



# Influence of human activities on some medium and large-sized mammals' richness and abundance in the Lacandon Rainforest



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## ABSTRACT

We evaluated the influence of six human activities (related variables) on the richness and abundance of large and medium-sized mammals in the southern portion of the Lacandon Rainforest, including protected and non-protected areas. The human activities measured have different influences on mammal richness and abundance. Our results show that some human activities (human density and anthropogenic land cover, and agriculture/cattle ranching) had no effect on large and medium-sized mammal populations, but community-based protection, such as medium levels of tourism and hunting, had a negative influence on richness and abundance. Those variables negatively influencing the mammal community were reported in one of the study sites. Data indicate both an opportunity for applied integral conservation actions that involve people and their activities, as well as an opportunity to support biodiversity conservation in agricultural landscapes by integrating human activities with protected areas and conservation.

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## 1. Introduction

The human population has grown and expanded to the point that the whole planet has been considered human-dominated for more than 15 years (Alessa & Chapin, 2008). Most of the threats affecting biodiversity are related to human activities which can act as a source of disturbance and stress for natural populations, influencing ecological processes and resulting in changes in the abundance of species, among other negative outcomes (Benedetti-Cecchi et al., 2001; Munguia, Trejo, González-Salazar, & Peñerías-Maqueo, 2016; Valenzuela-Galván, Arita, & Macdonald, 2008; Vuyiya et al., 2014). The conversion of natural habitats for agricultural, forestry, and grazing activities has been considered the major threat to biodiversity conservation and the

principal disturbance agent for natural communities, and as such, an important cause of species extinction (e.g. Ceballos, Arroyo-Cabrales, Medellín, & Domínguez-Castellanos, 2005; Munguia et al., 2016; Ochoa-Gaona 2000; Urquiza-Hass, Peres, & Dolman, 2009; Valenzuela-Galván et al., 2008). Studies have demonstrated that human activities have a significant influence on the global extinction risk of mammals (Ceballos & Ehrlich, 2002; Kerr & Currie, 1995). Cardillo et al. (2004) point out that all ongoing declines of mammal populations are caused by human population growth, resulting in several activities of negative impact for biodiversity, such as subsistence hunting, which has been related to the decline of mammal populations for several decades (Kerr & Currie, 1995).

Natural areas affected by human activities show differences in species abundance and composition compared to natural protected areas where human pressure is low (Caro 2002), but there are cases on a local level in which human activities may be favorable for some species because of the habitat heterogeneity it promotes (Ahmadi, López-Bao, & Kaboli, 2014; Caro 2001). Some areas embedded in a forest matrix could be beneficial to some species because of the "primary productivity taking place at ground level in treefall gaps or other open habitats". For example, studies performed in southern Mexico basically found no differences in species richness and community structure between oldfield and forest habitats,

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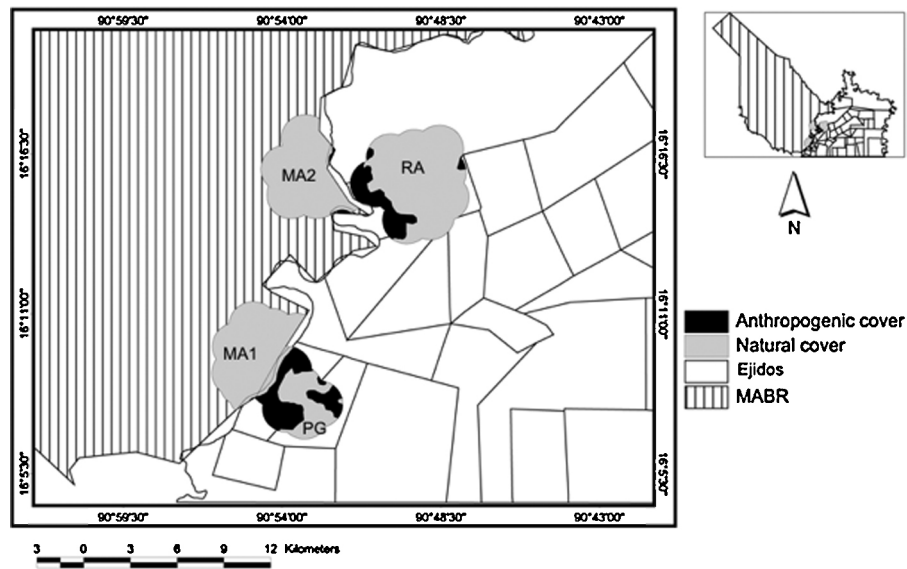


Fig. 1. Sample sites and land cover in the Lacandon Rain Forest.

arguing that the sort of relatively small clearings (*ca.* 3 ha) commonly found at the study sites (the Lacandon Rainforest) and when within a forest matrix allow forest-dependent mammal species to enter them, some of those species are *Tapirus bairdii*, *Cuniculus paca*, *Dasyprocta punctata*, *Tayassu pecari*, *Pecari tajacu* and *Mazama americana* (Medellín 1994; Medellín & Equihua, 1998).

