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Evidence for current presence of a collared peccary (*Pecari tajacu*) population in Guanajuato, Mexico

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Abstract.—On the basis of 86 photographic records, we report the presence of a relatively stable collared peccary (*Pecari tajacu*) population in the state of Guanajuato, Mexico. These records complement geographical and ecological information for the species along the Gulf of Mexico. The species' predominant habitat is submontane scrub, which corresponded to 54.6% of the records. Family groups (herds) were observed with 3.9 ± 2.9 (mean ± SD) individuals on average. The presence of young indicated 2 reproductive periods per year (March and August). The presence of collared peccaries in the region of greatest biological diversity in Guanajuato provides additional value to the protected areas of the state. This herbivorous species plays a fundamental ecological role as a preferred prey of this area's main predators, such as the jaguar (*Panthera onca*) and the cougar (*Puma concolor*). It is important to continue monitoring wild fauna with the purpose of delimiting distributions and estimating populations at the local level.

Resumen.—Presentamos a través de 86 registros fotográficos la presencia de una población relativamente estable de pecaríes (*Pecari tajacu*) en el estado de Guanajuato, México. Estos registros complementan la información geográfica y ecológica para la especie a lo largo del Golfo de México. El hábitat predominante es el matorral sub-montano, con 54.6% de los registros. Se observaron grupos familiares (piaras) de 3.9 ± 2.9 individuos en promedio. La presencia de crías indica dos períodos reproductivos por año (marzo y agosto). La presencia del pecarí de collar en la región de mayor diversidad biológica de Guanajuato aporta valor adicional a las áreas protegidas del estado. Debido a su herbívora, esta especie juega un papel ecológico fundamental al ser una de las presas preferidas de los depredadores tope como el jaguar (*Panthera onca*) y el puma (*Puma concolor*). Es importante seguir monitoreando la fauna silvestre con el propósito de delimitar la distribución y estimar la población a nivel local.

Ungulates play an important role in ecosystem dynamics. They are capable of altering the structure and composition of vegetation communities through the consumption of plants and the dispersion and predation of seeds. Additionally, ungulates are an important food source for predators and humans (Ripple et al. 2015, Meyer et al. 2016). In Mexico, ungulates are represented by 5 families (Ceballos et al. 2005), and among them, the Tayassuidae family hosts 2 species. The white-lipped peccary (*Tayassu pecari*) is limited in Mexico to zones of humid tropical forest but is widely distributed in the neotropics from northern Argentina to southeastern Mexico (Taber et al. 2011, Reyna-Hurtado et al. 2014). The collared peccary (*Pecari tajacu*) is an omnivorous, social, and relatively adaptable animal that inhabits a large variety of ecosystems including semiarid zones, montane woodlands, and mangrove forests located on either side of Mexico (Reyna-Hurtado et al. 2014). However, there are areas of central Mexico where the collared peccary has been extirpated (March and Mandujano 2005).

Guanajuato State is situated in central Mexico in a region that lacks current peccary records. The only evidence of peccary presence is from 2 records. The first is a specimen collected in the 19th century by the French naturalist Alfredo Dugès (Sánchez 2014, Sánchez et al. 2014). This specimen was

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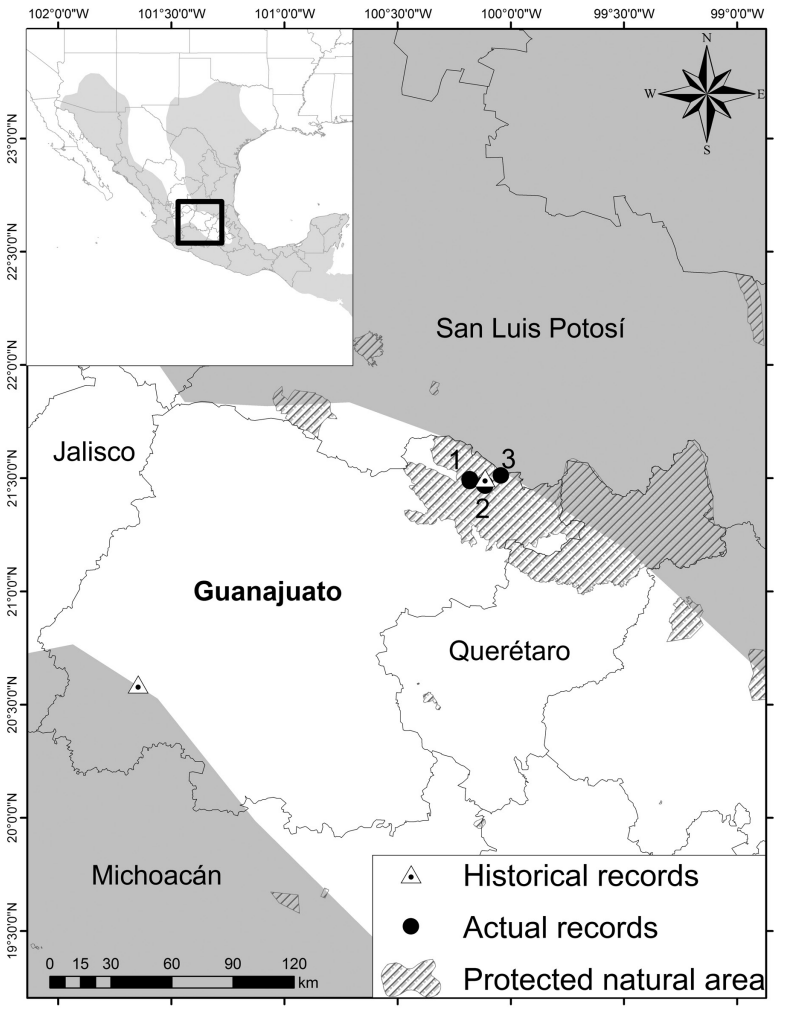

