

Recent records of *Tapirella bairdii* and *Panthera onca* in a region highly transformed by human activities in southern Veracruz, México

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The tapir (*Tapirella bairdii*) and the jaguar (*Panthera onca*) are two of the largest Neotropical mammal species suffering population declines caused by habitat loss and degradation and hunting. Tapirs and jaguars are considered endangered and near threatened, respectively, by the IUCN, and in Mexico, both species are listed as endangered and considered species with priority for conservation. These species are usually associated with large and remote areas of preserved forest. To evaluate local diversity of medium and large sized mammals, we placed five camera traps, three in old forest and two in secondary forest (445 trap days) at Ejido Ramos Millán (municipality of Minatitlán), on the northernmost part of the Uxpanapa Valley, in the Gulf of Mexico coastal plain, state of Veracruz, Mexico. This region has been highly transformed by human activities, where agricultural and livestock activities have caused the loss of most of its natural forests, resulting in a highly fragmented landscape, dominated by livestock fields, crops and secondary forests. Here we document images of three adult individuals of jaguar and two adult individuals of tapir, one of which was a lactating female, and one adult male tapir. The new records were 23 Km north of the most recent reports located in well preserved primary forests in the Uxpanapa/Chimalapas border area. Our results suggest that the highly fragmented tropical landscapes composed of both old-growth and secondary forests remnants, are able to provide sufficient resources to maintain at least temporarily individuals of jaguars and tapirs.

El tapir (*Tapirella bairdii*) y el jaguar (*Panthera onca*) son dos de las especies de mamíferos neotropicales más grandes en México, Centro y Sudamérica. A lo largo de su distribución, sufren una disminución poblacional causada por la pérdida y degradación del hábitat y la caza. El tapir y jaguar son considerados en peligro y casi amenazados, respectivamente, por la UICN, y en México, ambas especies están consideradas en peligro de extinción y se consideran especies prioritarias para la conservación. Estas especies generalmente se asocian a grandes y remotas extensiones de bosque preservado. Para evaluar la diversidad local de mamíferos medianos y grandes, colocamos cinco fototruampas, tres en fragmentos de bosque viejo y dos en bosques secundarios (445 días trampa) en el Ejido Ramos Millán (municipio de Minatitlán), en la parte más al norte del valle de Uxpanapa, en la planicie costera del Golfo de México, estado de Veracruz, México. Esta región ha sido altamente modificada por las actividades humanas, en donde las actividades agrícolas y ganaderas han causado la pérdida de la mayoría de los bosques naturales, resultando en un paisaje fragmentado, dominado por pastizales ganaderos, cultivos y bosques secundarios. Aquí documentamos imágenes de tres individuos adultos de jaguar y dos individuos adultos de tapir, uno de los cuales era una hembra lactante y un tapir macho adulto. Los nuevos registros se localizaron 23 Km al norte de los registros más recientes ubicados en bosques primarios bien conservados en el área fronteriza de Uxpanapa/Chimalapas. Nuestros resultados sugieren que los paisajes tropicales altamente fragmentados, compuestos por fragmentos de bosque viejo y secundario, son capaces de proporcionar recursos suficientes para mantener al menos temporalmente individuos de jaguares y tapires.

Keywords: camera trap; jaguar; old forest fragments; secondary forests; tapir; tropical rain forest.

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Introduction

Tapirs (*Tapirella bairdii*) and jaguars (*Panthera onca*) are two of the most threatened large terrestrial mammals in the Neotropics (Quigley *et al.* 2017; García *et al.* 2016). Both species are considered “endangered” and “near threatened”, respectively, by the IUCN. In Mexico, they are listed as “endangered” (SEMARNAT 2010) due to habitat loss, habitat modification, and hunting (Chávez-Tovar *et al.* 2005; March and Naranjo 2005). Although historic distribution of both species extended over a broad distributional area (Chávez-Tovar *et al.* 2005; March and Naranjo 2005), local populations have been drastically reduced in most parts of the

country (Chávez-Tovar *et al.* 2005; March and Naranjo 2005; Naranjo 2009; Chávez-Tovar *et al.* 2016). Because of their status as endangered species, the Mexican government has considered jaguars and tapirs as priority species for conservation (García *et al.* 2016; Quigley *et al.* 2017).

