Therya Notes

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AMMAC
Asociación Mexicana de Mastozoología A.C.

THERYA NOTES tiene como propósito difundir exclusivamente notas científicas con información original e inédita relacionada con el estudio de los mamíferos en todas las disciplinas que contribuyen a su conocimiento. Es un foro abierto para profesores, investigadores, profesionales y estudiantes de todo el mundo, en el que se publican notas académicas en español e inglés. THERYA NOTES es una revista digital de publicación cuatrimestral (tres fascículos por año) que recibe propuestas para publicación durante todo el año. Tiene un sistema de evaluación por pares a doble ciego y es de acceso abierto.

En la Portada

Algunas especies de murciélagos filostómidos (familia Phyllostomidae) construyen sus propios refugios masticando hojas o frondas de diferentes plantas para crear tiendas. A pesar de que existen especies que construyen este tipo de refugios en la zona, este comportamiento es poco conocido en Centroamérica. En este fascículo se presentan detalles sobre el comportamiento de construcción de tiendas por Artibeus jamaicensis y Dermanura sp. en Guatemala, incluyendo las densidades de estos refugios y nuevos registros sobre las plantas utilizadas por estos murciélagos en el país (Fotografía de L. Trujillo).

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 delmono 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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Melanistic northern red muntjac (*Muntiacus vaginalis*) in Nilgiris, Tamil Nadu, India

Muntíaco rojo del norte (*Muntiacus vaginalis*) melánico en Nilgiris, Tamil Nadu, India

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Melanism, the dominance of dark brown eumelanin over pheomelanin, is a rare condition in the Northern red muntjac (*Muntiacus vaginalis*) in India, resulting in a markedly darker pelage. This study reports a rare case of melanism in the northern red muntjac in the Upper Nilgiris, Tamil Nadu. On March 5, 2024, we observed 2 muntjacs feeding in an invasive species eradication area in Kottagiri, one of which exhibited a distinctive dark brown, nearly black coloration, suggesting melanism. This is one of only 6 documented cases of melanism in this species in India. The Nilgiris' high-altitude habitat, with dense vegetation and humid conditions, aligns with environments where other melanistic mammals have been reported, suggesting potential ecological factors at play. Further studies are warranted to explore the ecological and genetic bases of melanism in this species in the Nilgiris.

Key words: Atypical pigmentation; Cervidae; ecological adaptation; Indian mammals; melanism.

El melanismo, predominancia de la eumelanina marrón oscura sobre la feomelanina, es una condición rara en el muntíaco rojo del norte (*Muntiacus vaginalis*) en India, lo que resulta en un pelaje notablemente más oscuro. Este estudio informa un caso raro de melanismo en el muntíaco rojo del norte en la región superior de Nilgiris, Tamil Nadu. El 5 de marzo de 2024, observamos 2 muntíacos alimentándose en un área de erradicación de especies invasoras en Kottagiri, uno de los cuales presentaba una coloración marrón oscuro distintiva, casi negra, lo que sugiere melanismo. Este es solo uno de los 6 casos registrados de melanismo en esta especie en India. El hábitat de gran altitud en Nilgiris, con vegetación densa y condiciones húmedas, coincide con entornos donde se han reportado otros mamíferos melanísticos, lo que sugiere posibles factores ecológicos. Se necesitan estudios adicionales para explorar las bases ecológicas y genéticas del melanismo en esta especie en Nilgiris.

Palabras clave: Cervidae; mamíferos de la India; melanismo; observación de vida silvestre; pigmentación atípica.

The northern red muntjac, or barking deer (*Muntiacus vaginalis*), is a small and shy cervid species widely distributed across South and Southeast Asia (Habiba *et al.* 2021; Singh *et al.* 2022). This species is characterized by its chestnut-red coat, dark brownish-black facial markings, and small antlers (Timmins *et al.* 2016). Despite its adaptability to diverse habitats, including areas near human settlements, the population of the northern red muntjac is facing a decline due to habitat fragmentation caused by scattered human settlements, urbanization, and developmental activities (Jnawali *et al.* 2011; Mishra 1982).

Melanism, a phenotype resulting from the dominance of dark brown eumelanin over reddish-yellow pheomelanin, leads to a very dark pelage (Kettlewell 1973). While melanism has been documented in several mammalian species in India, it remains an extremely rare occurrence in the northern red muntjac, with only a few recorded cases in the country (Mahabal *et al.* 2019). In this note, we report a rare case of melanism observed in the northern red muntjac from the Upper Nilgiris, Tamil Nadu, India, contributing to the limited knowledge of this unique phenotype in the species.

