

When the blanket is too short: potential negative impacts of expanding indigenous land over a national park in a high priority area for conservation

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Abstract

Land claims by indigenous peoples can cause changes in established protected areas. The consequences of such changes for biodiversity conservation will be context-dependent and influenced by characteristics of the indigenous population as well as the protected area affected. In the Cerrado-Caatinga ecotone of Brazil, there is an ongoing legal process to expand the Xacriabá Indigenous Land. The Xacriabás are claiming an additional 433 km², which overlaps with one third of Cavernas do Peruaçu National Park. I used local scale data and occupancy modelling to show that expanding this indigenous land at the expense of the already reduced area under strict protection in the Cerrado and Caatinga is likely to decrease the national park's conservation effectiveness. My analysis suggests that intensification of human presence in the overlapping area between the two land designations will result in loss of native vegetation, increase in the number of fires and might have a negative impact on populations of more sensitive species.

Keywords: protected areas; anthropogenic pressure; co-management; PADD; deforestation; fire.

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1. Introduction

Protected areas (PAs) are a cornerstone of conservation policy and have been established worldwide in order to mitigate the current environmental crisis (Watson et al., 2014). PAs can avoid conversion of natural vegetation (Carranza et al., 2014; Geldmann et al., 2013), support higher levels of biodiversity than unprotected lands (Coetsee et al., 2014; Gray et al., 2016), deliver crucial ecosystem services (Soares-Filho et al., 2010) and contribute to local economies in some regions (Balmford et al., 2009). However, a recent global increase in PA downgrading, downsizing and degazettement events (PADDD - see Mascia and Pailler, 2011 for definition) may pose a threat to the long-term conservation benefits these areas are expected to deliver. As demand to access and use natural resources are increasing worldwide (Rands et al., 2010), PADDD will become a crucial topic of land use and conservation policy in the near future.

In Brazil, PADDD events in the last 15 years were mainly driven by pressures from the agribusiness and energy sector (Bernard et al., 2014), but land claims by indigenous peoples can also result in PADDD. In the latter case the outcome is not necessarily negative from a conservation perspective, as areas managed by traditional populations may be effective in preventing deforestation (Carranza et al., 2014; Nepstad et al., 2006). Therefore, the consequences for biodiversity will be context-dependent and largely influenced by characteristics of the indigenous population claiming the land (population size, population density, intensity of natural resources use, type of land use implemented, etc), as well as features of the PA affected (category, implementation level, management effectiveness, etc).

Recent data show that 20% of all land claims by local communities in Brazilian federal strict PAs are made by indigenous groups, representing 27 cases in total – 18 of them in national parks (Madeira et al., 2015). A case in point is the proposed expansion of the Xacriabá Indigenous Land (XIL) over roughly one third of Cavernas do Peruaçu National Park (CPNP) (FUNAI, 2014), a strict PA (IUCN category II) located in the Cerrado-Caatinga ecotone of Brazil (Fig. 1A). The 568 km² CPNP was created in 1999 to protect the unique speleological system of the Peruaçu river valley, as well as the variety of species found in extensive areas of dry forests and savannas. CPNP is a high priority area for biodiversity conservation in Brazil (WWF-Brasil and MMA, 2015), supporting high diversity of endemic species restricted to caves (do Monte et al., 2015; Trajano et al., 2016), several threatened animal and plant species (Geoclock, 2005), and more than 70% of all large mammals found in the Cerrado (Ferreira and Oliveira, 2014). Alongside this impressive biodiversity, the park harbours numerous caves – at least 19

of them are in the area claimed by the Xacriabás – and archaeological sites of international relevance, which is leading to a proposal for recognition of the region as a UNESCO World Heritage site. Currently, the legally designated XIL encompasses 530 km² adjacent to CPNP and was established through two decrees, in 1987 and 2003 (ISA, 2018a), following years of struggle for their right to the land (de Almeida, 2006). Approximately 9,000 Xacriabás live in this area (ISA, 2018a) engaged mainly in small scale agriculture and cattle ranching (Clementino and Monte-Mór, 2006; ISA, 2018b; Paraiso, 1987), which are implemented using similar techniques adopted by the local non-indigenous society (Paraiso, 1987).

