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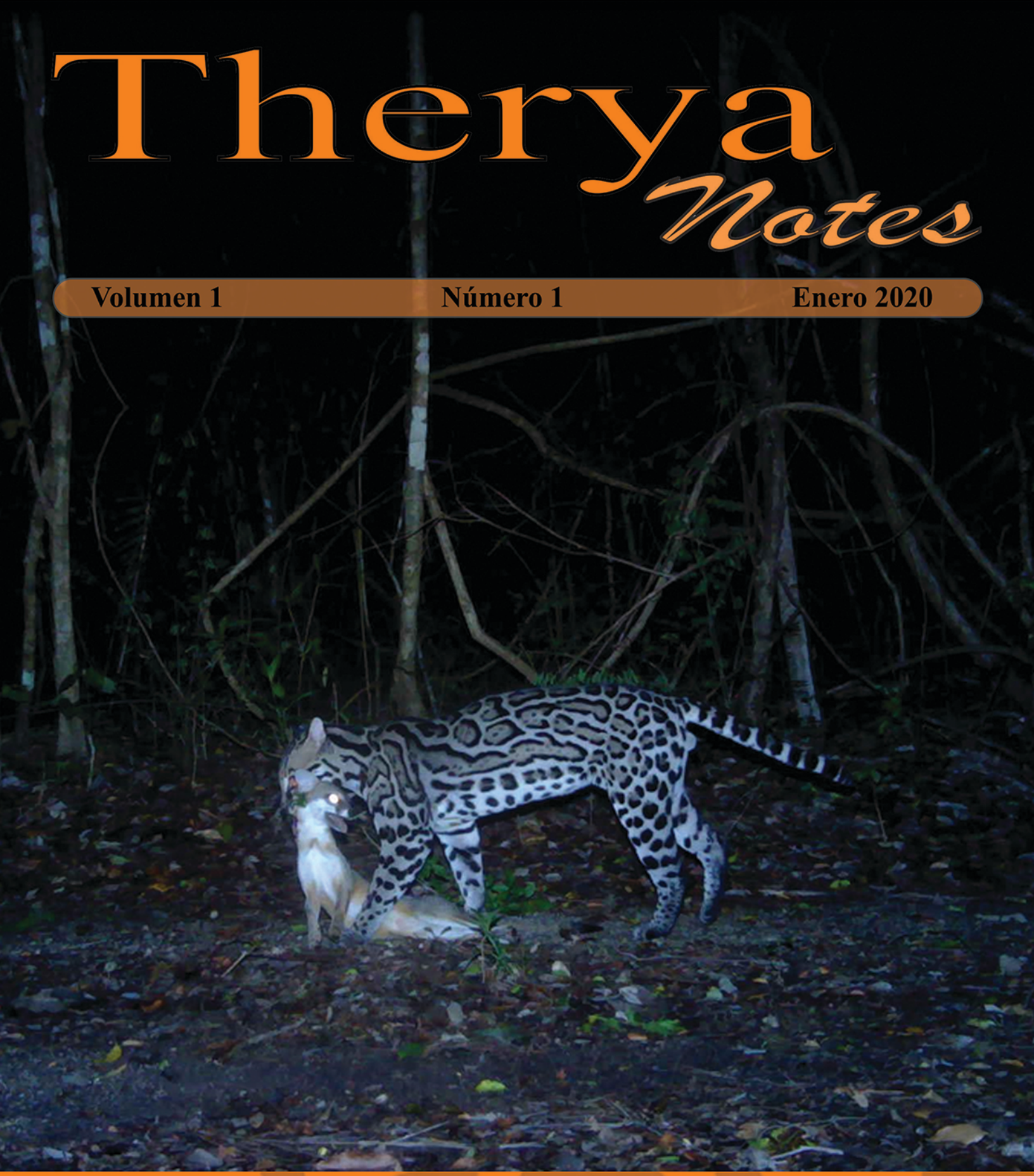

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En la Portada

La zorra gris (*Urocyon cinereoargenteus*) es comúnmente depredada por otros carnívoros, lo cual tiene como consecuencia reducciones locales en sus poblaciones. En los bosques tropicales, los depredadores potenciales de la zorra gris son en su mayoría felinos medianos y grandes. Como parte de un trabajo para determinar densidad de grandes felinos en la península de Yucatán, se obtuvo en una cámara trampa una fotografía en la que un ocelote (*Leopardus pardalis*) lleva en su boca una zorra gris.

(Fotografía de Hidalgo-Mihart et al. 2020)

El logo de la AMMAC: "Ozomatli"

El nombre de "Ozomatli" proviene del náhuatl se refiere al símbolo astrológico del mono en el calendario azteca, así como al dios de la danza y del fuego. Se relaciona con la alegría, la danza, el canto, las habilidades. Al signo decimoprimero en la cosmogonía mexica. "Ozomatli" es una representación pictórica del mono araña (*Ateles geoffroyi*). La especie de primate de más amplia distribución en México. " Es habitante de los bosques, sobre todo de los que están por donde sale el sol en Anáhuac. Tiene el dorso pequeño, es barrigudo y su cola, que a veces se enrosca, es larga. Sus manos y sus pies parecen de hombre; también sus uñas. Los Ozomatin gritan y silban y hacen visajes a la gente. Arrojan piedras y palos. Su cara es casi como la de una persona, pero tienen mucho pelo."

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EQUIPO EDITORIAL

CONTENIDO

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Expantion of distribution range of the Greater Grison (*Galictis vittata*) in México

Expansión del área de distribución del grisón (*Galictis vittata*) en México

Carlos Contreras-Díaz[1], Leroy Soria-Díaz[2]*, Claudia C. Astudillo-Sánchez[1], Hublester Domínguez-Vega[3], Yuriana Gómez-Ortiz, and Luis Martínez-García[2]

[1] Facultad de Ingeniería y Ciencias, Centro Universitario Victoria, Universidad Autónoma de Tamaulipas. Adolfo López Mateos, C P. 87149, Ciudad Victoria. Tamaulipas, México. Email: a2133010122@alumnos.uat.edu.mx (CC-D), ccastudillo@docentes.uat.edu.mx (CCA-S).

[2] Instituto de Ecología Aplicada, Universidad Autónoma de Tamaulipas, Av. División del Golfo No. 356. Col. Libertad, C P. 87019, Ciudad Victoria. Tamaulipas, México. Email: leroysoriadiaz@gmail.com, lesoria@uat.edu.mx (LS-D), martinez.garcialuisfer@gmail.com (LM-G).

[3] División de Desarrollo Sustentable, Universidad Intercultural del Estado de México, Libramiento Francisco Villa SN, C P. 50640, San Felipe del Progreso. Estado de México, México. Email: hublester.dvega@gmail.com (HD-V), yurianagomezortiz@gmail.com (YG-O).

*Corresponding author

The potential distribution of the Greater Grison, *Galictis vittata*, reaches east-central México including the southern portion of Tamaulipas state. However, there are no geographical records that confirm this potential range limit. Our study documents the first record of the Greater Grison photographed by camera traps at "El Cielo" Biosphere Reserve, Tamaulipas State, México. We installed 26 camera traps at "El Cielo" Biosphere Reserve. The cameras were programmed to take pictures and with the date and hour of each photo recorded automatically. Also, we created a map, which combined the Greater Grison's potential distribution and published occurrence records, to overlay on our new sightings in "El Cielo". One camera trap recorded two photos of a Greater Grison at "El Cielo" Biosphere Reserve, within a preserved pine-oak forest environment. These two records represent the only confirmed sightings of the Greater Grison in Tamaulipas state and they are located 64.4 km northwest of the nearest estimated potential distribution and 186 km north of the northern-most sighting in southern San Luis Potosí. The record of our study expand both the original potential distribution and the known distribution of this species toward the northwest and north, respectively. The sightings also increase the known elevation limit of the species in México from 1,500 to 1,790 m. We believe that the occurrence of Greater Grison at "El Cielo" is not unusual because this site has the conditions and habitat that are suitable to the distribution of this species.

Key words: Biosphere reserve; Mustelidae; northeast México; Sierra Madre Oriental.

La distribución potencial del gran grisón, *Galictis vittata*, llega al centro y este de México, incluida la parte sur del estado de Tamaulipas. Sin embargo, no hay registros geográficos que confirmen este límite. El presente estudio documenta el primer registro del gran grisón fotografiado por trampas cámara en la Reserva de la Biosfera "El Cielo", Tamaulipas, México. En el área de estudio se instalaron 26 trampas cámara que fueron programadas para obtener fotografías con la hora y fecha impresa. También se realizó un mapa en el que se integró la distribución potencial del grisón, los registros de ocurrencia publicados y los registros fotográficos de "El Cielo". Una trampa cámara registró dos fotografías del gran grisón en la Reserva de la Biosfera "El Cielo", dentro de un bosque de pino-encino conservado. Los dos registros representan el único avistamiento confirmado para el grisón en Tamaulipas, y están localizados a 64.4 km al noroeste de la distribución potencial estimada y a 186 km al norte del registro confirmado en el sur del estado de San Luis Potosí. Los registros de este estudio expanden tanto la distribución potencial como la distribución conocida del grisón hacia el noroeste y al norte, respectivamente, y también, aumentan el límite de elevación conocido en México de 1,500 a 1,790 m. La presencia del gran grisón en "El Cielo", se debe probablemente a que este sitio tiene las condiciones de hábitat para que se pueda distribuir esta especie.