The Nilgiris district (11° 00′ 00″ N – 12° 00′ 00″ N and 76° 00′ 00″ E – 77° 15′ 00″ E) is situated in the southern part of the Western Ghats in Tamil Nadu, India, covering an area of 2,543 km^2. This region forms a mountainous plateau at the confluence of the Eastern and Western Ghats, featuring an elevation range of 300 to 2,700 m. The climate in the Nilgiris exhibits considerable variation, with summer maximums reaching 21–25 °C and winter minimums dropping to 10–12 °C. The upper Nilgiris is characterized by montane shola

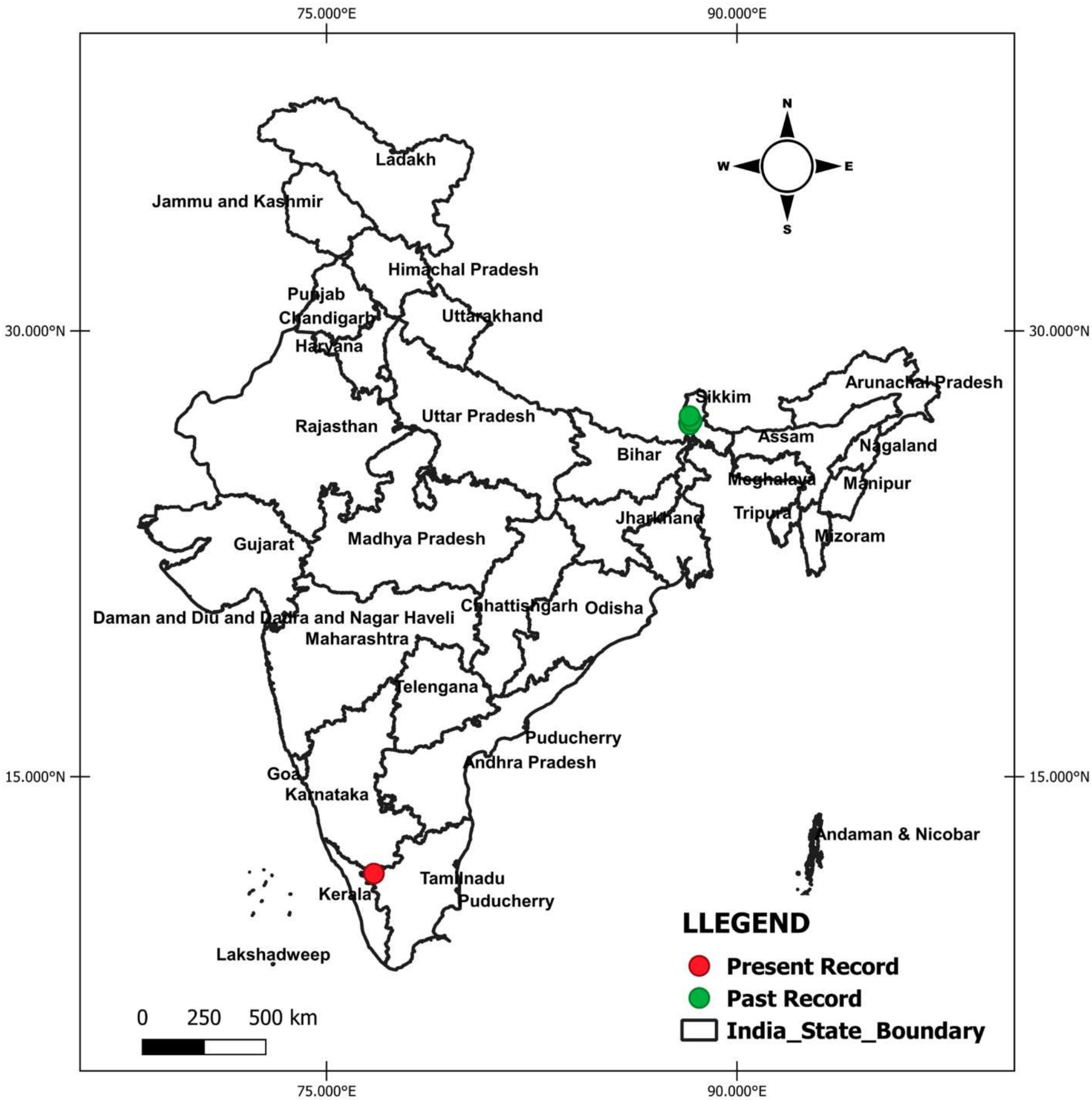

Figure 1. Map showing the past (green dot) and present (red dot) records of melanistic northern red muntjac (*Muntiacus vaginalis*) in the Upper Nilgiris, Tamil Nadu, India.