A study approved by FUNAI (Brazilian government agency for indigenous affairs) argues that the current area does not represent the entirety of the land donated to the Xacriabás in the 18th century and claims an additional 433 km² to be designated as indigenous land (FUNAI, 2014), of which around 180 km² overlaps with CPNP (Fig. 1A) – mostly in a zone designated to safeguard species and natural habitats of outstanding scientific value according to the national park's management plan (Geoclock, 2005). The remainder of the new claim is privately owned land, part of it designated as a multiple-use protected area (IUCN category V) where human occupation and use of natural resources are permitted. The additional Xacriabá claim has not yet undergone the full legal designation process (FUNAI, 2018) and ICMBio (Brazilian government agency for biodiversity and protected areas) has formally challenged the understanding that the area overlapping with CPNP should be considered part of the indigenous land (ICMBio, 2017a). Recognizing the relevance of such issue a working group has been recently formed by members of CPNP's advisory council to debate this topic (ICMBio, 2017b). This is an ongoing judicial process that may last for a few years with several possible outcomes, ranging from the maintenance of the national park as it is to the *de facto* downsizing of CPNP, with a challenging co-management agreement between ICMBio and the Xacriabás siting anywhere in the middle depending on the restrictions to human activities in the area.

To help inform this decision-making process from a conservation perspective, I conducted an assessment of potential environmental changes likely to happen at the overlapping area in case anthropogenic pressure increases (driven by direct use or occupation). While this is only one of multiple possible outcomes, such evaluation is needed due to the serious consequences for regional conservation of an eventual *de facto* downsizing of the national park. I must highlight this assessment focus solely on the biodiversity component of a complex issue and does not intend to contest the anthropologic validity of the

Xacriabá claim. Furthermore, it is restricted to the overlapping area between the new claim and CPNP, and does not apply to claimed areas outside the national park.