Palabras clave: Mustelidae; noreste de México; reserva de la biosfera; Sierra Madre Oriental.

The Greater Grison, *Galictis vittata* (Shreber, 1776), is a medium-sized mustelid with an elongated body and distinctively short legs (Álvarez-Castañeda *et al.* 2015). Its potential distribution indicate it could range from the southeastern portion of México including the Yucatán peninsula, south through Central America, and throughout the northern half of South America (Yensen and Tarifa 2003; Tarifa *et al.* 2010; Bornholdt *et al.* 2013). It has been recorded in tropical forests, rainforests, grasslands, arid regions, tropical dry forests, coffee plantations and secondary vegetation (Estrada *et al.* 1993; Gallina *et al.* 1996; De la Torre *et al.* 2009; Hodge and Arbogast 2016; Manduano *et al.* 2018).

The Greater Grison is of special interest because it is one of the least-known mammals in the Americas; because of the low numbers of studies or records reporting its pres-

ence, we know very little about the biology and ecology of this species throughout its range (Tarifa *et al.* 2010; Hernández-Hernández *et al.* 2018).

In México, the laws of faunal protection consider *Galictis vittata* to be an endangered species (SEMARNAT 2010). According to our literature search, the potential distribution of Greater Grison in México includes 11 states located at the east and southeast of the country (Escalona-Segura *et al.* 2002; Ramírez-Pulido *et al.* 2005; González-Christen 2008; Olguín-Monroy *et al.* 2008; De la Torre *et al.* 2009; Hernández-Hernández *et al.* 2018; Mandujano *et al.* 2018). In México, the Greater Grison lives at altitudes ranging from sea level to 1,500 m above sea level, but mostly below 500 m (Yensen and Tarifa 2003). Although the potential distribution of the Greater Grison reaches into the extreme southeastern portion of Tamaulipas state (Yensen and Tarifa 2003; Cuarón *et al.* 2016), there were no records confirming its presence in this state (Vargas-Contreras and Hernández-Huerta 2001), until now. In this study, we submit the first confirmed record of occurrence of the Greater Grison (*Galictis vittata*) in Tamaulipas state, México, expanding its potential and known distribution limits.

This study was conducted at "El Cielo" Biosphere Reserve, located in the Northeast of México, in Tamaulipas state and is part of the bio-geographical region of the "Sierra Madre Oriental" (SMO). This reserve is an important zone of transition between the Nearctic and the Neotropical regions, with altitudes ranging between 100 and 2,300 m that provide different environmental conditions and different types of vegetation (Steinberg *et al.* 2014). From December 2017 to January 2019 we installed 26 camera traps (Scoutguard HCO model SG565) at "El Cielo". The cameras were one km apart, in two types of habitat: cloud forest and pine-oak forest and were programmed to take pictures, with the date and hour of each photo recorded automatically.

We created a map, which combined the Greater Grison's potential distribution (Cuarón *et al.* 2016) and published occurrence records (Global Biodiversity Information Facility 2019; database updated until January 2019), to overlay on our new sightings in "El Cielo."

One camera trap recorded two photos of a Greater Grison in 2018; the first on 17 July at 1818 H and the second on 1 November at 1052 H (Figure 1). These photos clearly show the typical color pattern of the species: blackish marbled gray dorsally with a white stripe starting at the forehead, passing under the ears and above the eyes, and ending at the shoulders. Anatomically, the limbs are very small and the tail is short, as is typical of the Greater Grison (Figure 1; Álvarez-Castañeda *et al.* 2015). The camera trap that took both pictures was positioned at 23° 2' 44.70" N, -99° 15' 45.90" W at an elevation of 1,790 m (Figure 2). It was within a preserved pine-oak forest environment (mostly *Pinus patula*, *P. pseudostrobus*, *Quercus germana, Q. affinis* and *Q. polymorpha*; González-Medrano 2005; Pérez and Valencia-A. 2017) and very close to the cloud forest (approximately 200 m away).

Figure 1. Photographic evidence of the Grater Grison (*Galictis vittata*) on "El Cielo" Biosphere Reserve Tamaulipas, México, in a pine-oak forest.

These two records in the "El Cielo" Biosphere Reserve represent the only confirmed sightings of the Greater Grison in Tamaulipas, México. They are located 64.4 km northwest of the nearest estimated potential distribution and 186 km north of the northern-most sighting in southern San Luis Potosí (Figure 2). Together, these two sightings expand both the original potential distribution and the known distribution of this species toward the northwest and north, respectively. The sightings also increase the known elevation limit of the species in México from 1,500 (Yensen and Tarifa 2003) to 1,790 masl. However, another study in Colombia sighted a Greater Grison at 2,200 m (Escobar-Lasso and Guzmán-Hernández 2014).

The San Luis Potosí specimen of *Galictis vittata* mentioned above, was collected from the Xilitla locality (21° 23' 10" N, -98° 59' 24" W), was preserved and deposited on the Louisiana state University Museum of Natural Science, Mammal Collection. Record ID: urn: catalog: LSUMZ: Mammals: 2769. Source: http://ipt.vertnet.org:8080/ipt/resource.do?r=lsumz_mammals (published on 03-19-2015).

Other mustelid species have been recorded in previous studies conducted at the "El Cielo" (*e. g.*, *Eira barbara senex* and *Mustela frenata frenata*; Vargas-Contreras and Hernández-Huerta 2001), but the Greater Grison had

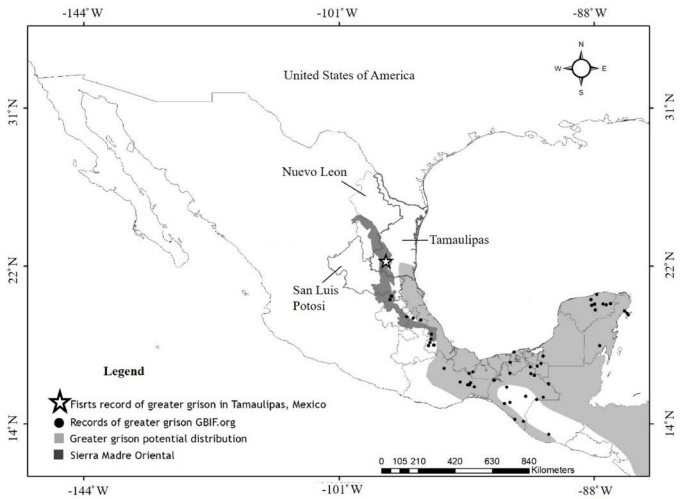

Figure 2. First record of the Greater Grison (*Galictis vittata*) for the Tamaulipas state, México. White star = first record of Greater Grison in Tamaulipas, México; black dots = records of the Greater Grison in GBIF.org; light gray = potential geographic distribution of Greater Grison; dark gray = Sierra Madre Oriental.

not been mentioned before, not even as an anecdotal record. We believe that the occurrence of Greater Grison at "El Cielo" is due to that the reserve has the conditions and habitat that are suitable to the distribution of this species (cloud forest, tropical forest and grassland). Other research in México, have registered this species in tropical forests, rainforests, grasslands, cloud forest, arid regions, tropical dry forests, coffee plantations and secondary vegetation (Estrada *et al.* 1993; Gallina *et al.* 1996; De la Torre *et al.* 2009; Mandujano *et al.* 2018). On the other hand, "El Cielo" is undergoing a consistent process of plant regeneration that started 35 years ago when the biosphere reserve was established by decree (1985) and forestry exploitation stopped completely (Steinberg *et al.* 2014). Maybe now, with less human activity and better conservation of the reserve, it will be possible for species like the Greater Grison can reach these areas. Furthermore, the geographical position of "El Cielo" within the eastern mountain range, Sierra Madre Oriental, allows the Reserve to function as an important biological corridor, connecting the wild fauna populations of Nuevo Leon and San Luis Potosi states (Steinberg *et al.* 2014), and opening the possibility for species from other States to arrive at Tamaulipas (Figure 2). Finally we want to highlight that camera trap are an efficient tool to discovering new species and document the expansion of species into new areas, as described in our writing.