In the specific case of agricultural activities, it is known that some practices can contribute to species conservation (Daily, Ceballos, Pacheco, Suzán, & Sánchez-Azofeifa, 2003; Medellín & Equihua, 1998). For example, Declerck et al. (2010), proposed an approach for conservation in Mesoamerica, which addresses conservation challenges in human-dominated landscapes characterized by constant human disturbance through such means as the integration of sustainable agricultural systems with existing efforts in protected areas (also see Harvey et al., 2008).

A key strategy for protecting biodiversity from external pressures has been the establishment and maintenance of protected areas, which can have a positive influence on mammals because they are able to maintain higher population densities of mammalian species or other species, in comparison with unprotected areas, partly due to the restriction of human activities (Kerr & Currie, 1995). Worldwide, protected areas remain isolated from one another, and in many cases, natural biological corridors for plant and animal dispersal become disrupted by anthropogenic barriers (Becker, Fonseca, Haddad, Batista, & Prado, 2007; Epps, Wehausen, Bleich, Torres, & Brashares, 2007). This anthropogenic matrix occupies, in several places, the majority of the landscape and acts as a filter for animal dispersal between forest patches (Gascon, Lovejoy, Bierregaard, Malcolm, & Stouffer, 1999; Gibbs 1998).

The Lacandon Rainforest region in Mexico includes protected (federal and community-based) and non-protected areas. Some factors affecting biodiversity conservation in this region include human immigration and colonization, economic development with no environmental impact planning, overexploitation of natural resources, deforestation, poaching and wildlife smuggling (Cuarón, 1997; Vásquez-Sánchez, March, & Lazcano-Barrero, 1992; Vleut, Levy-Tacher, Boer, Galindo-González, & Vazquez, 2013). It is important to take into account, as it is mentioned by Medellín and Equihua (1998), that disturbed areas surrounded by a forest matrix can result in an overall higher diversity because of the coexistence of forest and open-area species.

With our research we evaluated the influence of human activities on species richness and abundance of large and medium-sized mammals on a local scale in the Lacandon Rainforest in Mexico. We evaluated sites including federal protected areas, community-based protected areas and non-protected areas.

## 2. Methods

### Study area

Our study was carried out in the southern region of the Lacandon Rainforest in Chiapas, Mexico, which is mainly a tropical rainforest (Rzedowski, 1978), but also includes some areas of cloud forest, savannah, riparian forest, agricultural land, grassland, plantations, and secondary vegetation (March & Flamenco, 1996). Land tenure is mainly community-based (known in Mexico as ejidos), and the principal economic activities are agriculture and extensive livestock (Vásquez-Sánchez et al., 1992; INE-SEMARNAP, 2000), although fishing and subsistence hunting and gathering are also practiced (Naranjo, 2002).

The Montes Azules Biosphere Reserve (MABR) is located in the Lacandon Rainforest in Chiapas and protects one of the largest areas of remaining tropical rainforest in the country (INE-SEMARNAP 2000). It presents an altitude interval of 200 to 1500 masl, with an annual precipitation of 2300 to 2500 mm and a mean annual temperature of 25°C (INE-SEMARNAP, 2000). Dominant soils are Rendzinas and local climax vegetation is tropical evergreen forest (Miranda, 1998; INE-SEMARNAP, 2000).

Within the MABR (located in the subregion of Montes Azules; INE-SEMARNAP, 2000) we selected two sampling sites (MA1 and MA2) and two more outside the MABR, in two different ejidos (PG and RA; Fig. 1) within the subregion of Marques de Comillas. The four sites are located next to the Lacantun River and were selected because of their accessibility, topography and the information available from previous research (Naranjo et al., 2003; Naranjo, 2002).

According to the MABR management program, sites MA1 and MA2 are located within the “restricted use zone” of the MABR, where human activity must be low or non-existent (INE-SEMARNAP, 2000). The two selected areas outside the MABR present different types of human activities and land use. At Playon

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