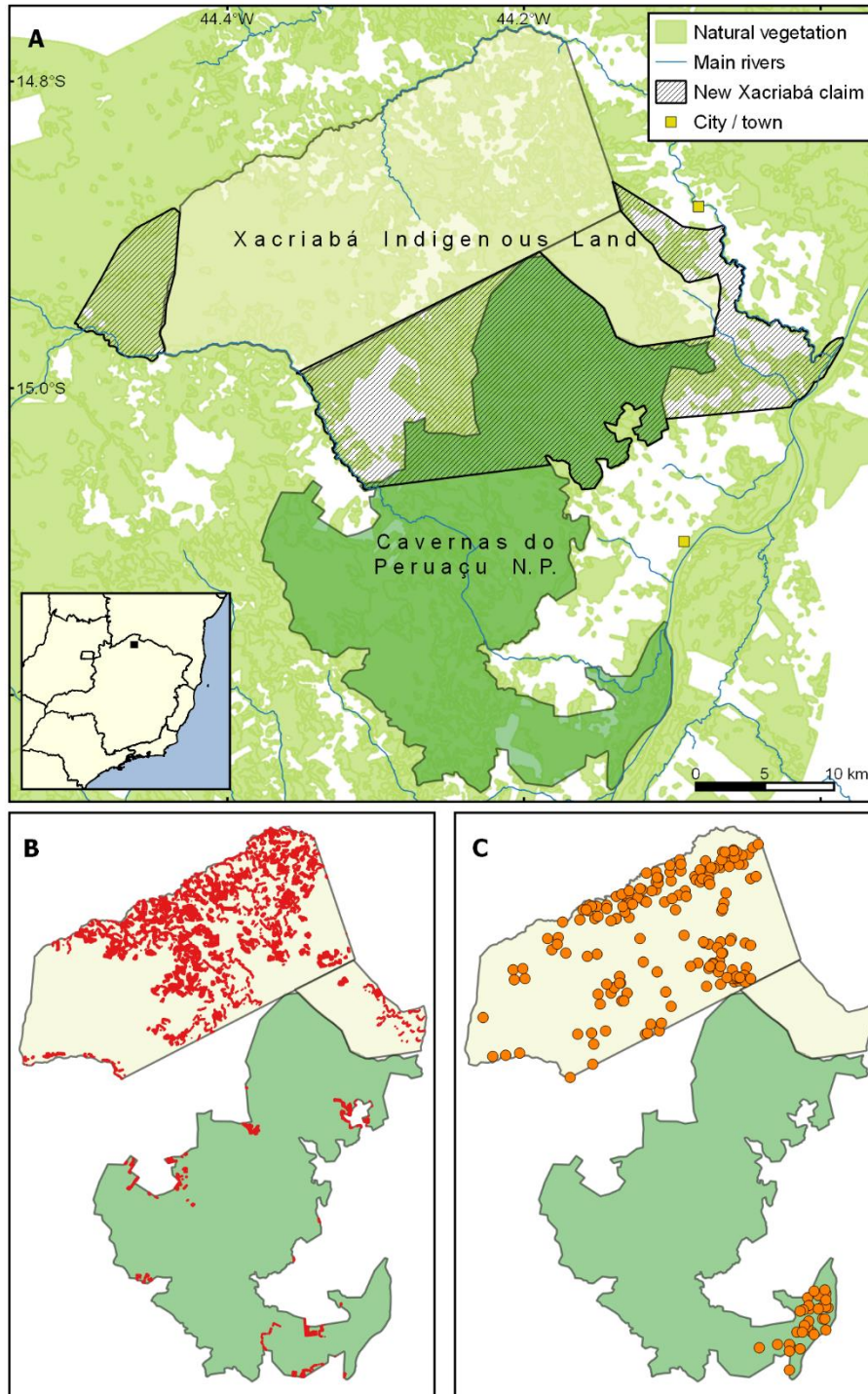


Figure 1: A) Location of Cavernas do Peruaçu National Park, Xacriabá Indigenous Land and the new Xacriabá claim; B) Deforestation between 2010-2012; C) Fire occurrence between 2010-2016.

2. Potential negative consequences for Cavernas do Peruaçu National Park

To assess potential changes in vegetation cover at the overlapping area I compared data on deforestation and fire occurrence at CPNP and XIL. I used data on the conversion of natural vegetation between 2010 and 2012 (WWF-Brasil, 2014) and on the occurrence of fires (heat anomalies detected by satellites) between 2010 and 2016 (MCTI/INPE, 2017). To avoid counting the same fire event more than once, I only used data from the reference satellite (AQUA M-T) used by governmental agencies to monitor fires over long temporal series. Although the reference satellite only detects a fraction of all fire events, due to methodological standardizations it provides the most adequate data to investigate spatial and temporal trends in fire occurrence (MCTI/INPE, 2017). Fire data was available for the whole of CPNP and for 86% of XIL (no data available for the Xacriabá-Rancharia area), whereas deforestation data was available for the whole region.

Conversion of natural vegetation and total number of fires are much higher at XIL than at CPNP (Fig. 1B, C). The amount of vegetation lost at XIL was 11 times greater than at CPNP during the period investigated (approximately 5,450 ha vs 480 ha). Similarly, the reference satellite detected five times more fires in the indigenous area than in the national park (171 vs 32) and the annual average of fire occurrence between 2010-2016 was significantly lower at CPNP (24.43 vs 4.57; t-test: $t = 3.22$, $df = 9.16$, $p = 0.01$). Besides the large differences in deforestation and fire occurrence, their spatial distribution also show how anthropogenic pressure is more pervasive at XIL than at CPNP (Fig. 1B, C). Although I did not control for confounding variables because the areas are adjacent, a significant part of the difference can be attributed to their distinct management regimes. Also due to their distinct objectives it was expected that the parameters investigated would have greater values at XIL, but this illustrates the potential changes that may occur if anthropogenic pressure increases in the overlapping area and highlights the need for strict PAs to maintain natural vegetation cover in the region.

This local scale result agrees with recent Cerrado-wide studies showing that although indigenous land usually avoid deforestation, strict PAs are even more effective (Carranza et al., 2014) and that deforestation is lower in strict than in multiple-use PAs, particularly in areas where land tenure issues have been solved (Françoso et al., 2015). Furthermore, subtle habitat degradation that does not result in complete conversion of natural vegetation can have significant impacts on biodiversity (Barlow et al., 2016). Chronic anthropogenic impacts in the Caatinga, such as firewood extraction, selective logging and extensive grazing – all activities likely to happen at the overlapping area of CPNP if direct use is allowed – have been linked to

the replacement of old-growth dry forests by shrub-dominated vegetation and to the phylogenetic impoverishment of the flora (Ribeiro et al., 2016, 2015).

To understand the potential effects of increased human pressure on local biodiversity, I used data from a standardized camera trap survey (TEAM Network, 2011) conducted between 22 June and 14 August 2014, in which 60 camera traps (model Bushnell TrophyCam) were deployed at a density of 1 unit per 2 km², covering approximately 120 km² of the central portion of CPNP. I used the single season occupancy framework (MacKenzie et al., 2006) to investigate the effect of environmental and anthropogenic variables on collared peccaries (*Pecari tajacu*), a species favoured by poachers and hunters throughout the Neotropics (Antunes et al., 2016; Cullen et al., 2000; Urquiza-Haas et al., 2009) and that can be negatively affected if anthropogenic impact is high (Chiarello, 1999; Urquiza-Haas et al., 2011). Occupancy modelling was conducted using the 'unmarked' package (Fiske and Chandler, 2011) for R (R Development Core Team, 2015) and following similar procedures as described in Ferreira et al. (2017). To obtain variables for this analysis, I used the software QGIS to extract Euclidian distances from each camera trap site to the nearest river, main road, CPNP's border and human settlement (regardless of ethnicity). Additionally, I used variables representing cattle frequency at the camera trap site (number of cattle records divided by survey effort) and describing the broad vegetation type of each site (savanna, dense savanna, dry forest). Location of settlements (mostly small rural households) was obtained from data on the Brazilian population in 2010 at 1 km² resolution (IBGE, 2017), whereas all other spatial layers were obtained from the economic and ecological zoning platform of Minas Gerais state (SEMAD, 2017).