Fig. 1. Location of collared peccary populations in Guanajuato: 1 = Agua Fría, 2 = El Platanito, 3 = Cañuelas. The gray shaded area represents the distribution of collared peccary (*Pecari tajacu*) in Mexico (Patterson et al. 2007).

collected in the municipality of Cueramaro in the southeastern portion of Guanajuato and constitutes the first record of the collared peccary in the state. It is curated at the Museo de Historia Natural Alfredo Dugès (Alfredo Dugès Museum of Natural History) of the University of Guanajuato (MADUG-MA-8) (Sánchez et al. 2014). The second is a skull collected in 2000 by local hunters from the municipality of Victoria in the northeastern part of Guanajuato and deposited in the Escuela Nacional de Ciencias Biológicas del Instituto Politécnico Nacional (National School of Biological Sciences of the National Polytechnic Institute; ENCB-IPN 43311; Sánchez et al. 2014). Before this study, the 2 records cited above constituted all the information on the occurrence of collared peccary in Guanajuato (Sánchez et al. 2014).

The Bajío region in southeastern Guanajuato is considered to be within the limits of the potential distribution of the collared peccary in Mexico (Reyna-Hurtado et al. 2014). However, this region has suffered a grave transformation of natural vegetation in the last century, as it is considered a highly important zone for agricultural activities in Mexico. Highway infrastructure construction and ongoing industrial activities have also flourished (Cuevas and Zorrilla 2012). Currently, the only region of suitable habitat for the collared peccary is the northeastern part of Guanajuato,

Fig. 2. A group of 12 collared peccaries (*Pecari tajacu*), including one juvenile (arrow), in El Platanito, Victoria, Guanajuato, Mexico.

in the Reserva de la Biosfera Sierra Gorda Guanajuato (RBSGG = Biosphere Reserve of the Sierra Gorda Guanajuato). This reserve has a surface area of 236,882 ha and is the largest protected area with the highest level of biodiversity conservation in the state, as it has been the least impacted by human activities (Cuevas-Carillo and Zorrilla 2012). The reserve has several types of vegetation, with small areas of dry tropical forest, xerophytic scrub, and pine-oak forest, but the predominant habitat is submontane scrub (Zamudio 2012).

From 2007 to 2013, studies focused on understanding the diversity of medium and large mammals in the RBSGG using camera traps. However, none of these traps recorded a collared peccary (Iglesias et al. 2008, Cecaira-Ricoy at al. 2012, Iglesias-Hernández et al. 2012, Charre-Medellín et al. 2016). According to potential distribution models and recent records, we suggest that this region may constitute the distribution limit of the species in the central portion of the Gulf of Mexico (Reyna-Hurtado et al. 2014).

With the objective of documenting the wild fauna in the RBSGG, we placed 15 camera traps (LTL Acorn Outdoors, Green Bay, WI, USA; Wildview and Stealth Cam, LLC, Grand Prairie, TX, USA) between July 2014 and July 2016 in 3 locations: Agua Fría, El Platanito (Victoria) and Cañuelas (Xichu) (Fig. 1). These locations are between 1200 and 1700 m above sea level in an area dominated by submontane scrub and oak woodland (Zamudio 2012). The cameras were located along paths, gullies, and the banks of water bodies. They were placed 50 cm above ground level and more than 500 m from the nearest neighboring camera to maximize the likelihood of capture. Seventy percent of cameras were located in submontane scrub and 30% in oak woodland. The cameras were programmed to take 3 photos per event, taking into account that an independent record is one that has the largest

number of individuals in a photograph during a cycle of 24 h in each location (Botello et al. 2008). We divided the activity periods into the following categories: daytime (08:00 to 18:00), nighttime (20:00 to 06:00), and twilight (dawn and dusk; 06:00 to 08:00 and 18:00 to 20:00, respectively).