In southeastern Mexico, both jaguars and tapirs have been recently reported in tropical rainforests, tropical dry forests and cloud forests, along the states of Veracruz, Oaxaca, Chiapas, Tabasco, Campeche, Yucatán, and Quintana Roo (Chávez-Tovar *et al.* 2005; Naranjo 2009). However, the distribution of tapirs is more restricted, and no recent records have been reported in Tabasco and Yucatán (March

and Naranjo 2005). Currently, both species still have relatively high population sizes in large forest fragments of difficult access, low human presence, and with some degree of protection (e. g., Los Chimalapas and Sierra Norte in Oaxaca, Sierra Madre de Chiapas and Lacandona in Chiapas, Calakmul in Campeche and Sian Ka'an in Quintana Roo; Naranjo 2009; Chávez-Tovar *et al.* 2016; Botello *et al.* 2017). However, Chávez-Tovar *et al.* (2016) and Luja *et al.* (2017) indicated that jaguars may occur in unprotected or highly fragmented sites with human impact. Also, the two species play important roles in the ecosystem; tapirs are important herbivores and seed dispersers of various plant species (Naranjo 2009), and jaguars are the largest predators in the Neotropics (Chávez-Tovar *et al.* 2005).

Although jaguars and tapirs were historically distributed across the Coastal Plain of the state of Veracruz, in the northern portion of the Isthmus of Tehuantepec (Chávez-Tovar *et al.* 2005; March and Naranjo 2005), both species are thought to be nearly extirpated from the area (March and Naranjo 2005; SEMARNAT 2009), particularly, in the Uxpanapa valley, where livestock and agricultural activities have caused high deforestation rates since the 1970s (Ellis *et al.* 2011). For example, in Las Choapas and Minatitlán the forest cover decreased 17 % and 14 %, respectively, between 2001 and 2017 (Global Forest Watch 2018). In addition, this area has important petrochemical complexes, causing high pollution levels (Espinosa-Reyes *et al.* 2013). The most recent records for both species in Veracruz have been documented at most 10 km north from the Uxpanapa/Chimalapas border where the largest remnant of tropical rainforest in Mexico still exists, and it is believed that large viable populations of these two species still exist (Lira-Torres *et al.* 2014; Naranjo *et al.* 2015).

Local efforts by inhabitants in the Uxpanapa valley have promoted the regeneration and conservation of large extensions of secondary and old forest fragments. With these efforts, natural forest regeneration appears to provide suitable environmental conditions and resources that are already promoting the return of large mammals. Here we reported the presence of jaguar and tapir in sites previously unsampled with camera traps, in the northern portion of the Uxpanapa valley, being the most recent records of these two species in the municipality of Minatitlán.

Materials and methods

Study site. Sampling was done in tropical rain forest remnants in the Ejido Gabriel Ramos Millán (17° 22' 21.75" N, -94° 10' 33.68" W), Municipality of Minatitlán, located on the upper northern limits of the Uxpanapa valley (southeastern Veracruz; Figure 1a, b). The original vegetation in the region was tropical rainforest extended along plains, soft hills and ravines (Hernández *et al.* 2013); but in the last 40 years, changes in land use derived from agricultural and livestock activities, and the large fire occurred in 1998, destroyed more than 70 % of the original vegetation cover (Hernández *et al.* 2013).

Sampling. We conducted two sampling seasons, the first from July to October 2018 and the second from December 2018 to April 2019. We set five camera stations with one camera trap each (Cuddeback®, Bushnell® and Wildgame®). Three stations were placed in two old growth forest fragments as followed: Station 1 (17° 22' 23.38" N, -94° 13' 48.25" W, 117 masl), placed in a 380 ha fragment of old growth forest surrounded by a > 10,000 ha large fragment of secondary forest; Station 2 (17° 20' 56.05" N, -94° 10' 1.90" W, 74 masl), placed in a 220 ha old-growth forest fragment surrounded by secondary forests and cattle pastures; and Station 3 (17° 21' 06.37" N, -94° 11' 35.98" W, 120 masl), placed in a 149 ha old-growth forest fragment surrounded by secondary forests and cattle pastures. Two more stations were placed in a 20-year secondary forests: Station 4 (17° 21' 30.5" N, -94° 10' 06.3" W, 37 masl), placed in a forest fragment of 160 ha; and, Station 5 (17° 20' 45.5" N, -94° 09' 07.7" W, 68 masl), placed in a forest fragment of 166 ha (Figure 1c).