At CPNP collared peccary occupancy (a measure of probability of using a location) approached zero close to human settlements and increased sharply at sites further away from houses and villages, indicating a negative effect of human presence (Fig. 2). In fact, distance from settlements was the most important factor influencing the species: this variable was present in three of the four top-ranked models explaining the species occupancy. This clear negative anthropogenic effect may be at least partly caused by hunting pressure, an activity that happens in CPNP (pers. obs.), and presumably within XIL. However, the mere presence of humans and the associated noises and smells, as well the presence of domestic dogs, may be enough to create an unfavourable buffer zone for collared peccaries around settlements, in practice reducing the amount of habitat available for the species. I acknowledge that not all species will respond similarly to anthropogenic pressure, but the effect on collared peccary is a plausible model of what may be happening to rare and threatened mammal species that occur

in the region, such as white-lipped peccary (*Tayassu pecari*), giant anteater (*Myrmecophaga tridactyla*), and bush dog (*Speothos venaticus*) (Ferreira et al., 2017; Ferreira and Oliveira, 2014), but for which there was not enough data for analysis.

These results indicate that expanding the indigenous land over CPNP has the potential to negatively impact vegetation cover and local biodiversity, influencing the national park's conservation effectiveness. A key assumption, however, is that similar land uses currently happening at XIL would also take place at the overlapping area. Despite the possibility of many levels of natural resource use on indigenous land, this assumption is not unrealistic considering the land use and activities usually developed by the Xacriabás (Clementino and Monte-Mór, 2006; Paraiso, 1987) and that XIL is among the indigenous land with the largest loss of native vegetation in the Cerrado (MMA, 2014) – although FUNAI and the Xacriabás have stated that there is no intention to occupy or use the overlapping area (ICMBio, 2017b). While this commitment is appealing, it is uncertain how feasible it is to be fulfilled given the dynamic nature of human communities and the extent to which the Xacriabás rely on agriculture and cattle ranching. A single disagreement between some of the indigenous leadership could result in a group demanding direct use of the overlapping area, ultimately compromising their conservation commitment.

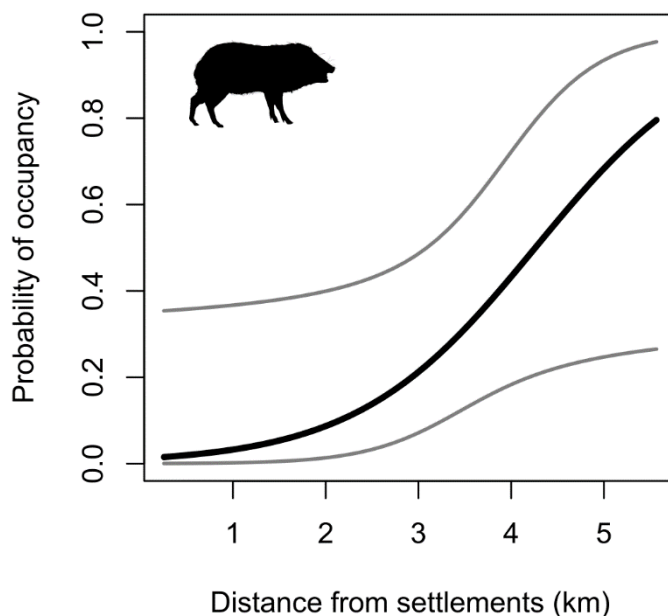


Figure 2: Effect of distance from human settlements on collared peccary occupancy at Cavernas do Peruaçu National Park.