With a total sampling of 2785 camera-days (Agua Fría = 720, El Platanito = 1440, Cañuelas = 625), we obtained 86 independent collared peccary events (Agua Fría = 11, El Platanito = 72, Cañuelas = 3). We counted 13 individuals in the photograph with the largest herd (Fig. 2), although the average was 3.9 ± 2.9 (mean ± SD) individuals per event. The presence of collared peccaries in the region was regularly documented after the first photographic record in October 2014. In Cañuelas and El Platanito, young were observed twice per year (March and August) in 2015 and 2016. With regard to the habitat, 54.6% of the records were obtained in submontane scrub and 45.4% in oak woodland. We observed that the activity distribution of the peccaries was 43.5% diurnal, 37.5% nocturnal, and only 19% crepuscular (twilight), with a peak of activity between 08:00 and 10:00 comprising 30% of the photographic events.

This population of collared peccaries in Guanajuato is likely to be in the process of dispersion, because studies conducted prior to 2014 in the same region did not record the species despite a large sampling effort (Iglesias et al. 2008, Cecaira- Ricoy at al. 2012, Iglesias-Hernández et al. 2012, Charre-Medellín et al. 2016), and the inhabitants of this region confirmed the species' absence.

Due to the large distance between the 3 locations where the collared peccary herds were observed (>7 km), and considering the short time lapse of most record intervals between locations (<24 h), we assume that the records correspond to independent herds. In addition, peccaries normally restrict their movements to areas of about 5 km^2 in arid and tropical environments (Taber et al. 2011, Reyna-Hurtado et al. 2014). The localities nearest to our study region with contemporary presence of collared peccaries are in protected areas of the neighboring states of San Luis Potosí and Querétaro (March and Mandujano 2005). It is important to mention that the inhabitants of Agua Fría and El Platanito ranches considered the species to be dispersing and that the inhabitants of the Cañuelas settlement recognized the species as extremely rare.

The activity pattern observed in this study is similar to that observed by Briceño-Méndez et al. (2016) in the south of Mexico, where the collared peccary was found to be more active during the day. The average number of individuals observed per herd in this region (3.9 individuals) corresponds to the upper limit of the average observed herd size (1 to 5.3 individuals) in both humid and tropical regions of Mexico (Mandujano 1999, Naranjo 2002, González-Marin et al. 2008, Briceño-Méndez et al. 2016). Despite the year-round breeding pattern documented in the literature (Taber et al. 2011, Reyna-Hurtado et al. 2014), our records for this area indicated that young are present during March and August.

In tropical zones of Mexico, the diet of peccaries is composed of available fruits throughout the year, roots during the dry season, and soft leaves during the wet season; therefore, the diet is affected by seasonal climatic variation (March and Mandujano 2005, Pérez-Cortez and Reyna-Hurtado 2008). The potential diet of the species in this region and its influence on peccary breeding activity and mobility is still unknown. We suggest that the presence of young peccaries may correspond with periods of peak fruiting of the local cactus species. We assume that breeding activity during the dry season (February–May) may be correlated with pitaya cactus (*Stenocereus queretaroensis*) fruit abundance, while breeding activity during the wet season (July–November) may be correlated with prickly pear cactus (*Opuntia* spp.) fruit abundance (Taber et al. 2011, Zamudio 2012). Evidence supporting this assumption includes the high consumption of *Opuntia* fruit in the dry and arid habitats of Arizona and Texas, where these fruits constitute a key diet component of peccaries (Medeiros-Prado 2013, Hominick 2014). Future research should include the assessment of various key fruiting resources in the region. This information is particularly needed to inform the management plans for the reserve, as no published information is available on the diet components of peccaries in reserve habitats.

To maintain a viable collared peccary population in the RBSGG for the long term, the species' habitat requirements and herd

territory size need to be understood. Fruiting plants should be planted in degraded areas, and poaching should be eliminated. Determination of peccary carrying capacities for the reserve's different habitats should be a main objective, as peccaries constitute an important diet component of large predators such as jaguars (*Panthera onca*) and mountain lions (*Puma concolor*) (Aranda 2012, Ceballos et al. 2016). Although jaguar presence in the region has not been confirmed, there is a hypothesis that considers the distribution of the jaguar to possibly extend over the Guanajuato region, particularly due to dispersal from neighboring states such as San Luis Potosí and Querétaro (Dueñas-López et al. 2015).

It is important to outline the distribution range of collared peccaries within the RBSGG and to determine whether the species is maintaining its presence and population growth trends or whether these herds are in the region only temporarily. The possible mobility of these populations between the existing reserves in the region should be studied using satellite telemetry. The species may coexist with the inhabitants of the RBSGG. However, this coexistence will depend on the successful implementation of management programs focused on determining the optimum population size and the feasibility of a solution that benefits human communities.

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