grasslands, interspersed with plantations of exotic species such as wattle (*Acacia* spp.), blue gum (*Eucalyptus* spp.), and pine (*Pinus* spp.), contributing to a unique ecological landscape (Santhoshkumar and Kannan 2016).

As part of conservation efforts in this region, invasive alien species removal programs have been implemented to restore native vegetation. During fieldwork in Kotagiri, specifically monitoring the growth of plant species after the removal of invasive species, we observed a Barking Deer (*Muntiacus muntjak*) in the area. This sighting highlights the ecological significance of habitat restoration and its potential benefits for native wildlife.

On March 5, 2024, at 13:30 hr, we recorded 2 northern red muntjacs feeding in an invasive species eradication area in Kottagiri (11° 25′ 42.49″ N, 76° 51′ 11.57″ E, 1,981 m), Nilgiris, Tamil Nadu, India. We captured photographs and video footage of these individuals. Upon close examination of the media, we observed that 1 individual displayed a completely different coloration, appearing dark brown, almost black (Appendix 1). Based on this distinct coloration, we concluded that this northern red muntjac exhibited melanism.

Melanism can be defined as the excessive deposition of the pigment melanin resulting in an atypically dark individual (Kettlewell 1973). Such color aberration is quite common in mammals (Caro 2005). The natural coat color of the northern red muntjac grayish brown, reddish, or dark brown (Menon 2014). In India, only 5 prior records document melanism in the northern red muntjac (Figure 1). Inglis (1952) noted "very dark brown and nearly black barking deer" in the forests of Darjeeling District (27° 2′ 45.6″ N, 88° 14′ 42.0″ E), West Bengal. Sunar *et al.* (2012) reported a dark-colored individual in Senchal Wildlife Sanctuary (26° 59′ 34.8″ N, 88° 15′ 54.0″ E), also in Darjeeling District, West Bengal. Choudhury (2014) referenced a dark-colored coat observed by the Forest Department in Kitam Bird Sanctuary (27° 6′ 25.2″ N, 88° 21′ 0.0″ E), Wildlife Wing, Namchi, Sikkim in October 2013. Additionally, Choudhury (2014) documented a dark brownish-grey northern red muntjac near Legship (27° 15′ 57.6″ N, 88° 15′ 57.6″ E) close to Pelling, West Sikkim, on June 15, 2014.

The Nilgiris is a mountainous habitat characterized by dense vegetation, with altitudes reaching up to 2,500 m. Historical evidence suggests that similar vegetation exists in mountainous regions such as Darjeeling in West Bengal and Namchi and Pelling in Sikkim. This evidence supports the theory that tropical ecosystems may reinforce the idea that melanism offers a survival advantage in certain ecological contexts (Caro 2005; Allen *et al.* 2010).

Furthermore, a hypothesis suggests a link between darker individuals and environments characterized by high moisture levels and dense vegetation (Gloger 1833; Cott 1940; Ulmer 1941; Ortolani and Caro 1996).

Factors such as habitat fragmentation, environmental stress, and inbreeding may play a role in the occurrence of melanism (Tougias 2011; Ramakrishnan *et al.* 2016). Therefore, further observations are needed to clarify the reasons for the presence of melanism in the northern red muntjac in the Nilgiris.

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Appendix list

Appendix 1. Melanistic northern red muntjac (*Muntiacus vaginalis*) in the Upper Nilgiris, Tamil Nadu, India. Video of S. Karthick, available at: https://doi.org/10.5281/zenodo.15066003.

