant species in other seasonally dry Neotropical ecosystems subjected to fire (Hartig & Beck, 2003; Roos et al., 2010). Therefore, indirect fire effects may have also played a role in the sustained decrease of *P. arachnoideum* aboveground biomass in the burnt site. For example, we observed leaf-cutting ants (*Atta* spp.) foraging on newly emerged *P. arachnoideum* fronds in the two final surveys, when the frond height was the lowest. Herbivory by these insects is common in disturbed environments (Wirth et al., 2007) and also affects other

Cerrado species (Costa et al., 2008). However, leaf-cutting ants often show preference for more palatable plants (Farji-Brener, 2001), and a previous study reported that leaf-cutting ants could have led to a high mortality of newly emergent fronds and hence contribute to the retraction of *P. arachnoideum* dominated patches (Xavier et al., 2019). The effect of leaf-cutting ants on the biomass after fire may be an additive effect worth of further research, as it could enhance our comprehension about the dominance of *P. arachnoideum* in tropical grassland landscapes.

Notwithstanding the increasing evidence for the importance of periodic fires to avoid woody encroachment and hence maintain the typically high plant diversity of the Cerrado (Durigan & Ratter, 2006, 2016), fires may also provide opportunity for the spread of invasive or overdominant species in already degraded Cerrado sites (Pivello et al., 1999, 2018). Thus, even though we showed that a single fire had negative effects on the standing biomass of *P. arachnoideum*, extrapolating these results to the effects of periodic fires, and even of single fire events, should be done with care. For example, the outcome of a high-intensity fire in a Cerrado site already fully dominated by *P. arachnoideum* could have been different from that obtained in our study, in which we assessed the response to a single controlled fire event at a site where this species had a high biomass but was only partially dominant. In addition, whereas the recovery of *P. arachnoideum* may be slow and hence the currently low biomass and height in the burnt site appeared to be relatively stable, it is also possible that, after a period of reserve accumulation, *P. arachnoideum* will show a period of fast growth, quickly regaining the lost biomass (Pakeman & Marrs, 1993; Marrs et al., 1998; Le Duc et al., 2000). Future medium or long-term studies may clarify the interactions between pre-burn *P. arachnoideum* dominance and local biotic (e.g. herbivory pressure) and abiotic (e.g. water regime) factors affecting its response to fire in the Cerrado and other Neotropical savannas. Although we highlight that fire management on Cerrado sites should be site-specific, our results do point out that fires may be one management strategy considered on sites dominated by *P. arachnoideum*.

Conclusions

Our study shows that a fire, possibly interacting with herbivory and water deficit, can have short-term negative effects on the standing biomass and height of *P. arachnoideum* fronds. The effective clonal growth of *P. arachnoideum* likely contributed to the lack of a stronger effect of fire on frond density, whereas the overall litter biomass was similar to pre-burn levels after a single year, possibly as a result of the low fire intensity. Although local factors such as invasion level, herbivory pressure and water regime may also affect responses to fire and should be further investigated and considered prior to management actions, our study demonstrates that fire may limit the performance of *P. arachonoideum* in the Cerrado.

We have showed that a prescribed fire reduced the biomass of *P. arachnoideum* at a Brazilian savanna site. However, given the weak effects on frond density and litter and the limited time span of this study, we recommend performing additional studies to better explore the potential of prescribed burning for the control of this species in the Cerrado and in other fire-prone environments. We suggest that these studies accompany the growth of *P. arachnoideum* for a longer period after the fire to assess how long it takes to recover to pre-burn levels. Studies on the response of this species to different fire regimes (for example, fires every year, every two years, every five years, and so on) would permit to assess its viability and invasion potential under natural and anthropic fire regimes common in the Cerrado. Finally, an assessment of the effects of fire alongside other forms of control, such as manual removal of emerging fronds, may permit the development of more efficient strategies for the control of this super-dominant species in environments such as the one studied here. Nevertheless, our study shows that prescribed fires, which may be used to avoid woody encroachment in Neotropical savannas, not necessarily increase the dominance of *P. arachnoideum* and may even be a viable control strategy.

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Supporting Information

Original data and summary statistics for the number of fronds, mean frond length, standing biomass, and litter biomass of *Pteridium arachnoideum* before and after a prescribed fire, for a burnt and a control site, in Central Brazil (Electronic Supplement. Summary statistics and original data for a burnt and a control site with *Pteridium arachnoideum* before and after a prescribed fire in the study area (Central Brazil)) may be found in the **Supporting Information**.

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ЛЕСНЫЕ ПОЖАРЫ ИМЕЮТ КРАТКОВРЕМЕННЫЕ ОТРИЦАТЕЛЬНЫЕ ЭФФЕКТЫ НА СУПЕРДОМИНИРУЮЩИЙ ПАПОРОТНИК *PTERIDIUM ARACHNOIDEUM* (DENNSTAEDTIACEAE) В БРАЗИЛЬСКОЙ САВАННЕ

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Лесные пожары играют главную роль в преобладающем распространении сверхдоминантного папоротника-орляка *Pteridium arachnoideum* в неотропических лесах. Однако не ясно, применимо ли это утверждение к бразильской саванне (Серрадо), чья растительность естественным образом приспособлена к огню. Мы оценили воздействие пожара на надземную биомассу *P. arachnoideum* в экологическом заповеднике с Серрадо в центральной части Бразилии. Мы измерили высоту вайи, плотность, биомассу почвы и лесной подстилки до и в течение двух лет после пожара, а также взяли пробы из контрольной зоны для контроля сезонных изменений и выявления других возможных причин гибели растений. Через 18 месяцев на местах пожара средняя высота листьев *P. arachnoideum* и надземная биомасса уменьшились более чем в три раза. Густота вайи уменьшилась как на участках пораженных огнем, так и на контрольном участке, что указывает на то, что это могло быть вызвано другими причинами, помимо пожара. Биомасса лесной подстилки уменьшилась вскоре после пожара на сгоревшем участке, но уже через год вернулась к допожарному уровню. Возможным объяснением столь тяжелых последствий пожара на рост *P. arachnoideum* является проведение пожара в начале засухи, а также активность муравьев-листорезов. Эти факторы, вероятно, ограничили немедленное восстановление растения. Тем не менее, эффективный клональный рост *P. arachnoideum*, по-видимому, не позволил огню полностью уничтожить растение на участке пожара. Мы пришли к выводу, что воздействие пожаров может привести к снижению численности *P. arachnoideum* в Серрадо. Таким образом, контролируемые пожары могут быть использованы в качестве инструмента управления численностью *P. arachnoideum* на участках Серрадо, где этот вид является супердоминирующим, в идеале в сочетании с другими мерами борьбы.

Ключевые слова: клональный рост, контролируемый пожар, нарушение, неотропический папоротник-орляк, Серрадо