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COMMENTARY

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One step forward, two steps backward: The frailty of howler monkey conservation in Los Tuxtlas, Mexico

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Abstract

Most primate taxa are threatened by extinction and their populations are decreasing. The persistence of primates is thus conditional on conservation actions aimed at protecting them and their habitat. Here, we focus on the conservation of mantled howler monkeys (*Alouatta palliata*) in the Los Tuxtlas Biosphere Reserve, Mexico. Following the creation of the reserve in 1998, habitat availability and howler monkey abundance increased, suggesting that progress was being made in terms of the conservation of this species. Recent events, however, suggest otherwise, as mantled howler monkey habitat within the biosphere reserve is being disturbed by mining operations endorsed by the Mexican government. We report this case to raise awareness about the challenges for primate and habitat conservation in protected areas.

KEYWORDS
habitat disturbance, howler monkeys, Los Tuxtlas, mining, reserves

1 | INTRODUCTION

With more than 60% of taxa threatened by extinction and an even larger proportion showing declining population trends (IUCN, 2022), primates face an uncertain future. Thus, the persistence of threatened primates depends on conservationist actions aimed at protecting them and their habitats (Ruiz-Miranda et al., 2019; Strier, 2021). One of the main approaches for biodiversity conservation, including primates, is the establishment of protected areas (Gray et al., 2016; Terborgh et al., 2002). However, protected areas are under growing human pressure (Jones et al., 2018), and nearly 30% of protected areas are not effective in reducing forest loss (Yang et al., 2021). Thus, without proper governance and law enforcement (Wich & Marshall, 2016) it is unlikely that protected areas will safekeep primates in the long-term.

When we first visited Los Tuxtlas (state of Veracruz, Mexico) in the 1990s as students, the region was a textbook example of the negative impact of government programs aimed at promoting economic development at the cost of natural resources (Dirzo & Miranda, 1990; Durand & Lazos, 2004). This was also the place where some of the first evidence of the effects of anthropogenic disturbance on nonhuman primates emerged in the continent (Estrada, 1982). When the area was declared a biosphere reserve by the Mexican government in November of 1998, prospects of a better future for biodiversity, including nonhuman primates, grew. In the following years, numerous conservation initiatives were boosted by federal and international funding, further suggesting that this natural preserve could become a model for socioecological sustainability (Von Thaden et al., 2018). Twenty-four years after the 1998 milestone, it is with dismay that we see mantled howler monkey habitat within the biosphere reserve being disturbed by mining operations endorsed by the Mexican government. We report this case to raise awareness about the challenges for primate and habitat conservation in protected areas.

1.1 | A glimpse at Los Tuxtlas

Los Tuxtlas is a mountainous range between the Gulf of Mexico and the lowlands of the Petén-Veracruz Moist Forests ecoregion (Ricketts et al., 1999; Figure 1a). Its complex orography is linked to past volcanic activity, which produced numerous cones, cinerites, lava

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flows, and volcanogenic lakes scattered through the landscape (Espíndola et al., 2016). The climate at Los Tuxtlas is tropical, but a pronounced variation within the region in geographical relief and altitude (0 to 1780 m a.s.l.) results in several microclimates. Annual rainfall, for instance, varies between 1272 and 4201 mm from the southwest to the northeast, respectively (Gutiérrez-García & Riker, 2011; Soto & Gama, 1997).

Los Tuxtlas is the northern limit of tall evergreen forests in the Americas (González-Soriano et al., 1997). The Nearctic and Neotropical biogeographic regions converge here, and thus Los Tuxtlas harbors organisms from both regions, as well as several endemic taxa. Species diversity is notable, with records of at least 3300 plant species, 560 bird species, and 130 mammal species, among many other organisms (National Committee of Protected Natural Areas [CONANP], 2009).

Archeological evidence suggests that humans have lived at Los Tuxtlas for 4000 years. During the Prehispanic period, the area was sequentially occupied by the Olmecs, Popolucans, and Nahuas (Guevara, 2010; Santley, 2007). These groups were hunter-gatherers and subsistence farmers. During the colonial period (16th to 19th centuries) the impact of human activities on natural resources increased with the introduction of cattle grazing and sugarcane plantations. At the beginning of the 19th century, further activities began in the region, including tobacco crops and intensive wood extraction. In this period new railways and highways connected the region with the city of Veracruz and other major cities, favoring the growth of the human population (Guevara, 2010). The exploitation of natural resources intensified during the second half of the 20th century when the Mexican government promoted the occupation of the area and cattle ranching became the predominant economic activity (Durand & Lazos, 2004). By the end of the 1980s more than 80% of the old-growth forest had been lost (Dirzo & García, 1992).