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First record of *Sphaeronycteris toxophyllum* on Bonaire Island

Primer registro de *Sphaeronycteris toxophyllum* en la Isla de Bonaire

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Bats have great dispersal capacities and many species are capable of flying across areas of open sea while migrating, commuting, or foraging, covering a broad range of distances. Our goal is to report and provide possible explanations for the presence of a visored bat, *Sphaeronycteris toxophyllum*, captured on Bonaire Island, Dutch Caribbean. In October 2023, the bat was found alive hanging from the stairs of a resort on the west coast of Bonaire, pictures were taken and, immediately after, the animal was captured and transported to the Bonaire Wild Bird Rehabilitation Center. Taxonomic identification was conducted and the bat was properly maintained with food, hydration, and roost until its death. Then, the animal was preserved in ethanol. This is the first known record of *S. toxophyllum* for Bonaire and the ABC Islands. The specimen corresponds to a female, adult, non-pregnant, not lactating, weighing 19 g, and forearm length 40.3 mm. Stomach and intestines were examined and found empty, suggesting that the animal did not ingest food during the last hours or days before its death. We propose two possible explanations for the arrival of this bat in Bonaire, the animal either flew from Venezuela's coast after getting disoriented, crossing nearly 90 km, or it was transported on a boat, used as a temporal roost, that had this island as destination. This finding illustrates the rare, but still possible, events of bat arrivals from the coasts of Venezuela into the ABCs and nearby islands.

Key words: Bonaire; Caribbean; seawater; *Sphaeronycteris toxophyllum*; visored bat.

Los murciélagos tienen una gran capacidad de dispersión y muchas especies pueden volar sobre mar abierto mientras migran, se desplazan o buscan alimento, cubriendo un amplio rango de distancias. Nuestro objetivo es informar y proponer explicaciones sobre la presencia de un murciélago de visera, *Sphaeronycteris toxophyllum*, capturado en Bonaire, Caribe Holandés. En octubre de 2023, el murciélago fue encontrado vivo, colgado en las escaleras de un complejo turístico en la costa oeste de Bonaire, fue fotografiado y luego capturado y transportado al Centro de Rehabilitación de Aves Silvestres de Bonaire. Se llevó a cabo la identificación taxonómica y fue mantenido adecuadamente con alimento, hidratación y refugio hasta su muerte. Después, el espécimen fue preservado en etanol. Se trata del primer registro de *S. toxophyllum* para Bonaire y las Islas ABC. El espécimen corresponde a una hembra, adulta, no preñada, no lactante, con 19 g y longitud del antebrazo 40.3 mm. El estómago y los intestinos se encontraron vacíos, lo que sugiere que el animal no ingirió alimento durante las últimas horas o días antes de su muerte. Proponemos dos posibles explicaciones para la llegada de este murciélago a Bonaire, el animal voló desorientado desde la costa de Venezuela, cruzando cerca de 90 km, o fue transportado en un barco, que usó como refugio temporal, con la isla como destino. Este hallazgo ilustra los raros, pero posibles, eventos de llegada de murciélagos desde las costas de Venezuela a las Islas ABC e islas cercanas.

Palabras clave: Bonaire; Caribe, mar; murciélago de visera; *Sphaeronycteris toxophyllum*.

Bats have great dispersal capacities and many species are capable of flying across areas of open sea while migrating, commuting, or foraging, covering a broad range of distances, from tens to hundreds of kilometers in a single night (Fleming and Nassar 2002; Ahlén *et al.* 2009; Shilton and Whittaker 2009; Thompson *et al.* 2015; Lagerveld *et al.* 2021; Solick and Newman 2021). These physiological and behavioral attributes of many bats make possible mainland-island and island-island colonization and recolonization events, helping explain the current and past distributions of many insular bat species worldwide. In the case of the Caribbean, the arrival of bats to the islands has been explained by dispersal events from mainland in most cases (Hedges 2001; Genoways *et al.* 2005).

Aruba, Bonaire, and Curaçao (ABCs) form the 3 westernmost islands of the Dutch Caribbean, separated from Venezuela's western coast by 30-90 km, depending on the island. In the case of Bonaire, the bat fauna recorded comprises 6 species, *Natalus tumidirostris*, *Myotis nesopolus*, *Molossus molossus*, *Mormoops megalophylla*, *Leptonycteris curasoae*, and *Glossophaga longirostris* (Hummelinck 1940; Genoways and Williams 1979; Smith *et al.* 2012; Simal *et al.* 2021). Our objective is to report and provide possible explanations for the first record of a visored bat, *Sphaeronycteris toxophyllum* Peters, 1882, (Phyllostomidae: *Stenodermatinae*), captured on Bonaire.