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Xenomys nelsoni predation by the snake *Senticolis triaspis* in México

Depredación de *Xenomys nelsoni* por la serpiente *Senticolis triaspis* en México

Patricia Hernández-López[1], Ángel Rodríguez-Moreno[2], and José L. Jaramillo-Alba[3]*

[1] Parque Nacional Lagunas de Chacahua, CONANP. La Grúa Chacahua sin número, CP. 71800, Oaxaca. Oaxaca, México. Email: patricia.hernandez.lopez.01@gmail.com (PH-L).
[2] Departamento de Zoología, Instituto de Biología, UNAM. Ciudad Universitaria, 70-153, CP. 04510, Ciudad de México. Ciudad de México, México. Email: angelrodriguezmoreno14@hotmail.com (AR-M).
[3] Facultad de Estudios Superiores Iztacala, UNAM. Avenida de los Barrios 1, CP. 54090, Iztacala. Estado de México, México. Email: jaramillo.luis@ciencias.unam.mx (JLJ-A).
*Corresponding author

Dry jungles harbor a large number of species with restricted distribution or endemic, and little is known about the ecological processes involving these species. Such as activity periods, diet, or predation. In October 2016, we registered a predation event on the Mexican endemic rodent *Xenomys nelsoni* by the colubrid snake *Senticolis triapsis* in the Chamela-Cuixmala Biosphere Reserve. This rodent species is listed as endangered by the Mexican law. This is the first report of predation on individuals of this threatened rodent genus.

Key words: Colubridae; diet; dry forest; endemic rodent; predation.

Las selvas secas albergan un gran número de especies endémicas y con distribución restringida, de las cuales se sabe poco sobre los procesos ecológicos en donde participan. Como por ejemplo, los períodos de actividad, dieta, o interacciones con los depredadores. En octubre de 2016, registramos un caso de depredación del roedor endémico de México *Xenomys nelsoni* por el colúbrido *Senticolis triaspis* en la Reserva de la Biosfera Chamela-Cuixmala. Esta especie de roedor está considerado como especie amenazada por la ley mexicana. Este es el primer reporte en campo, de depredación a individuos de este género de roedores amenazado.

Palabras clave: Colubridae; depredación; dieta; roedor endémico; selva seca.

Dry forests are ecosystems that harbor a large number of endemic species (Ceballos and García 1995), many of which are species with restricted distribution (Arita *et al.* 1997). These ecosystems are natural laboratories that have been extensively studied (*e. g.,* the Chamela-Cuixmala region, México). However, some of the species inhabiting these areas have not been sufficiently investigated (Miranda 2002a); consequently, information gaps still remain regarding the ecological processes involving these species, *e. g.*, reproduction, periods of activity, diet, and others.

Knowledge about the feeding habits is essential to understand predator-prey relationships. However, the diet of taxa characterized by cryptic habits is poorly known, as is the case of snakes. In general terms, recorded prey include other reptiles (lizards and snakes), birds, and mammals (Seigel *et al.* 1987).

This paper reports the first record of predation on the arboreal rat *Xenomys nelsoni* by the snake *Senticolis triaspis,* a species of terrestrial and arboreal habits (Hammerson *et al.* 2015) that displays activity in twilight hours in captivity (Radke and Malcolm 2008). The diet reported for *S. triaspis* includes small mammals such as rodents of the genera *Mus*, *Peromyscus,* and *Neotoma* (Degenhardt *et al.* 1996; Radke and Malcolm 2005).

The Chamela-Cuixmala Biosphere Reserve is located on the west coast of Jalisco, México (19° 29′ N, -105° 01′ W). Mean annual precipitation is 798 mm, and mean annual temperature is 24.6 °C (García-Oliva *et al.* 2002). Altitude ranges from 0 to 500 meters above sea level, and the vegetation corresponds to tropical deciduous forest and medium subdeciduous forest (Bullock 1986). A total of 64 rodent species have been recorded for the state of Jalisco (Godínez and Guerrero 2014), with 13 species of rodents (Miranda 2002a) and 63 species of reptiles (Ramírez-Bautista 1994) in the reserve.

From 10 to 19 October 2016, night walkthroughs were conducted (20:00 to 00:00 h) where the predation event reported in this note was incidentally recorded. The snake was identified to species at the Chamela-Cuixmala Biological Station and subsequently released; regurgitated prey specimens were identified by comparison with samples in the National Collection of Mammals of the Institute of Biology, UNAM.

On 18 October 2016, at 21:24 h in the Chamela-Cuixmala Biosphere Reserve (19° 29′ 58.95″ N, -105° 2′ 32.59″ W), we found an individual of *Senticolis triaspis* (Ramírez-Bautista 1994; 1.175 mm total length and 205 g total weight) falling from a tree branch while preying on *Xenomys nel-*

soni (Figure 1a). The snake also showed distension of the middle part of its body, indicating the presence of a second prey undergoing digestion. Upon noticing the lamp lights, the snaked loosened the prey from its jaws; four hours after being captured, it regurgitated the second prey (Figure 1b).

The two prey individuals corresponded to juveniles of the rodent *Xenomys nelsoni*. Both were identified to species based on the presence of taxonomically distinctive morphological traits (Álvarez-Castañeda *et al.* 2015). Externally, both specimens display white spots in the eyes, a unique feature that is absent in all other cricetid rodent species living in Mexico. The pelage of the ventral region is white; the monochromatic tail is shorter than the head and body. As to the characteristics of the skull, auditory bullae are large, which is also a distinctive trait. Both *X. nelsoni* specimens were deposited in the National Collection of Mammals with catalog numbers CNMA 49520 and 49521.

Xenomys nelsoni is a species endemic to Mexico, characterized by strictly nocturnal and arboreal habits (Schaldach 1960). It lives exclusively in thorny forests and tropical deciduous forests, in areas with high tree density and closed canopy (Schaldach 1960; Ceballos 1989, 2005; Miranda 2002b). *Xenomys nelsoni* is a rodent of which little is known, listed as threatened by the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT 2010) and as Endangered A2c by the International Union for the Conservation of Nature (Vázquez 2018). Its critical conservation status relates to its restricted distribution and the deforestation of its natural habitat (Ceballos 1989; Arita *et al.* 1997; Ceballos *et al.* 2002).

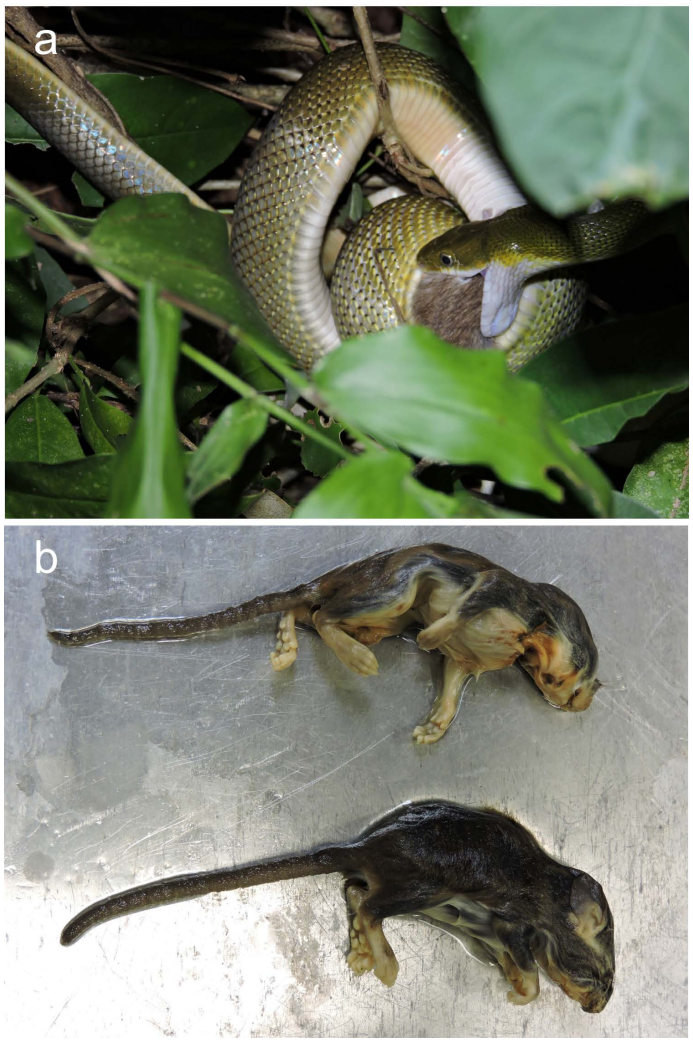

Figure 1. a) Adult individual of *Senticolis triaspis* feeding on the rodent *Xenomys nelsoni*, b) Juvenile specimens of *X. nelsoni*.

There is little information available on the ecological aspects of *X. nelsoni*; some specimens have been collected on trees of *Trichilia cf. hirta*, *Annona reticulata*, *Bursera simaruba*, *Castilla elastica*, and *Calocarpum mammosum* (Schaldach 1960; Ceballos *et al.* 2002). Previous studies suggest that the reproductive period of *X. nelsoni* occurs in the dry season and in the rainy season from May to November (Ceballos and Miranda 2000). This species nests in hollow trees and has a litter size of two young (López-Forment *et al.* 1971).