Camera traps were set at least 1.0 Km away from each other (1.6 Km on average) on natural paths, between 50 to 60 cm height on tree trunks (Lira-Torres *et al.* 2014; Briones-Salas *et al.* 2016). Every camera trap was georeferenced using a Garmin, Etrex® 20x global positioning system (GPS). The sampling effort was calculated in trap-days by multiplying the total number of camera traps set by the total number of days cameras were active (Briones-Salas *et al.* 2016), totaling 1,005 trap-days (445 trap-days between July and October, 2018, and 560 trap-days between December 2018 and April 2019). All images were deposited in the Phototrap Collection at the Institute of Biology, Universidad Nacional Autónoma de México, and are available for request.

Results

Of the five stations, four (stations 1, 2, 4 and 5) recorded individuals of jaguars (two stations) or tapirs (three stations) during the two sampling seasons: In station 1, in the first sampling season (between July 28 and August 31, 2018), we recorded 18 images and 10 independent events of two adult jaguars (Figure 2a, b). In the second sampling season (between December 24, 2018 and January 25, 2019), we recorded 10 images and 9 independent events of one adult jaguar. In station 2, in the first sampling season, we recorded one image of an adult jaguar on July 27, 2018, and an adult tapir in two independent events, the first on July 31, 2018 (Figure 2c), and the second in September 10, 2018. During the second sampling season (between December 26, 2018 and April 2nd, 2019), we recorded 11 images and eight independent records of an adult tapir. In station 4, in the first sampling season, we recorded one adult tapir in two independent events, the first on August 11th, 2018, and the second in October 6th, 2018 (Figure 2d). In the second sampling season (between December 25, 2018 and March 9th, 2019), we recorded 11 images and four independent events of an adult tapir. In station 5, during the first sampling season (between August 11 and September 3rd, 2018), we recorded 64 images in 12 independent events of