On October 1, 2023, around 14:00 hr, a live but exhausted individual of *Sphaeronycteris toxophyllum* was sighted

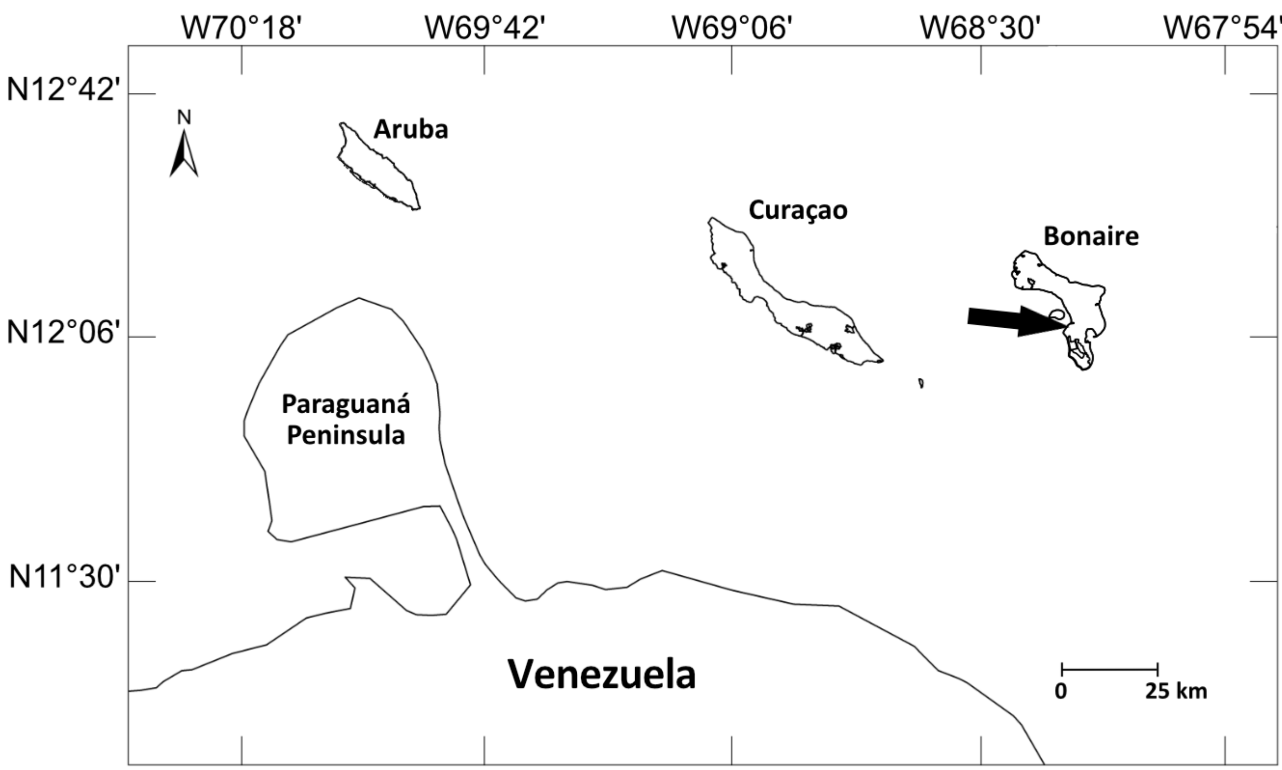

Figure 1. Map of the islands of Aruba, Curaçao, and Bonaire, showing the location of the Beach Resort facilities (black arrow), in the west coast of Bonarie, where the individual of *Sphaeronycteris toxophyllum* was observed and captured. (Credits: Juan Carlos Rivero — Bonsai B.V.)

hanging from the stairs of Beaches Resort (12° 7′ 41.9″ N, 68° 17′ 5.9″ W), on the west coast of Bonaire (Figure 1). Pictures were taken (Figure 2), the animal was captured, and about half an hour later it was delivered to the Bonaire Wild Bird Rehabilitation Center, where the staff have the technical expertise to assist injured and sick bats. The individual was identified at the species level using external traits of the body and rostrum following taxonomic keys by Linares (1987) and Díaz *et al.* (2016). The animal was properly maintained with food, hydration, and roost until its death, 24 hrs later. On October 3, the fresh body was stored frozen (-20 °C) at WILDCONSCIENCE, Bonaire. Several months later, the specimen was dissected and preserved in ethanol and prepared to be shipped in 2025 to the Royal Ontario Museum, Canada (catalog number ROMM126634).