Nests of *X. nelsoni* can be found in tree cavities (Valdivia-Hoeflich *et al.* 2005) and branches of *Trichilia cf. hirta* at 10 to 13 meters high (Schaldach 1960). However, it is currently unknown whether the nests found correspond to *X. nelsoni*, *Nyctomys sumichrasti*, or *Handleyomys melanotis* (Domínguez-Castellanos *et al.* 2007). Considering the litter size reported, both specimens of *X. nelsoni* may have been preyed on or near the nest, since they were juveniles. The *S. triaspis* individual was spotted in the closed canopy of the low deciduous forest, a habitat where the presence of nests of *X. nelsoni* has been reported in the literature (Valdivia-Hoeflich *et al.* 2005).

Although it is thought that the potential natural predators of *X. nelsoni* include snakes, birds of prey, and medium-sized mammals, no previous observational data on the predators of this species had been noted before this report (Schaldach 1960; Ceballos 1989; Ceballos and Miranda 2000; Domínguez-Castellanos *et al.* 2007). In this sense, this report represents the first direct evidence of predation of *X. nelsoni*, and also provides information on the diet of the snake *S. triaspis,* hence contributing data on the interactions between both species in the ecosystem.

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Morelet's crocodile predation by jaguar in the Calakmul Biosphere Reserve in southeastern México

Depredación del cocodrilo de pantano por jaguar en la Reserva de la Biósfera Calakmul en el sureste de México

David E. Simá-Pantí[1], Fernando M. Contreras-Moreno[2*], Carlos Coutiño-Cal y Mayor[1], José A. Zúñiga-Morales[1], Gabriela Méndez-Saint Martin[1], and Rafael A. Reyna-Hurtado[3]

[1] Comisión Nacional de Áreas Naturales Protegidas, Reserva de la Biosfera de Calakmul. Calle Puerto Rico s/n, CP. 24640, Campeche. Campeche, México. Email: davidenri62@hotmail.com (DES-P), ccalymayor@hotmail.com (CC-CYM), jzuniga@conanp.gob.mx (JAZ-M), mendez.blue93@hotmail.com (GM-SM).

[2]Proyecto GEF Especies en Riesgo, CONANP-PNUD, Reserva de la Biósfera de Calakmul. Calle Puerto Rico s/n, CP. 24640, Campeche. Campeche, México. Email: fernandom28@hotmail.com (FMC-M).

[3]Departamento de Conservación de la Biodiversidad, El Colegio de la Frontera Sur, Unidad Campeche. Av. Rancho, Polígono 2A, CP. 24500, Campeche. Campeche, México. Email: rreyna@ecosur.mx (RR-H).

* Corresponding author

Panthera onca is the largest feline in America. Its diet has been studied in several countries, and reptiles have been identified as part of it. Despite being one of the most studied felines in Mexico, the depredation of *P. onca* towards crocodiles had not been documented with photographic evidence until now. This note documents for the first time with a photograph, a *Crocodylus moreletti* depredated by a *P. onca*, in southeastern Mexico.

Key words: Calakmul; carnivores; diet; mammals; whaterholes; wild cats.

Panthera onca es el felino más grande de América, su dieta ha sido estudiada en diversos países, y se ha identificado que los reptiles son parte de ella. A pesar de ser uno de los felinos más estudiados en México, hasta ahora no se había documentado con evidencia fotográfica la depredación de *P. onca* hacia cocodrilos. En esta nota se documenta por primera vez en fotografía un individuo de *Crocodylus moreletti* depredado por un *P. onca*, en el sureste de México.

Palabras clave: Aguadas; Calakmul; carnívoros; dieta; felinos silvestres; mamíferos.

In México, the most important jaguar populations are found in the southeast of the country. An estimated population size of over 900 jaguars has been estimated in the Calakmul region of Campeche alone (Ceballos *et al.* 2002). This area has been classified as high priority for jaguars (Sanderson *et al.* 2002). Actually the potential habitat for jaguar, is mainly found in the Jaguar Conservation Units (JCU) located in the southern and eastern portions of the Yucatán Peninsula, in areas such as Calakmul (including the Maya Reserve in Guatemala and Río Negro in Belize; Rodríguez-Soto *et al.* 2011; Rabinowitz and Zeller 2010). Recently a study to validate a corridor for jaguars in Campeche, Hidalgo-Mihart *et al.* (2015, 2017), found the presence of jaguars in various of the areas considered as part of the Calakmul-Términos Lagoon corridor. Camera trapping showed female jaguars, as well as the presence of animals for more than one season in the same area, which could be considered as evidence of a resident population.

Jaguars are opportunist carnivores whose diet varies according to prey availability, including more than 85 species of mammals, birds, reptiles and large invertebrates (De Azevedo and Murray 2007; Reid 2009; Aranda 2012), in México has been documented as variable but some preys are preferred, such as the white-tailed deer (*Odocoileus virginianus*), the collared peccary (*Pecari tajacu*), the coatimundi (*Nasua narica*) and the nine banded armadillo (*Dasypus novemcinctus*; Aranda and Sánchez-Cordero 1996; Núñez *et al.* 2000). Recently, it has been documented that jaguars have modified their diets to include smaller animals, unlike Pleistocene's Era where they mainly fed on large animals (Ripple *et al.* 2014). Reptile predation by jaguar has been documented in México but mostly on turtles (Emmons 1989; Cuevas *et al.* 2014). The crocodilians also are components of the jaguar diet, especially during the first stages of jaguar life. In Amazonia, jaguars frequently feed on caiman (*Melanosuchus niger*; Cavalcanti and Gese 2010; Da Silveira *et al.* 2010). However, in México crocodilian predation has been poorly documented. For example, in Calakmul, Pérez-Flores (2018) documented jaguar predation on *Crocodylus moreletti*, based on evidence left on a crocodile's dead body.

In this article we report a case of *C. moreletti* captured by a jaguar based on photographic evidences collected by camera traps in the Calakmul Biosphere Reserve (CBR), near waterholes (locally called aguadas) which are the main source of water, both for wildlife and for humans.

These waterholes are the only source of water for wildlife and for most of the human communities that surround the protected area (Reyna-Hurtado *et al.* 2010). This water scarcity in the region makes these waterholes a meeting point for several wild species. The change in rainfall patterns in recent years in Calakmul due to climate change increases the problem of waterholes (Mardero *et al.* 2019).

From February to June 2019 ten digital camera traps: Cudddeback (Non Typical Inc., De Pere, WI, USA), and Browning (Trailcam pro), were deployed in 10 waterholes (calls locally aguadas) located in the CBR with the goal of recording wildlife species visits to southern México. Cameras were tied to a nearby tree at an approximate height of 50 cm and were aimed at the waterhole. The cameras were programmed to take pictures continuously for 24 hours.

On March 19, 2019, a camera located at 18°18'42.27" N and 89°51'22.93" W took a photographic record of a male jaguar carrying, in its mouth, a dead juvenile *C. morelletti* (Figure 1). In Calakmul region, *C. morelletti* is the only species of crocodilians that has been recorded (Barao-Nóbrega *et al.* 2016). The photo shows the jaguar holding the dead C. *morelletti* by the head, apparently transporting it to another place. It is also possible to observe the jaguar's body covered in mud, most likely from getting the crocodile from the waterhole.

This photo is an evidence of a natural jaguar behavior that is reported as very common in South America but has rarely been documented in México, which may be due to the lack of camera traps in wetlands. The photo was taken in March, one of the driest months of the year in the area.

Figure 1. a) Jaguar (Panthera onca) carrying a crocodile (*Crocodylus moreletti*) obtained with camera trap in 18°18'42.27" N and 89°51'22.93" W, in Calakmul Biosphere Reserve on the Yucatán Peninsula, Mexico. b) The jaguar was observed returning to the same camera trap station 5 days later, suggesting that it is a resident of the area.

In the CBR the soil is made of calcareous origin and most of the rain falls percolate underground where there are only a few places for water to accumulate. In 2019, water levels in the waterholes were very low, due to a very poor rainy 2018 season, which made crocodiles an easy prey for jaguars. As seen in the photo, the jaguar was entirely covered in mud, suggesting that it entered the waterhole to capture its prey.