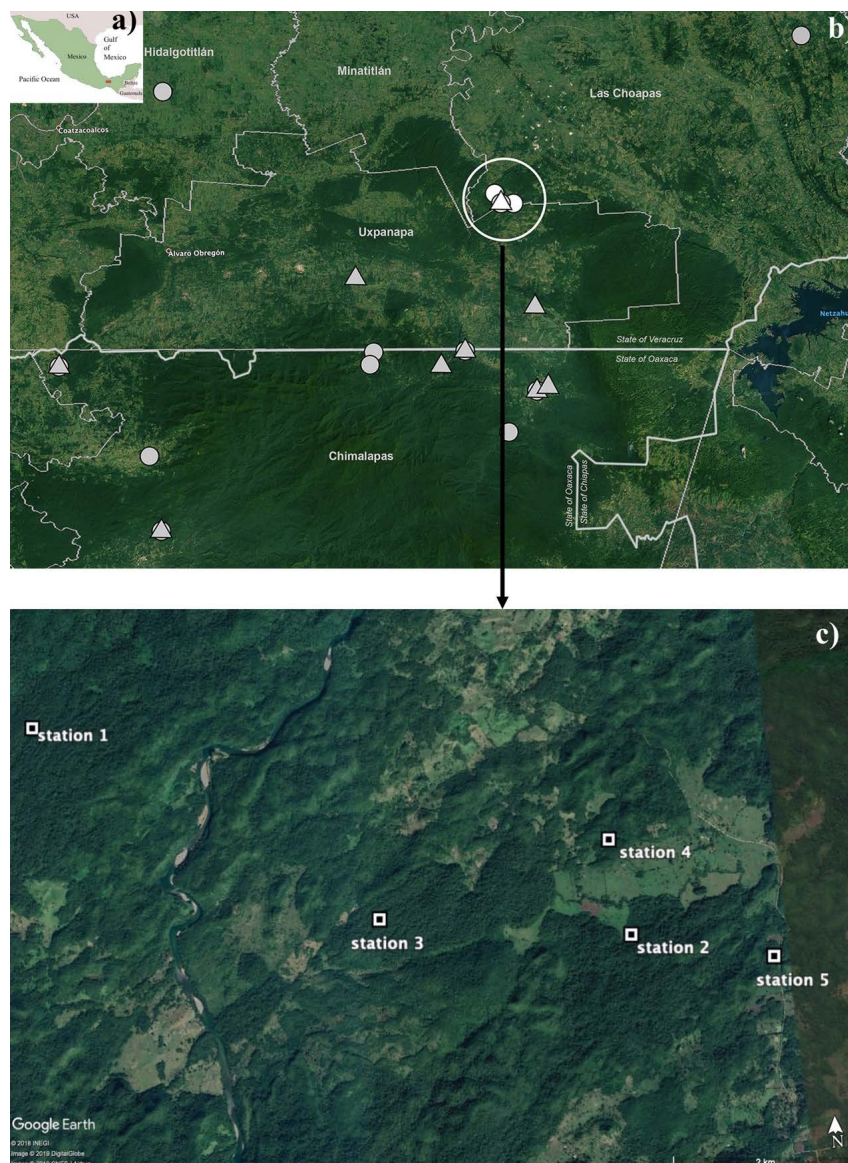


Figure 1. a) Location of the study area in southern Veracruz, Mexico. b) Historical (in gray) and recent (our study, in white), records for jaguar (circles) and tapir (triangles). c) location of the five camera stations within the "Ejido Ramos Millán", municipality of Minatitlán, Veracruz, Mexico.

adult tapirs. During the second sampling season (between December 23, 2018 and January 3rd, 2019), we recorded 27 images and three independent events of two adult tapirs (female and male). In many photographs it was possible to see that one tapir was a lactating female (Figure 2e), and in one video recorded in March 3rd, 2018, we documented an adult male (Figure 2f).

Discussion

Jaguars have been rarely recorded in the Uxpanapa valley. Only three records have been reported between 1990 to 2008 in three different sites, one located at approximately 50 km northeast, one 50 km northwest, and one 20 km south of our study site, between the Chimalapas/Uxpanapa border (Briones-Salas et al. 2016; Rodríguez-Soto et al. 2011). Our record represents the first record in the last 10 years in the Uxpanapa valley and the first historical record of the species in the municipality of Minatitlán, where the jaguar was considered already extirpated (SEMARNAT 2009). Jaguars are

normally recorded in localities immersed in or connected to dense tropical forests (Chávez-Tovar et al. 2005). We believe that jaguars recorded here were not only in-transit dispersing individuals from nearby large preserved forests (e.g., Chimalapas region), but animals residing in the site. In station 1, the same individual was photographed several days during the two sampling seasons along eight months, which suggests the old-growth forest fragment is part of its territory. Considering the size of the fragment where station 1 was set (> 10,000 ha, including secondary and old forest). We believe that this fragment can either work as a biological corridor or as a stepping-stone habitat (Luja et al. 2017), where jaguars can be established temporarily or even permanently. During our survey we abundantly recorded three main jaguar preys, the nine-banded armadillo (*Dasypus novemcinctus*), white-nosed coati (*Nasua narica*) and the collared peccary (*Pecari tajacu*; Chávez-Tovar et al. 2005). Additionally, the presence of karstic caves in the region may provide permanent refuge to jaguars (Chávez-Tovar et al. 2005).

Before our study, the last tapir records (2003-2015) were located not more than 10 km away from the border of the Chimalapas/Uxpanapa forest, which harbors one of the most important tapir populations in Mexico (Lira-Torres *et al.* 2014). However, our record extends as far as 22.5 km straight line to the north from “La Fortaleza” in Chimalapas, Oaxaca, into Minatitlán, Veracruz. Residents of Ejido Gabriel Ramos Millán indicated that tapir sightings began to occur approximately seven years ago (2011) in lowlands, floodplains and temporary streams. We believe that tapirs were already established within the forest remnants by the time camera-traps were placed. This is supported by the high frequency of independent photographs of individuals, the presence of adult tapirs of both sexes, and the record of a breeding female.

Secondary forests are the dominant component of lowland landscapes in the Neotropics (Melo *et al.* 2013). Much has been discussed about the importance of secondary forest for the conservation of biodiversity (Melo *et al.* 2013). Our records of jaguars and tapirs in human modified habitats suggest that local conservation efforts by the Ramos Millán people, preserving old growth and secondary forest in a fragmented landscape, have allowed the return of large mammals in sites where they were already extirpated. These species have been scarcely recorded in fragmented landscapes (*e. g.*, Marqués de Comillas region, Lacandona rainforest, Chiapas) as they prefer large fragments (at least 1,000 ha) of old-growth forest (Muench and Martínez-Ramos 2016). It has been documented