The external traits of the specimen corresponded to those described for *Sphaeronycteris toxophyllum* by Angulo *et al*. (2008), including reduced uropatagium, white spots on the shoulders, wings without horizontal bands, flattened and naked rostrum, swollen eyes, and a reduced inverted U-shaped nose leaf attached to a unique horizontal and fleshy outgrowth on the forehead (the visor). The specimen was an adult female, non-pregnant, not lactating, with a body weight of 19 g, forearm length 40.3 mm, ear width 6 mm, ear length 11.5 mm, and tragus length 3.1 mm. The stomach and intestines were examined and found empty, suggesting the animal did not ingest food during the last hours or days before its death.

Sphaeronycteris toxophyllum is considered an uncommon species throughout its geographical range in South America due to the small number of individuals recorded and collected (Emmons and Feer 1990; Angulo *et al.* 2008). Since no records of this species exist for Aruba and Curaçao (Hummelinck 1940; Husson 1960; Genoways and Williams 1979; Bekker 1996; Simal *et al.* 2021), we hypothesize that the individual captured in Bonaire either flew or was transported in a boat from Venezuela's coast (closest linear distance to Bonaire ~ 88 km) and arrived on the island on October 1 or the previous days. If the bat flew to the island, this implies that it was capable of crossing over open water nearly 90 km from Falcón State, in a north or northeastern direction, during the low trade winds season. This would be the most appropriate period of the year for this long-distance flight because winds reduce their speed (De Meyer 1998). However, bats are known to migrate hundreds of kilometers per night and have shown unexpected flexibility in their ability to migrate across a wide range of conditions (Hurme *et al.* 2025). Alternatively, the animal could have been transported by one of the small ships that transport fruit from Venezuela, although we think that a bat onboard would be easily disturbed during the operation of the ship

Figure 2. Female *Sphaeronycteris toxophyllum* found alive at the Beach Resort facilities on Bonaire Island, Dutch Caribbean. Left: closeup while handling it, right: animal hanging on stairs at the Beach Resort facilities when first sighted. (Credits: Bonaire Wild Bird Rehabilitation Center)

before departing or during the trip. There are records of bats that use ships on high seas as temporary roosting sites (Thompson *et al.* 2015).

A search of the Global Biodiversity Information Facility (GBIF.org 2025) indicates there are 170 records for this species in Venezuela, 4 from the Falcón State. Two of these were from Boca de Yaracuy, 28 km WNW Puerto Cabello along the coast, ~ 169 air kilometers from the Beaches Resort with the others collected further inland. It is likely this species occurs in other areas along the northeastern coast of Venezuela. It has a wide distribution including open areas, evergreen and deciduous forests, ranging from sea level to 2,240 m (Angulo *et al.* 2008). The majority of bats recorded flying over seawater are either migrating or are aerial insectivores or piscivores actively foraging (Ahlén *et al.* 2009; Shilton and Whittaker 2009; Thompson *et al.* 2015; Aizpurua and Alberdi 2018; Lagerveld *et al.* 2021). However, *S. toxophyllum* is strictly frugivorous (Angulo *et al.* 2008), and the only abundant naturally occurring fruits eaten by frugivorous bats on Bonaire are produced by columnar cacti (Simal *et al.* 2021), and we found no records that these fruits are part of its diet on the mainland. This could explain why we found no evidence of food ingestion in the specimen when examined.

The discovery of an individual of *S. toxophyllum* arriving on Bonaire illustrates the rare, but possible inadvertent dispersal of bats from the coasts of Venezuela into the ABCs if they become disoriented while foraging, commuting at night, or transported while roosting on ships. For the ABCs, there are other records of bat species that are rarely observed on these islands and may also be the result of accidental arrivals. One individual of *Myotis nesopolus* was reported near Fountain Cave, Aruba, by one of us (FS) in March 2012, and 3 more at Quadirikiri Cave, Aruba, by a local research team (Simal *et al.* 2021), while conducting inventories of cave-dwelling bats on this island. This species was not included as resident in the list of mammals of Aruba (Bekker,1996), but it is present in the Paraguaná Peninsula, Venezuela (A. Martino pers. comm.), Curaçao, and Bonaire (Simal *et al.* 2021), and likely disperses occasionally to Aruba from one of those locations. An adult male *Pteronotus davyi* was captured and released on Bonarie in 2010 at Cave Orizjan (F. Simal and D. Simal pers. obs.). Prior to this record, this species was not included as occurring on Bonaire (Hummelinck 1940; Genoways and Williams 1979) and it has not been recorded since (Simal *et al.* 2021). This bat likely dispersed from Curacao, where it occurs (Simal *et al.* 2021). For Curaçao, Husson (1960) reported the presence of *Ametrida centurio* and *Artibeus jamaicensis*, but Petit *et al.* (2006) did not report these during several bat surveys conducted on Curaçao. However, in 2017, one individual *Artibeus lituratus* was captured on Rooi Rincon, Curaçao (collection number: ROMM126271, Royal Ontario Museum) by Burton Lim and one of us (FS) during a bat survey on the ABCs. Several authors have reported contemporary interisland dispersal events of *A. jamaicensis* in the Caribbean (Fleming and Murray 2009; Fleming *et al.* 2009).