The waterhole where the photograph of a jaguar with a crocodile in its mouth was recorded is approximately a 1 ha area and is surrounded by trees with a dominance of *Haematoxylum campechianum* and *Bucida buceras*, which maintains a high canopy cover over the waterhole. It is a site where is kept a constant presence of tourists, since it is located on the only road to the archaeological zone of Calakmul. In this watering hole the biological monitoring is constant, on the behalf of the CBR. The aguadas in CBR are the main source of water, both for wildlife and for humans. A study by Reyna-Hurtado *et al.* (2019) mentions that the availability of water in the reserve was drastically reduced in early 2018. The level of aguadas in recent years has reduced due to the decrease in precipitation and the prolonged droughts. Recently, rainfall prediction models for the area and for the Yucatán Peninsula suggest that rainfalls have changed dramatically in the last 40 years. Over the past ten years, these changes have been particularly intense for the CBR (Mardero *et al.* 2019).

During the dry season, many aguadas are dry and some with minimum water levels. In the dry season, the fauna uses the waterholes to hydrate and reproduce, among other physiological needs. For example, the white-lipped peccary is one of the main preys of the jaguar, however, this species needs the aguadas for its survival. By decreasing the level of aguadas due to the lack of rainfall, the peccaries are forced to travel greater distances in the search for water. Also, this condition of aguadas has led crocodiles to become easy preys for jaguars. Normally, all the watering holes register presence of crocodiles. Jaguars are likely to stay within their range of activity by taking advantage of available prey, while peccaries make large migrations to more humid sites due to the size of the herd. This record provides information on the behavior of the jaguar and indicates that at least occasionally, it hunts morelet's crocodiles and that they are probably part of its diet in the CBR. All these changes in the ecosystem need to be monitored and understood to elaborate conservation or management actions to preserve Calakmul Biosphere Reserve's endangered species and their interactions.

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Interaction between Ground Squirrels with rattlesnakes in arid zones

Interacción entre ardillas terrestres con serpientes de cascabel en zonas áridas

Gabriel P. Andrade-Ponce[1], Sandra H. Montero-Bagatella[1*], Jessica Duran-Antonio[1], Alberto González-Romero[1], and Sonia Gallina[1]

[1]Red de Biología y Conservación de Vertebrados, Instituto de Ecología A. C., Carretera Antigua a Coatepec 351, CP. 91073, El Haya, Xalapa, México. E-mail: gpandradep@unal.edu.co (GPA-P), helena.bagatella@gmail.com (SHM-B), jess.durant@outlook.com (JD-A), alberto.gonzalez@inecol.mx (AG-R), sonia.gallina@inecol.mx (SG).
*Corresponding author

The predation of ground squirrels by rattlesnakes has influenced the development of specialized anti-predatory strategies by squirrels. This note describes two cases of encounters of squirrels with rattlesnakes in México, captured photographically. The first event is the interaction between an individual of *Xerospermophilus spilosoma* and one of *Crotalus atrox* in the Mapimí Biosphere Reserve, Durango, an arid area of the Chihuahuan Desert in northern México. The second event involved two individuals of *X. perotensis* and one of *C. scutulatus salvini* in the Perote Valley, a semi-arid zone of Veracruz. Both squirrel species displayed anti-predation behaviors reported for the genus, as well as the ability to spot snakes and communicate the alert status to other group members; thus, these observations contributes to the knowledge of the natural history of these species.

Key words: arid and semi-arid areas; behavior; México; predator-prey; *Xerospermophilus*.

La depredación de ardillas terrestres por serpientes de cascabel ha influido en el desarrollo de estrategias antidepredatorias especializadas por parte de las ardillas. En esta nota se describen dos casos de encuentros de ardillas con serpientes de cascabel, capturados fotográficamente en México. El primer evento es la interacción entre un individuo de *Xerospermophilus spilosoma* y uno de *Crotalus atrox* en la Reserva de la Biósfera de Mapimí, Durango, zona árida del Desierto Chihuahuense al norte del país. El segundo evento lo componen dos individuos de *X. perotensis* y uno de *C. scutulatus salvini* en el Valle de Perote, zona semiárida de Veracruz. Ambas especies de ardillas presentaron comportamientos antidepredadores reportados para su género, así como la capacidad para identificar a las serpientes y transmitir el estado de alerta a sus congéneres; por lo que estas observaciones contribuyen con el conocimiento de la historia natural de dichas especies.

Palabras clave: comportamiento; depredador-presa; México; *Xerospermophilus*; zonas árida y semiárida.

Ground squirrels are an important food source for rattlesnakes, representing up to 60 % of their diet (Fitch 1949). As a result, some sciurids have developed specialized anti-predator strategies (*e.g.*, resistance to venom, alerting and deterrence behaviors such as tail flagging; Clark *et al.* 2016). However, the knowledge of these strategies comes from the study of a limited number of species (*i.e.*, *Otospermophilus beecheyi*; Barbour and Clark 2012; Ayón *et al.* 2017), while others, such as those of the genus *Xerospermophilus,* have received less attention in spite of their higher vulnerability from their lesser physical capacity when facing an attack (Hersek and Owings 1993; Clark *et al.* 2016). In addition, most of their natural history is still unknown, including interactions with predators. Thus, this study aims to describe the anti-predator behaviors of the spotted ground squirrel, locally known as juancito (*Xerospermophilus spilosoma*) and the endemic Perote ground squirrel, commonly known as chichilote or moto (*X. perotensis*), during encounters with rattlesnakes in two different locations in México. *X. perotensis* is considered as endangered by the International Union for the Conservation of Nature (IUCN) and as threatened by the Official Mexican Norm NOM 059 (SEMARNAT 2010).

Study Area. The sightings occurred in the Mapimí Biosphere Reserve (MBR) and in the Perote Valley (PV). The MBR is a natural protected area in the Chihuahuan Desert located in the convergence of the states of Durango, Chihuahua, and Coahuila. Its elevation range is 1,100 to 1,400 m (CONANP 2006). The climate is dry semi-warm, with a mean annual precipitation of 264 mm and mean annual temperature of 20 °C (CONANP 2006). The dominant vegetation comprises halophilous grassland and xerophilous shrubland (CONANP 2006). The PV stretches across the border between the states of Veracruz and Puebla. Its elevation ranges between 2,300 and 2,500 m (Gerez 1985). Its climate is semi-arid temperate (García 2001), with a mean annual temperature of 14 °C and a mean annual precipitation of 500 mm. The vegetation includes pine forests with tascate juniper (*Juniperus deppeana*), thorny bushes, natural grasslands and induced pastures, hayfields, and halophilous vegetation (Gerez 1985).

Record collection. X. spilosoma was recorded in the MBR on September 10th 2018 through a camera trap (Cuddeback Black Flash®, Model 1231; 26° 45′ 37″ N, 103° 41′ 03″ W) used for sampling carnivore mammals (Andrade-Ponce

et al. 2020) and set to capture photographs at 10-second intervals, approximately. The habitat was a shrubland bordering a semi-stabilized dune and dominated by *Larrea tridentata* and *Opuntia imbricata*. The record of *X. perotensis* was a direct observation recorded and digitally photographed on 21th August 2013 near the town of San Antonio El Limón, Perote, Veracruz (19º 31' 05" N, 97° 19' 40" W), while conducting car trips searching for the species (Montero-Bagatella *et al.* 2017, 2018).

In the MBR, we recorded the agonistic encounter between *X. spilosoma* and *C. atrox*. The event occurred at 18:50 h and lasted 3 minutes; with a total of 14 photographs captured. The first photos show an individual of *C. atrox* in motion; one minute later, the presence of one specimen of *X. spilosoma* was recorded, which presumably made the snake to change the direction of its displacement (Figure 1). The squirrel intercepted the path of the snake and then adopted a posture that suggests a movement characterized by a rapid tail flagging. In the last frames, the squirrel remained approximately 30 cm away from the snake until the latter moved out of the camera's field of view.

In the PV, at approximately 14:00 h we observed the interaction between an individual of *X. perotensis* and an individual of *C. scutulatus salvini* in a short grassland (*Bouteloua* spp., *Aristida divaricata, Bidens anthemoides*). The squirrel deployed alerting behaviors while the snake moved across the vegetation. The squirrel adopted a bipedal posture accompanied by cervical movements in search of the snake, with the tail erect, tail flagging, and a repetition of short vocalizations. This behavior was received and replicated by another individual located 30 cm away. The squirrels kept a distance of 30 to 40 cm from the snake while moving quickly, in a parallel direction to it (Figure 2; Appendix 1). On several occasions, the squirrels crossed their paths, they stopped, adopted a bipedal position and vocalized. The vocalizations continued for some additional 1 to 2 minutes, despite the snake already being far away. The event lasted approximately 4 to 5 minutes.

Figure 1. Enlarged photograph of the encounter between the Spotted ground squirrel (*Xerospermophilus spilosoma*) and a Western diamond-backed rattlesnake (*Crotalus atrox*) in the Mapimí Biosphere Reserve, México.

Figure 2. Photographic records of the encounter between a Perote ground squirrel (*Xerospermophilus perotensis*) and a Perote grassland rattlesnake (*Crotalus scutulatus salvini*) at Perote Valley, México.