1.2 | The Los Tuxtlas Biosphere Reserve (LTBR)

Although there are several accounts of the biodiversity of Los Tuxtlas dating back to the Prehispanic mythology and the colonial codices, it was during the second half of the 20th century that its systematic study began. Numerous studies on the ecology of different taxonomic groups lead to the emergence of a community of researchers that fostered the creation in 1967 of the Tropical Biology Station Los Tuxtlas by the National Autonomous University of Mexico (Coates, 2017). In the following decades, research centered in the 700 ha encompassed by the Tropical Biology Station Los Tuxtlas grew extraordinarily (González-Soriano et al., 1997) and contributed to disseminating the significance of the natural resources of Los Tuxtlas and the importance of their protection. These efforts paved the way for the creation of the LTBR in 1998 by the Mexican Government, which was incorporated into the United Nations Educational, Scientific and Cultural Organization (UNESCO)'s World Network of Biosphere Reserves in 2006.

Highlights

- In 1998, a 155,000 ha natural reserve was established in southern Mexico that was due to protecting nonhuman primates, among other organisms.
- In May 2021, mining operations endorsed by the Mexican government started within the reserve near the habitat of mantled howler monkeys (*Alouatta palliata*), threatening several groups.
- This case study underscores the frailty of primate conservation in Mexico, even within protected areas.

The LTBR is managed by the National Committee of Protected Natural Areas (CONANP hereafter), the federal agency that oversees natural reserves in Mexico. The 155,122 ha encompassed by the LTBR are classified into two categories, core and buffer zones. According to CONANP, the core zone (29,720 ha) aims at preserving ecosystem integrity in the medium and long term whereas the buffer zone (125,402 ha) aims at promoting sustainable activities while creating the necessary conditions to achieve long-term ecosystem conservation (CONANP, 2006). The activities that are allowed in core zones include conservation, research, environmental education, forest restoration, and ecotourism. In buffer zones several economic activities are allowed, including agriculture, fishing, agroforestry, and the construction of tourism infrastructure.

The LTBR faced several challenges from its inception, beginning with the expropriation of lands located in the core areas of the reserve (Von Bertrab, 2002). Conflicts between landowners and both federal and state authorities emerged during this process and lead to strong opposition by locals to the establishment of the LTBR, which persists today in some areas. Despite these challenges, the conservation and management activities of LTBR grew with the support of federal and international funding, particularly from the United Nations Development Program: for instance, between 2001 and 2007, approximately US$8 M were spent in sustainable development actions at the LTBR overseen by a local office of CONANP (Figueroa-Peña & Escobar-Chontal, 2017). As a result of these actions, deforestation decreased (from an annual rate of deforestation of 2.3% to −1.8%), and between 1998 and 2011 forested areas increased (Von Thaden et al., 2018). Yet, by 2011 deforestation again had increased (1.0%), mainly through the logging of young secondary forests and riparian vegetation in the buffer zone.

1.3 | Primates at Los Tuxtlas

Two of the three primate species that live in Mexico can be found at Los Tuxtlas, the mantled howler monkey (*Alouatta palliata*) and the Geoffroy's spider monkey (*Ateles geoffroyi*). Historically, both species were hunted for the pet trade and spider monkeys were hunted for

FIGURE 1 Location of Los Tuxtlas (a) and Balzapote (b) and a photograph of the quarry from where rock is being extracted (c). In a, red polygons depict the core zones of the reserve (1= Volcán San Martín Tuxtla; 2 = Sierra de Santa Marta; 3 = Volcán San Martín Pajapan) and the orange oval indicates Balzapote. In b, the orange polygons mark the quarry currently under exploitation (the brownish area near the center) and the area where the rock is crushed and heavy machinery is parked (to the north). The black polygon indicates the 1980s quarry and the purple, yellow, blue, and red polygons roughly indicate the areas used by mantled howler monkey groups.

their meat (Duarte & Estrada, 2003; Estrada & Coates-Estrada, 1988). The study of primates at LTBR began in the late 1970s and since those pioneering studies, it was suggested that primates were being affected by habitat disturbance, mainly through forest loss and fragmentation, but also by hunting (Estrada, 1982; Estrada & Coates, 1984). Subsequent research in the region demonstrated that changes in habitat spatial patterns (e.g., habitat loss and fragmentation) and food availability affected primate demography

(e.g., Cristóbal-Azkarate et al., 2005; Estrada & Coates, 1996), behavior (e.g., Dunn et al., 2009), health (e.g., Cristóbal-Azkarate et al., 2010; Valdespino et al., 2010), and physiology (e.g., Gómez-Espinosa et al., 2014). An unequivocal consequence of such disturbances is that spider monkeys have not been observed in the northern portion of the LTBR for at least 30 years.