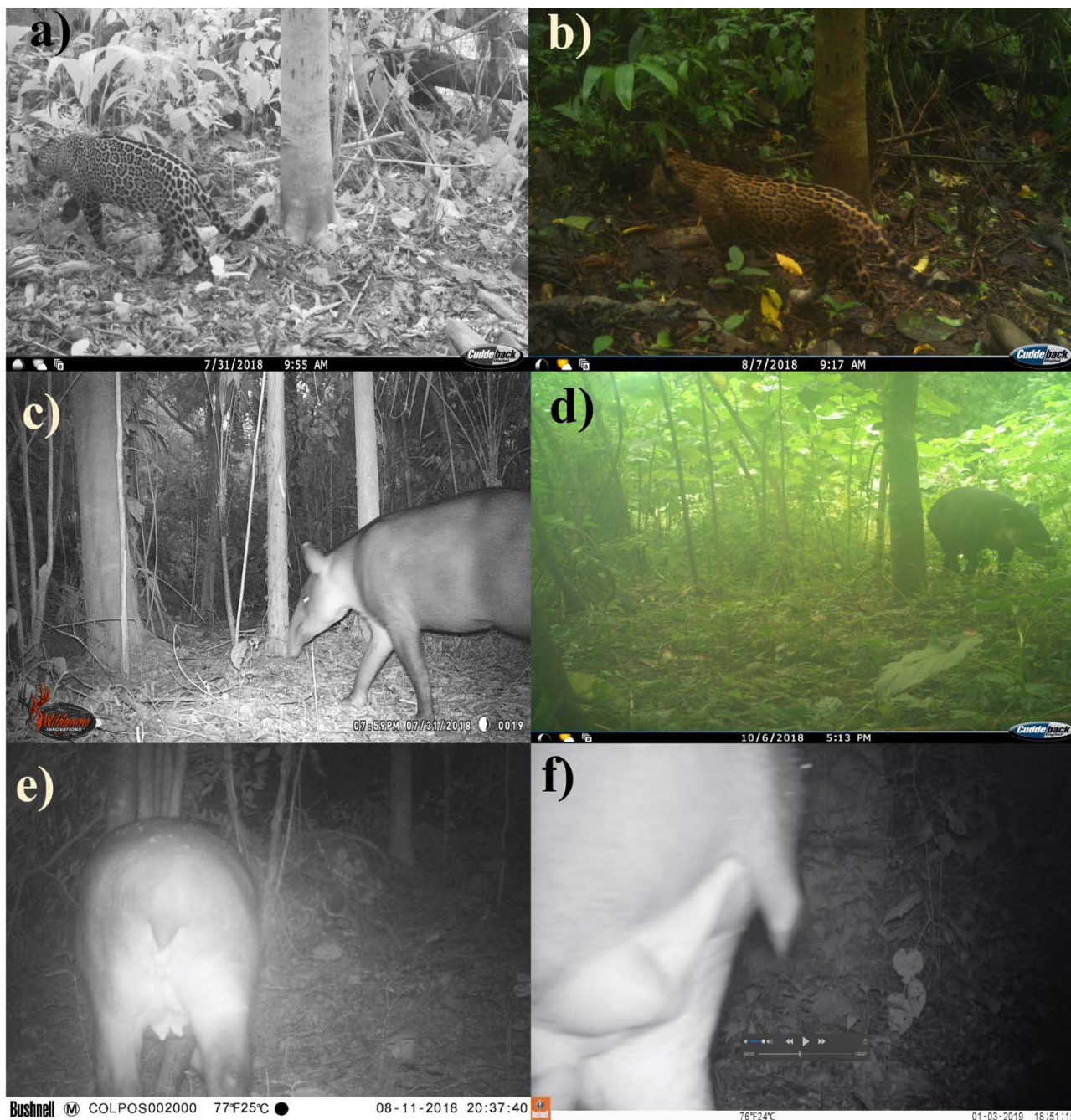


Figure 2. Photocaptures of specimens registered in the lower basin of the Uxpanapa valley, Veracruz. a) Adult jaguar “Individual 1” in an old forest fragment (Station 1). b) Adult jaguar “Individual 2” in an old forest fragment (Station 1). c) Adult tapir in an old forest fragment (Station 2). d) Adult tapir at day in a secondary forest fragment (Station 4). e) Adult tapir female (Station 4). f) Adult tapir male (Station 4).

that in natural protected areas with large forested fragments, tapirs prefer sites with abundant water (streams and swamps) and with secondary vegetation dominated by edible species (Naranjo 2009). It is likely that the collective decision of local people in Ejido Ramos Millán to preserve their forests and to prohibit hunting of both species, has promoted environmental conditions (such as abundant food and abundant water) that allow the establishment and reproduction of resident individuals within the northern part of Uxpanapa valley.

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