The squirrels exhibited anti-predator behaviors as reported for species of the same genus, including tail flagging, inspection of the predator, and vocalizations to alert other squirrels (Clark *et al.* 2016). In the case of *X. perotensis*, the vocalizations and alertness status were maintained after the withdrawal of the predator, which is likely to increase the chances of survival in future attacks (Putman and Clark 2014). Nevertheless, this was not evidenced for *X. spilosoma* due to methodological limitations of camera-traps. *Ictidomys mexicanus,* a species of similar size to those studied, is resistant to rattlesnake venom and can even get to counterattack the snake (Martinez *et al.* 1999). However, the records obtained are not conclusive as to the presence of these traits in the studied species. Nonetheless, the observations reported here suggest the ability of both species to detect the presence of snakes and producing communication alerts to other nearby squirrels. The above provides approximations about the natural history and evolution of interacting species, as characteristics such as size, physiology, habitat, and coevolution with the predator influence anti-predator behaviors; which may differ in species of close lineages (Clark *et al.* 2016). Therefore, further research efforts are needed to characterize the anti-predator strategies of species of the genus *Xerospermophilus*.

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Appendix 1

Video of the encounter between *Xerospermophilus perotensis* and *Crotalus scutulatus salvani* at Perote Valley, México.

https://drive.google.com/file/d/1LUWGZ61QO_BCuFLoeJ6v8Rd__1_5kLCe/view

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New record in the diet of *Philander andersoni*

Nuevo registro en la dieta de *Philander andersoni*

Alejandra Niño-Reyes[1]*, Baltazar González[3], Alejandro Navarro-Morales[2], Albeiro Moreno[2], Alexander Velásquez-Valencia[2], Gover Capera[4], and Juan Camilo Cepeda-Duque[5]

[1]Centro de Investigación Ambiental y de Estudios Socioeconómicos (AMAZONIAMBIENTAL), Gestión y Evaluación de Proyectos, Universidad de la Amazonia, CP. 180002, Florencia, Caquetá, Colombia. Email: alejandra.vtab@gmail.com (AN-R).

[2]Centro de Investigación de la Biodiversidad Andino Amazónica (INBIANAM), Universidad de la Amazonía, CP. 180002, Florencia, Caquetá, Colombia. Email: alejandronavarromorales@gmail.com (AN-M), amorenooliveros@gmail.com (AM), alexandervelasquezvalencia@gmail.com (AV-V).

[3]Centro de Investigaciones Esquel de Montaña y Estepa Patagónica (CIEMEP), CP. 9200, Esquel, Chubut, Argentina. Email: baltazargch@gmail.com (BG).

[4] Junta de acción comunal, Vereda Peregrinos, CP. 184018, Solano, Caquetá, Colombia.

[5]Grupo de investigación en Biología de la Conservación y Biotecnología de la Corporación, Universitaria de Santa Rosa de Cabal, CP. 661020, Risaralda, Colombia. Email: acinonyxjubatus96@gmail.com (JCC-D).

*Corresponding author

Marsupial species of the family Didelphidae comprise the most diverse extant group of Metatherians inhabiting South America and part of North America. This family comprises more than 95 species, among which the members of the subfamilies Didelphinae and Caluromyinae include the largest species (> 150 g). Although widely distributed, information about their feeding habits is relatively scarce, especially for species of the genus *Philander*. Here we present the first record and description of a predatory event on the Tropical Flat Snake (*Siphlophis compressus*) by the Anderson's Four-eyed Opossum (*Philander andersoni*) in the Amazonian region of Colombia. During the predation event, we made *ad libitum* observations for about 12 minutes, using a camera to record the feeding behavior of *P. andersoni*. The event was recorded on October 31, 2018. During a nocturnal survey, we observed one individual adult of *P. andersoni* while consuming a specimen of *S. compressus*. The marsupial bited and pulled the snake body with its premolar dentition and forelimbs respectively to consume the prey's soft parts. This record shows that although *S. compressus* exhibits several antipredator characteristics, such as an aposematic elapid-like colored pattern, elusive behavior and Durvenoy glands, *P. andersoni* was able to feed upon this species in a stereotyped way. To the best of our knowledge this is the first documented consumption event of this snake by a mammal species, yielding new information about the feeding habits of *P. andersoni* and the predators of *S. compressus*.

Key words: Amazonian region; behavior, Colombia; Didelphidae, diet, rainforest.

Las especies de marsupiales de la familia Didelphidae comprenden el grupo más diverso de marsupiales que habitan América del Sur y América del Norte. Esta familia está integrada por más de 95 especies entre las cuales, las pertenecientes a las subfamilias Didelphinae y Caluromyinae son las de mayor tamaño corporal (>150 g). A pesar de su amplia distribución, la información sobre sus hábitos alimenticios es escasa, especialmente para las especies pertenecientes al género *Philander*. Aquí presentamos el primer registro y descripción de un evento de depredación de *Philander andersoni* sobre la serpiente plana tropical *Siphlophis compressus,* en la región Amazónica de Colombia. Por medio de observación *ad libitum* describimos la conducta alimenticia de *P. andersoni* sobre un individuo de *S. compressus*. El evento se registró el 31 de octubre de 2018. Durante un transecto nocturno se observó un individuo adulto de *Philander andersoni* mientras consumía a un espécimen de *Siphlophis compresus*. El marsupial mordió y haló el cuerpo de la serpiente con ayuda de su dentición premolar y sus extremidades anteriores para extraer y consumir las partes blandas del cadáver. Este registro indica que a pesar de que *S. compressus* presenta una serie de mecanismos antidepredatorios, como el patrón aposemático de coloración semejante a los elápidos, las conductas evasivas y las glándulas de Durvenoy, *P. andersoni* tiene la capacidad de consumir a esta serpiente de forma estereotipada. Este es el primer evento de consumo de *S. compressus* por un mamífero y aporta nuevos detalles acerca de los hábitos alimenticios de *P. andersoni*.

Palabras clave: Colombia; comportamiento; Didelphidae; dieta; región Amazónica; selva.

With slightly more than 100 species, the living South American marsupials (Marsupialia: Metatheria) are one of the most taxonomically and ecologically richest groups of mammals in the Neotropics (Goin *et al.* 2016). Among this group, the family Didelphidae comprises more than 95 species distributed in approximately 19 genera (Voss and Jansa 2009). Within the extant subfamilies, Caluromyinae and Didelphinae contain the largest members of the group (> 150 g), some of them with distinctive morphological traits, such as the presence of colored patches above the eyes, distinctive of the genera *Philander* and *Metachirus* (Voss and Jansa 2009).

Given the highly opportunistic feeding behavior of several species within the didelphid group, the inclusion of animal-related items in their diet is common (Vieira and Moraes 2003). For example, the species of the genus *Philander* are

occasional predators which consume a wide variety of arthropods and, to a lesser extent, vertebrates (Vieira and Moraes 2003; Cáceres 2004; Macedo *et al.* 2010; Voss *et al.* 2018).

The genus *Philander* includes eight cursorial or scansorial species with omnivorous habits, mostly inhabiting in primary and secondary rainforests (Voss *et al.* 2018). The distribution of *Philander* ranges from the Tamaulipas region in the northeastern portion of Mexico to the Atlantic rainforest of southern Brazil (Voss *et al.* 2018). Information about the natural history, ecology, and behavior of several species within the genus is still scarce (Vieira and Moraes 2003). Regarding their feeding habits, there is some information available about *P. frenatus* (Cáceres 2004) and *P. opossum* (Castro-Arellano *et al.* 2000; Gómez-Martínez *et al.* 2008), while for *P. andersoni,* information remains scarce.

Here we report the first documented event of predation and consumption on the Tropical Flat Snake (*S. compressus*) by *P. andersoni* in the Amazonian forests of Solano, Caquetá and discuss some issues related to *P. andersoni* and *S. compressus* in Colombia.

The predation event was recorded on the right margin of the Caquetá river near of vereda Peregrinos (00° 03′ 48.8″ S, 74° 34′ 19.1″W), Solano municipality, at the limit between Putumayo and Caquetá department. The area has a mean elevation of 172 m, a mean annual temperature of 25°C, and a mean annual precipitation of 3,000 mm. The geography consists mainly of low fertility soils that are dry for part of the year but flood during rainy seasons (Cortes-Ávila and Toledo 2013). The vegetation displays features of a stationary flooded rainforest with a high degree of intervention due to logging activities, as well as crop and pasture production (Cortes-Ávila and Toledo 2013). On October 31st 2018, at 18:11h on a nocturnal expedition, both species were observed during an *ad libitum* mammal inventory developed as part of a larger project named "Community agrotourism for the enhancement of economic income, promotion of responsible and sustainable participatory initiatives in a territory with a zero-deforestation approach" in Solano, Caquetá, and was conducted by the University of Amazonia (Colombia).