At the national level Los Tuxtlas is considered a priority area for primate conservation due to the presence of two primate species, estimated population sizes, and amount of remaining primary forest (Tobón et al., 2012). Furthermore, Los Tuxtlas is the only priority area for primate conservation located in the state of Veracruz that is also a protected area. The population of mantled howler monkeys of Los Tuxtlas represents the forefront of the expansion of the species into Central America (Cortés-Ortiz et al., 2003), and due to founder effects, has very low genetic diversity (Melo-Carrillo et al., 2020; Solórzano-García et al., 2021). It is thus vulnerable to inbreeding and genetic drift, which may increase extinction susceptibility (Radespiel & Bruford, 2014).

A recent study suggests that the population of mantled howler monkeys may have increased in the LTBR. From 2001 to 2013 there were changes in the spatial attributes of forest fragments, such as an increase in size and decrease in isolation, which were associated with an increase in the abundance of individuals (Alcocer-Rodríguez et al., 2021). Thus, forest recovery occurring after the establishment of the LTBR (Von Thaden et al., 2018) may have had a positive effect on mantled howler monkeys, even in the short term. It remains to be determined whether the increase in deforestation after 2011 is again depressing primate demographic parameters.

1.4 | Mining, money, and monkeys

Balzapote (18.618585°N, 95.071298°W; Figure 1b) is a small coastal village of ca. 500 inhabitants located in the northern portion of the LTBR (Figure 1). It was founded in 1945 although it was not until the 1970s that its population expanded (Alvarez-Buylla et al., 1988). Following an initial period during which small-scale subsistence agriculture was the predominant economic activity, from the 1970s onward cattle ranching became the most important activity, and with it, the conversion of tropical forest to pasturelands. In the early 1980s the Mexican government promoted the exploitation of basalt rock in a hill to the east of the village to construct the *Dos Bocas* port, in the state of Tabasco. This was a period of economic growth for the community, as several villagers were hired, and the community received financial compensation for the extraction of rock. This compensation was used to relocate the village closer to the coast (Alvarez-Buylla et al., 1988). The mining operations ceased in 1986. There is no information about the ecological impact of the 1980s mining operations.

The management plan of the LTBR indicates that mining operations in the reserve should have a small environmental impact and that the use of explosives in the buffer zone where Balzapote is located is forbidden (CONANP, 2006). Additionally, it is stated that, if mining concessions become active, the administrative board of the LTBR should oversee the mining operations and work with the mining companies to assess the environmental impact of the extractive activities and design mitigation measures. It was thus surprising that in 2014 the Secretary of Environment and Natural Resources (SEMARNAT hereafter), a federal agency of which CONANP is part, allowed the extraction of 7,000,000 m^3 of rock from the Balzapote quarry, which would be used to expand the Veracruz port. Remarkably, an independent technical evaluation of the environmental impact assessment that SEMARNAT used to grant the permit included compelling arguments on the negative environmental impact that mining operations would have in the area (e.g., local extinction of threatened taxa, loss of functional connectivity between landscape components). On that occasion, environmentalist organizations and scientists took action to deter the mining operations (e.g., https://balzapote.wordpress.com/), which eventually were not conducted. The permit is valid for 10 years and in April 2021, the 2014 permit was reactivated. Less that 10 days later heavy machinery was present in Balzapote. In May of that year, the area surrounding the quarry was fenced, protected by private security personnel, and explosions began. As in the 1980s, mining has brought several economic benefits to the community, including an initial payment of US$2000 to each landowner (*ejidatario*), a boom in house rentals, and a surge in job opportunities.

A group of mantled howler monkeys has lived in a riparian fragment located to the west of the quarry at least since 1995 (Estrada et al., 1999). By 2001, when one of the authors (PAD Dias) surveyed the area, vegetation had regenerated around the 1980s quarry and in the following years, secondary forest connected the riparian fragment on the west to another one on the east. No mantled howler monkeys were observed in the regenerating area in the early 2000s (Cristóbal-Azkarate et al., 2005), but by 2017 a group comprising 15 individuals was living there. This group was systematically studied in the following years (e.g., de la Torre et al., 2021; Rangel-Negrín et al., 2021) and recent surveys (March 2022) indicate that there are at least another four mantled howler monkey groups in the ca. 40 ha forest fragment that surrounds the quarry.