In the majority of cases, such accidental arrivals of bats to the ABCs likely end up with the death of the animals before they have chances to become established or in sufficient numbers to reproduce, as was the case for the single female *S. toxophyllum* reported here. Under these circumstances, such records should not be included as part of the regular bat fauna present on these islands but noted as accidental arrivals. With the potential impacts of climate change, we cannot rule out the possibility of future colonizations from such dispersals, especially if arrivals are recurrent and sufficient roosting and food resources are available to maintain the colonizers until they reproduce. A program of systematic bat surveys over time on the ABCs could facilitate keeping track of these episodic bat arrival events from the mainland or nearby islands. For example, acoustic monitoring would be a cost-effective and non-invasive means of detecting aerial insectivores such as *M. nesopolus, M. molossus, P. davyi,* and others that may arrive from the mainland.

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New record of jaguar, *Panthera onca*, in central Colima state, México

Nuevo registro de jaguar, *Panthera onca*, para el centro del estado de Colima, México

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The jaguar (*Panthera onca*) is an endangered species due to habitat loss and illegal hunting throughout its range. In the state of Colima, México, the latest sightings date back to the late 1960s. Here we report a new record for the center of the state. As part of a study to evaluate the diversity of mammals in the buffer area of the Holcim Cement Plant in Tecomán, Colima, 12 camera traps were installed on trees at a height of approximately 50 cm from the ground along trails, separated by 500 m between each other; traps operated 24 hr, 7 days a week between October 2019 and May 2023. After a sampling effort of 16,056 camera-days, 1 adult male jaguar was captured in a low deciduous forest in the town of Caleras on 29 March 2023. The record reported here confirms the presence of jaguars in central Colima. This record is located 50 km south of the previous report of the species for the state in 1969. Sampling in the conserved and buffer areas in the state of Colima is necessary to evaluate the conservation status of the jaguar and identify potential ecological corridors in the state and at the regional level.

Key words: Camera traps; Colima; Felidae; jaguar; new record; Tecomán.

El jaguar (*Panthera onca*) es una especie en peligro de extinción debido a la pérdida de hábitat y la cacería ilegal a lo largo de su rango de distribución. Para el estado de Colima, México, los últimos avistamientos datan de finales de la década de 1960. Aquí presentamos un nuevo registro para el centro del estado. Como parte de un estudio de evaluación de la diversidad de mamíferos en el área de amortiguamiento de la Planta de Cemento Holcim de Tecomán, Colima, se colocaron 12 trampas cámara en árboles a una altura aproximada de 50 cm del suelo en senderos, separadas entre cada una 500 m, permaneciendo activas 24 hr, los 7 días de la semana entre octubre de 2019 y mayo de 2023. Después de un esfuerzo de muestreo de 16,056 días-cámara, el 29 marzo de 2023, se tomó un video de un jaguar macho adulto en el interior de una selva baja caducifolia en la localidad de Caleras. Confirmamos la presencia de jaguar para el centro de Colima. Este registro se ubica a 50 km al sur del último reporte de la especie para el estado, en 1969. Son necesarios los muestreos en las áreas conservadas y de amortiguamiento en el estado de Colima para evaluar el estado de conservación del jaguar e identificar potenciales corredores ecológicos en la entidad y regionalmente.

Palabras clave: Colima; Felidae; jaguar; nuevo registro; Tecomán; trampas cámara.