Given that we were unable to collect the observed individual of *P. andersoni*, we identified the species based on its distribution (Astúa *et al.* 2016; Patton and da Silva 1997) and external morphology, following Hershkovitz (1997) and Voss *et al.* (2018). Accordingly, *P. andersoni* can be identified by the presence of a well-marked dorsal stripe and a creamy to creamy-gray colored venter, together with an Amazonian distribution. Regarding the snake identification, we were unable to measure and count the scales to identify the individual. Instead, we based the identification on the coloration and geographic distribution of the species, as described by Aponte-Gutiérrez and Vargas-Salinas (2018). At the moment both individuals were observed, we recorded a video and photos to describe the behavior of *P. andersoni*.

One adult of unknown sex of *P. andersoni* was recorded feeding on a *S. compressus* exhibiting a series of behaviors that we describe herein. At the moment of sighting, the marsupial was attacking the prey at ground level, using its snout and forelimbs to sense and grasp the snake. After being alerted by the investigator's presence, the marsupial took the prey (still alive) in his mouth and transported it to a less-open refuge for subsequent feeding (Figure 1a). After finding refuge, the opossum used repeatedly its snout and forelimbs to explore the long body of the snake, seemingly to locate the cloacal region (Figure 1b). At this time, the snake ceased to move, however the exact moment at which *P. andersoni* killed the snake could not be determined.

The carcass manipulation consisted of an iterated use of the opossum's mouth and forelimbs to identify potential tissues to consume. The opossum smelled the body, grasped the snake's scales with the premolar dentition while grabbing the prey with the forelimbs. During this exploratory phase, *P. andersoni* kept a semi-erect posture (although somewhat more horizontal than vertical), where the weight of the body rested mainly on its hindlimbs and vertebral column (Figure 1b). This phase lasted about 2 minutes, but during this time the opossum stopped several times to sniff the air, which could be caused by the investigator's presence (Figure 1a).

After locating the cloacal region, *P. andersoni* used its premolars and molars to perforate the body while holding the snake firmly with the forelimbs. Subsequently, the opossum used the tongue and incisors to extract the gonads from the carcass, holding the organs with its mouth. Then, by repetitive pulling movements with the head while pushing down the carcass with the forelimbs, *P. andersoni* separated the gonads and ingested them. Next, *P. andersoni* continued to consume the snake's guts in the same way described for the gonads. When necessary, *P. andersoni* also used its premolars and molars for cutting and separating parts of the carcass to ingest. When *P. andersoni* was chewing, it used its forelimbs to hold down the carcass and to lean on the ground at the same time, thus adopting a more quadrupedal position than when exploring the snake carcass (semi-erect position). At one point, *P. andersoni* used one forelimb to grasp the guts of the snake rather than to hold the carcass, as observed earlier. Chewing and consuming events were alternated with exploratory events, in which the opossum used its teeth and mouth rather than the forelimbs to manipulate the carcass. We did not register any grooming behavior during and before the feeding lapse, however our observation time was relatively short (approximately 12 minutes).

Here we presented the first record of *P. andersoni* preying on a *S. compresus* snake. Our report adds to the list of prey items reported for didelphids, and specifically, offers new insights about the diet and feeding behavior of *P. andersoni*.

Although this is a single observation, evidence from other related marsupials when feeding upon snakes (*e.g.*, *Didelphis marsupialis*; Almeida-Santos *et al.* 2000, and *P.*

Figure 1. Photographs of an Anderson's Four-eyed Opossum (*Philander andersoni*) feeding on a Tropical Flat Snake (*Siphlophis compressus*) at vereda Peregrinos, Solano, Caquetá, Colombia on October 31, 2018, showing: a) alerted watching in-between episodes of feeding; b) manipulative posture and forelimb handling of the snake carcass. Photos by A. Moreno.

opossum; Gómez-Martínez *et al.* 2008) suggests that the predation behavior observed is stereotyped rather than random. For example, our observation of a non-attacking behavior by the snake while the opossum fed from the posterior end of it, was registered by Almeida-Santos *et al.* (2000) when a *Crotalus durissus* was offered to an individual of *D. marsupialis*. Besides, these authors registered that killing the snake by biting his head occurred only when the snake counter-attacked the opossum, which is consistent with our observation: *S. compressus* did not exhibit a defensive behavior towards the opossum while the predation event occurred, and *P. andersoni* did not directly bit or killed the snake by the head. This differs from the observations made by Emmons 1990 of a *P. opossum* feeding upon a coral snake where decapitation of the snake was made, but presumably after the snake counter-attacked.

Regarding the carcass manipulation, *P. andersoni* displayed differences compared to other marsupials' behavior. For example, when feeding upon snakes, *D. marsupialis* sat entirely on its hindlimbs and, during the complete event, manipulated the prey with its forelimbs (Almeida-Santos *et al.* 2000; see also Streilein 1982). Rather, we observed *P. andersoni* assuming a quadrupedal position when taking bites of flesh or guts (using its forelimbs for counter-force) and when chewing (Appendix 1). However, when exploring the carcass, *P. andersoni* sat on its hindlimbs, like *D. marsupialis*. Similar but not identical manipulation behavior has been observed in other marsupials, including *Lestodelphys halli* (Martin and Udrizar-Sauthier 2011) and *Caenolestes fuliginosus* (Martin and González-Chávez 2016). In addition, consuming the posterior end of the snake first is consistent with previous evidence about the preference for soft tissues, such as the cloaca (Almeida-Santos *et al.* 2000) and the brain (Martin and Udrizar-Sauthier 2011), we did not record registered any grooming behavior, but it is usual for didelphids to display this type of behavior before and after the feeding (Martin and Udrizar-Sauthier 2011). Unfortunately, we were unable to record these phases. Future observations should clarify if *P. andersoni* displays stereotyped grooming behaviors as other didelphids.

Several non-venomous snake species display antipredator traits than can be morphological (*e.g.*, aposematic coloration, removable tail), behavioral (*e.g.*, tree-scape reaction, body contortion, raising, coiling into s-shape), and physiological (*e.g.*, segregation of low-concentrated venom and highly repulsive substances; Greene 1983; De Oliveira *et al.* 2018). For instance, *S. compressus* can produce and segregate a low-concentrated paralyzing venom with its opisthoglyphous dentition, together with a harassing substance secreted by the Durvenoy's and anal glands, and reddish and black body color pattern (Solórzano 2004; De Fraga *et al.* 2013). Yet, as described here, *P. andersoni* was able to feed readily, seemingly unaffected by this type of antipredator traits, upon the snake.

In this sense, it has been established that the aposematic characteristics of these snakes are not usually effective to repel mammals capable of tolerating high concentrations of venom (Voss and Jansa 2012) or where predators are able to discriminate between lethal and non-lethal snake species (Buasso *et al.* 2006; França *et al.* 2016). Furthermore, species of the genus *Philander* usually feed on carcasses (Gómez-Martínez *et al.* 2008; Macedo *et al.* 2010), which can be related with the ability to tolerate decomposition smells and thus catch and consume preys capable of expelling repulsive substances. Consequently, this report is in some way circumscribed by previous knowledge (*i.e.*, an opossum preying on a non-venomous yet aposematic snake). However, to the best of our knowledge, there is no published evidence of hunting and consumption on *S. compressus* by a Neotropical mammal (Emmons 1990; Martins *et al.* 2008) and this report is the first filmed and published evidence of such event.

The lack of information about many Neotropical marsupials can be related to their elusiveness, nocturnal habits, and small size, compared to other mammals (Voss *et al.* 2019). This is the case for *P. andersoni* and many other species that although present in local assemblages, few studies exist about their biology. In this sense, information from unrelated projects (as the case of this note) can be useful for augmenting and improving our knowledge of these species and their importance in the areas they inhabit.

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Appendix 1

Video of an Anderson's Four-eyed Opossum (*Philander andersoni*) feeding on a Tropical Flat Snake (*Siphlophis compressus*) at vereda Peregrinos, Solano, Caquetá, Colombia.

https://drive.google.com/file/d/1lgJzwMlKvhMoGFfgV5unjfhfKShl8ern/view?usp=sharing

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Ocelot (*Leopardus pardalis*) potential predation on a gray fox (*Urocyon cinereoargenteus*)

Depredación potencial de zorra gris (*Urocyon cinereoargenteus*) por parte de un ocelote (*Leopardus pardalis*)

Mircea G. Hidalgo-Mihart[1,2]*, Alejandro Jesús-de la Cruz[2], and Rugieri Juárez-López[1]

[1] División Académica de Ciencias Biológicas, Universidad Juárez Autónoma de Tabasco, km 0.5 carretera Villahermosa-Cárdenas, CP. 86040, Villahermosa, Tabasco, México. E-mail: mhidalgo@yahoo.com (MGH-M), ecolrugieri@hotmail.com (RJ-L).
[2] Panthera México, Recreo 48, Col. Centro, CP. 37700, San Miguel de Allende, Guanajuato, México. E-mail: alexjc05@hotmail.com (AJ-C).
* Corresponding author

Gray fox (*Urocyon cinereoargenteus*) are commonly killed by other carnivores which can cause local population reductions. In tropical forests, the potential predators of gray fox are mostly large and medium sized felids. As part of a biodiversity survey using camera traps in the Yucatán Peninsula, we recorded an ocelot (*Leopardus pardalis*) carrying a gray fox in its mouth. Although we did not find evidence that the ocelot effectively predated the gray fox, the fact that was carried by the ocelot, potentially indicates the predation event. If this predation event is confirmed, this is the first time that a gray fox has been recorded being predated by an ocelot. Given that gray fox is the most abundant carnivore in the region, current reduction in ocelot populations due to human disturbances could have important effects on the species, such as an increase in their population size due to the reduction in predatory pressure.