At the time of writing, mantled howler monkey groups had not left the area, probably because the extraction of rock focused mostly on steep slopes with scrub vegetation that howler monkeys do not regularly use. Still, some trees plunged and the remarkable increase in the number of people, vehicles, and noise in the area may affect the behavior and physiology of mantled howler monkeys, as previously demonstrated (Cañadas-Santiago et al., 2020; Gómez-Espinosa et al., 2022). Additionally, there are unofficial accounts that the mining operations will expand in the future, which could critically affect the vegetation in the habitat of mantled howler monkeys. During informal interviews with mining workers, we were told that the monkeys have occasionally visited the area where heavy-duty vehicles are parked, which could lead to accidents.

Forest fragments in the LTBR are important for maintaining plant diversity as, independently of their size, they comprise diverse native plant communities, including endangered and economically important

forest species (Arroyo-Rodríguez & Mandujano, 2006a; Arroyo-Rodríguez et al., 2009). In this landscape the likelihood of occupation by mantled howler monkeys increases in forest fragments with an area of >32 ha (Arroyo-Rodríguez et al., 2008), probably because they have greater basal area of top food resources and more large primary trees in the canopy (Arroyo-Rodríguez & Mandujano, 2006b). Additionally, from a metapopulation perspective, all forest fragments are highly valuable for mantled howler monkeys not only as permanent habitat but also as stepping-stones while moving through the landscape (Mandujano & Escobedo-Morelos, 2008) and for landscape supplementation (i.e., as alternative food sources: Asensio et al., 2009). Therefore, the preservation of forest fragments, such as that located in the Balzapote quarry, is important for the conservation of mantled howler monkeys in the LTBR.

1.5 | The broad context

The rock extracted from Balzapote will be used as ballast for the railroad tracks of the Maya Train, a federal megaproject that aims at constructing 1500 km of railroads across southeastern Mexico. The two projects are further intertwined. First, the Mexican government (through SEMARNAT) supports them based on environmental impact assessments. Unfortunately, environmental impact assessments often fail to identify the risks they are supposed to, either due to poor design, bad implementation, or vested interests (Laurance, 2022). Second, both projects were challenged by environmental organizations and scientists due their potential negative impacts on the environment, biodiversity, and cultural heritage (e.g., https://balzapote.wordpress.com; Pérez-Ortega & Gutiérrez-Jaber, 2022; Radwin, 2022; Whelan & Ruiz, 2020). However, the Mexican government has repeatedly refused to open the discussion on costs and benefits of these projects to the society. This is not an uncommon situation. For instance, a hydro-power project in North Sumatra is predicted to destroy an important proportion of the reaming habitat of the Critically Endangered Tapanuli organgutan (*Pongo tapanuliensis*). That project is grounded on a poor environmental impact assessment, but the Indonesian government has not replied to calls by scientists on the matter (Laurance et al., 2020). Third, by implementing both projects, the Mexican government is disrespecting the rule of law (i.e., the management plans of natural reserves are promulgated via official decrees), and international conventions (e.g., UNESCO Man and the Biosphere Programme). This reflects poor governance, which plagues primate range countries and hinders biodiversity conservation (Estrada et al., 2020).

Together, these projects will directly impact four biosphere reserves (LTBR, Calakmul, Los Petenes, Sian Ka'an) and several additional federal and state protected areas (e.g., Área de Protección Cañón del Usumacinta, Balam Kin y Balam Kú, Parque Nacional Palenque). Large primate populations inhabit these reserves, which are priority areas for their conservation (Tobón et al., 2012). Habitat deforestation, fragmentation, and degradation associated with development projects are thus expected to impact Mexican primates throughout southern Mexico in the coming years. As for the situation in Balzapote, it clearly illustrates how a step forward (habitat regeneration with corresponding increase in mantled howler monkey abundance) may be followed by several steps backwards (habitat degradation, disregard for the rule of law in protected areas) in primate conservation.

AUTHOR CONTRIBUTIONS

Pedro A. D. Dias: Conceptualization (equal); investigation (equal); writing – original draft (equal); writing – review & editing (equal). **Ariadna Rangel Negrín**: Conceptualization (equal); investigation (equal); writing – original draft (equal); writing – review & editing (equal).

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

This study has no associated data.

ETHICAL STATEMENT

This commentary did not involve the observation of primates or interviewing of humans, and therefore did not require permissions and compliance documentation.

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