In case that the disputed area is eventually designated as indigenous land (after the full legal process), a co-management agreement between ICMBio and Xacriabás seems to be the approach favoured by FUNAI and at least some of the indigenous leadership (ICMBio, 2017b). Although such an agreement is possible in theory (e.g. Cundill et al., 2013), it is likely to be extremely challenging in practice due to the distinct objectives of an indigenous land and a national park, as well as the contrasting levels of natural resource use and human occupation allowed in those areas – not to mention two different governmental agencies under different ministries. For instance, Zanatto (2016) reports that formal agreements to manage fisheries and regulate cattle ranching in an overlapping area between indigenous land and Araguaia National Park in central Brazil is not being followed by any of the stakeholders involved. A hint on how challenging an agreement at CPNP would be comes from the report characterising the Xacriabá claim (FUNAI, 2014): it mentions the potential for a joint administration of the area overlapping CPNP, as long as the uses and traditions of the Xacriabás are considered. However, most, if not all, direct uses would immediately clash with the national park regulations (Brasil, 2000), restricting the breadth of activities allowed in the area. In view of this, a co-management solution where the national park objectives are achieved and the Xacriabá uses and traditions are implemented seems to be an extremely optimistic win-win situation, which would not only be hard to achieve, but could also generate conflicts and be harmful to the current respectful relationship between ICMBio, FUNAI and the Xacriabás.

3. Final remarks and recommendations

The number of overlap cases between strict PAs and indigenous land in Brazil (Madeira et al., 2015) suggests that several managers and organizations have faced similar issues as the ones currently affecting CPNP. Useful lessons should be learnt from these situations, so that future decisions are based on past experiences and evidence. However, the existing literature on this topic focus largely on describing the anthropological and legal aspects of individual cases, with very few broadly applicable recommendations. Systematic assessments of environmental changes (particularly in vegetation, given the availability of satellite images) in consolidated or ongoing land claims over PAs would help to understand the trade-offs involved and, more importantly, could objectively inform in which context negative consequences for biodiversity are more likely to happen. Without adequate and objective information the debate will be based on big assumptions and wishful thinking, frequently becoming ideological and making it hard to reach a compromised solution. Furthermore, to achieve solutions and

avoid future overlap cases, communications between conservation and indigenous agencies must be improved so they can act synergistically, instead of competing for the same piece of land. Finally, in cases where the geographical overlap exists and there is also an overlap of objectives (for instance, ICMBio, FUNAI and Xacriabá leaders all agree that the overlap area at CPNP should be protected and not have direct use – ICMBio, 2017b), the solution most likely to achieve the common goal should be adopted. At CPNP it seems that the most effective solution to safeguard native vegetation and biodiversity is to maintain the national park's integrity without overlap with indigenous land.

Impacts caused by indigenous peoples are certainly not the main reason behind the dire status of many species and ecosystems in Brazil. However, in a context of widespread conversion of natural areas (such as in the Cerrado, Caatinga and Atlantic Forest) and of indigenous groups adopting productive techniques of the non-indigenous society, their impacts on the ecosystem become significant and a trade-off between the use of natural resources and biodiversity conservation will often exist in land claims over strict PAs. I am not here questioning the legitimacy of expanding and creating indigenous land, neither its overall relevance in avoiding deforestation and holding back the agricultural frontier (e.g. Carranza et al., 2014; Nepstad et al., 2006). Also, I am not arguing that lands managed by Xacriabás are devoid of conservation value; the currently designated XIL still holds a fair amount of native vegetation cover and have a role to play in the regional conservation context. However, expanding this indigenous land over CPNP is likely to negatively impact the national park. The data I presented here strongly suggest that an intensification of human activity or presence in the overlapping area between CPNP and the new Xacriabá claim will result in loss of native vegetation, increase in the number of fires and, will possibly have a negative effect on populations of more sensitive species, such as the collared peccary. In fact, similar impacts have been observed following the establishment of indigenous lands over other strict PAs in Brazil, such as fires negatively affecting the natural vegetation at Araguaia National Park (Zanatto, 2016), clearing of old growth forests at Monte Pascoal National Park (Timmers, 2004), and negative impact on large mammals and birds at Ilha do Cardoso State Park (Olmos et al., 2004).

Given the potential negative effects and the prospects of a challenging co-management between ICMBio and the Xacriabás, I argue against expanding the indigenous land at the expense of the already reduced area under strict protection in the Cerrado and Caatinga (3.1 and 2%, respectively - Brandão and Françoso, 2017; MMA, 2017). A mix of policies have recently been proposed to avoid the collapse of Cerrado's biodiversity

(Strassburg et al., 2017) and key among them is the extension of the PA network, which is also one of the main objectives of an inter-ministry action plan for preventing deforestation and fires in the Cerrado (MMA, 2014). Therefore, putting CPNP at risk is certainly not contributing towards these long-term goals and is unlikely to be a sound decision for the conservation of biodiversity in northern Minas Gerais, or elsewhere in the Cerrado and Caatinga.

Conflicts of interest

The author used to be member of CPNP's advisory council representing Instituto Biotrópicos, which still composes the council.

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