Key words: Balam Ku; Calakmul; Campeche; diet; intraguild predation.

La zorra gris (*Urocyon cinereoargenteus*) es comúnmente depredado por otros carnívoros lo cual tiene como consecuencia reducciones locales en sus poblaciones. En los bosques tropicales, los depredadores potenciales de la zorra gris son en su mayoría felinos medianos y grandes. Como parte de un trabajo para determinar densidad de grandes felinos en la península de Yucatán, obtuvimos en una cámara trampa una fotografía en la que un ocelote (*Leopardus pardalis*) lleva en su boca una zorra gris. No encontramos evidencia de que la zorra gris fuera efectivamente depredada por el ocelote, pero el hecho de que el ocelote lleve en su boca a la zorra gris indica que potencialmente pudo existir el evento de depredación. De confirmarse este evento, sería la primera vez que se registra la depredación de una zorra gris por un ocelote. La zorra gris es el carnívoro más abundante de la región. La reducción actual en las poblaciones de ocelotes debido a disturbios humanos en la Península de Yucatán podría tener efectos importantes en especies como la zorra gris al favorecer el aumento de la población de esta especie ante la reducción de la depredación.

Palabras clave: Balam Ku, Calakmul; Campeche; dieta; depredación.

The gray fox (*Urocyon cinereoargenteus*) is a medium sized canid that is widely distributed from southern Canada to northern South America. In the United States, their major source of mortality is human related (Cypher 2003), but the gray fox is also commonly killed by other carnivores, raptors (Cypher 2003; Farias *et al.* 2005) or by disease (*e.g.*, distemper; Nicholson and Hill 1984), which can cause local population reductions. The most important gray fox predator is the coyote (*Canis latrans*); which usually only kills them but does not consume the meat (Farias *et al.* 2005), a process known as interspecific killing (*i.e.*, the killing of potentially competing species without any immediate energetic gain to the predator species; Polis *et al.* 1989). However, in areas where coyotes are inexistent or uncommon, such as the tropical forests of southeastern México and the Yucatán Peninsula, Central America and northern South America (Hidalgo-Mihart *et al.* 2004), the potential predators of the gray fox are the jaguar (*Panthera onca*), puma (*Puma concolor*) and the ocelot (*Leopardus pardalis*; De Oliveira and Pereira 2014).

Diet analyses have observed that pumas and jaguars occasionally feed on gray fox (Monroy-Vilchis *et al.* 2009; Ávila-Nájera *et al.* 2018). In the case of ocelots, although their food habits have been extensively studied in areas where ocelots and gray foxes are sympatric (*e.g.*, De Villa-Meza *et al.* 2002; Booth-Binczik *et al.* 2013; Gómez-Ortíz *et al.* 2015), gray fox remains have only been recorded in one ocelot scat in Belize (Mesa-Cruz *et al.* 2016). It is not possible to determine if this Belize gray fox was predated or scavenged. Ocelots scavenging behavior on road killed foxes (Crab eating fox; *Cerdocyon thous*) was commonly observed in Brazil (Crawshaw 1995), indicating that scavenging on fox species by ocelots it is an usual behavior for this species, supporting the possibility that the presence of gray fox remains in a scat in Belize could be due to scavenging. In this note, we describe for the first time a likely predation event of an ocelot on a gray fox obtained in a series of pictures from a camera trap in the Balam-Ku State Reserve, Campeche.

As part of a study aimed to determine the jaguar density in the Calakmul and Balam-Ku area in the south of the

Yucatán Peninsula, we installed a network of 69 camera trap stations separated for at least 2 km from each other, in an approximate area of 500 km^2. The area was located in the western part of the Calakmul Region in Campeche, a landscape of low hills that varies from 50-150 m. Climate in the region is warm (mean temperature during the year 26-28 °C) with precipitation ranging from 1000-1500 mm y^{-1} that occurs mostly during a five months rainy season (June to October; Instituto Nacional de Estadistica y Geografía 2015). The vegetation of the area is mostly composed by preserved tropical semideciduous forest (Rzedowski 2006) but selective logging in the region is common and has impacted the forest's species composition. We set 45 single and 24 double camera trap stations (Pantheracam Model IV or V) that were active during the rainy season from early July to the first part of October of 2018. We set the traps along pathways, firebreaks and roads in the region, tied to trees at a height of 50 cm and programmed to function 24 h a day.

On August 4, 2018 at 00:35, we obtained a picture of a male ocelot carrying a gray fox (Figure 1c). The camera was located on a dirt road inside a preserved area of the Balam Ku State Reserve (UTM 15N 804377, 2019223). In the image, the ocelot appears to be moving from right to left with the gray fox in its mouth. This picture was preceded by two photographs of the same ocelot (identified by the individual coat spotted pattern observed in this single camera trap station, and in a double camera trap neighborhood station; Di Bitetti *et al.* 2006) at 00:23; 00:32, without the gray fox (Figure 1a-b). The feline was identified as an ocelot because it is a medium sized spotted cat with a tail that is not bushy and shorter than the length of the hind legs (Reid 2009). The only medium-sized spotted cat that can be confused in the study area is the margay *L. wiedii*, but the ocelot is larger and heavier than that species, and the margay has a bushy tail that is longer than the hind legs (Reid 2009). The canid was identified as a gray fox because of the small and slim body and the mostly grayish fur with rusty ears, legs and chest, as well as the bushy tail. Also, the gray fox is the only canid of this size distributed along the study area (Reid 2009). We found no evidence of the ocelot consuming the gray fox in pictures nor did we find remains around the camera trap. It has been observed that when bobcats (a felid with similar size than the ocelot) killed gray foxes, the gray fox is at least partially consumed (Farias *et al.* 2005), contrary to what occurs when gray foxes are killed by coyotes in interspecific killing events. This suggests that even we did not found evidences of the ocelot consuming the gray fox, it is highly possible that the gray fox was consumed outside of the camera trap vision area.

Ocelot diets are mainly comprised of small mammals, but also include medium to large mammals, reptiles, amphibians, birds and fishes (De Villa-Meza *et al.* 2002; Booth-Binczik *et al.* 2013; Gómez-Ortíz *et al.* 2015). Other carnivore species (*e.g.*, coati *Nasua narica*, racoon *Procyon lotor* and tayra *Eira barbara*) have also been reported in ocelot's diet although not commonly (see De Oliveira and Pereira 2014 for a review). With the exception of the Belize diet analysis, where gray fox remains were observed in an ocelot scat (Mesa-Cruz *et al.* 2016), there are no other reports of ocelots feeding on gray foxes.

Figure 1. a) and b) Pictures of male ocelot (*Leopardus pardalis*) roaming in front of a camera trap obtained at the Balam Ku State Reserve, in the Yucatán Peninsula, México. c) Picture of the male ocelot carrying a gray fox (*Urocyon cinereoargenteus*).

Currently, in the Yucatán Peninsula the gray fox is one of the most common and abundant carnivores (Urquiza-Haas *et al.* 2009; Ávila-Nájera *et al.* 2018). Even though this is the first time that a gray fox has been recorded being poten-

tially predated by an ocelot, due to the abundance of this canid in the Yucatán Peninsula it is possible that ocelots and gray foxes commonly interact, and these predation events occur frequently. To determine the importance of this canid in the ocelot's diet, it is necessary to increase our knowledge of ocelot diet in the region.

The removal of larger predators has resulted in the increase in the numbers of gray fox, suggesting that predation limits some fox populations (Crooks and Soule 1999; Henke and Bryant 1999). Jaguars, pumas, and ocelots are the species most likely to have an impact on the structure of the Neotropical carnivoran guild. Of these three species, it is likely that the medium-sized ocelots exert the greatest impact as they attain higher population densities (De Oliveira and Pereira 2014). Current reduction in felid populations and specially ocelots due to the increase in human densities and consequent pressure in the Yucatán Peninsula (Urquiza-Haas *et al.* 2009) could have important effects on their prey, especially species like the gray fox that are already abundant in the area and could be more susceptible to an increase in population size if there is a reduction in predation.

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