The jaguar (*Panthera onca* Linnaeus, 1758) is the largest solitary feline in the Americas, distributed from northern México to northern Argentina, thriving in diverse environments, from tropical forests to semi-desert environments (Quigley *et al.* 2017). Jaguar populations have declined throughout its range due to habitat loss and fragmentation, declining prey abundance, poaching, illegal trade, and conflicts arising from the coexistence between humans and jaguars (Ripple *et al.* 2014). Due to the problems facing this species, it is listed as "Near Threatened" by the International Union for Conservation of Nature (Quigley *et al.* 2017), while in México it is considered "Endangered" in the national environmental regulations (SEMARNAT 2010). In México, the jaguar is distributed mainly in tropical and subtropical environments from Sonora to Chiapas on the Pacific slope and from Tamaulipas to the Yucatán Peninsula on the Gulf of México slope, at altitudes ranging from sea level to 3,000 m (de la Torre *et al.* 2018; Ceballos *et al.* 2021). For the Pacific slope, an area that includes from Sonora to Chiapas, multiple records of jaguars are now available, from the boom in photo-trapping studies and the contributions of citizen science, such as the iNaturalistaMEX platform. In contrast, for the central Pacific region, there is a lack of recent records for the state of Colima but not for the states of Nayarit (Luja *et al.* 2022), Jalisco (Moreno-Arzate *et al.* 2022), and Michoacán (Charre-Medellín *et al.* 2013, 2014, 2018; Del Moral-Álvarez *et al.* 2023).

The oldest record for the state of Colima dates back to 1948 and corresponds to a hunted specimen (19° 06′ 41.73″ N, 104° 06′ 58.57″ W; INaturalistMX), based on photographic evidence deposited in the Historical Archive of the state of Colima. The second set of records belong to specimens (skin and skull) captured at the town of El Terrero in 1968 and 1969 (19° 26′ 41.17″ N, 103° 56′ 59.77″ W) and deposited in the Vertebrate Collection of the Natural History Museum of Los Angeles County (LACM). The third record does not provide a date or locality, but only the geographic coordinates (19° 14′ 35″ N, 103° 43′ 50″ W; GBIF 2024). On the other hand, Sánchez-Hernández *et al.* (2016) recently reported the presence of jaguars in the Manantlán Biosphere Reserve, in the section corresponding to the limits of the state of Jalisco, suggesting that the species could be present in the area that corresponds to Colima.

The jaguar has been considered in various projects to establish priority conservation areas and biological corridors in México (Rabinowitz and Zeller 2010; Núñez 2011; Rodríguez-Soto *et al.* 2011, 2013; Ceballos *et al.* 2021). At the regional level, some trials have been carried out where biological corridors are proposed for the states of Colima, Jalisco, Michoacán, and Nayarit (Núñez 2011; Ceballos *et al.* 2021). For this reason, collecting information on the current distribution and abundance of the jaguar is essential to develop conservation and management strategies at different spatial scales (Monroy-Vilchis *et al.* 2019).

The study area is located in the buffer area of the Holcim Cement Plant (18° 59′ 56.59″ N; 103° 52′ 06.63″ W), in the Caleras hill, town of Caleras, north of the municipality of Tecomán, Colima, México. The area is part of the physiographic subprovince named Sierra de la Costa de Jalisco (Jalisco Coastal Mountain Range) and comprises a system of mountain ranges that runs east-north along the border of the municipality of Tecomán. The local climate is semi-dry, very warm and warm, with summer precipitation (INEGI 2010). The dominant vegetation is low deciduous forest in a secondary succession stage (Arévalo *et al.* 2016).

Monitoring of medium-sized and large mammals was carried out from October 2019 to May 2023 using photo trapping. To this end, 12 camera traps of two different brands were installed: Bushnell (model 119717cw, Bushnell, USA) and Wosports (model G600, Haofan Technology Co., Hong Kong). The camera traps were affixed separately onto tree trunks at a height of approximately 50 cm from the ground and were set to capture one photo image and a 20-sec video per event, with a 1-minute pause after each recorded event. Traps were in operation 24 hr during the monitoring period. A single camera trap was installed per station; in turn, stations were located in trails and roads, with a separation of 500 m between them. Due to the weather conditions and the continuous use of the equipment, all camera traps were replaced with new ones after 2 years of field operation, before presenting any

Figure 1. Adult male jaguar, *Panthera onca*, recorded in Tecomán, Colima, México, in March 2023. Image from the video deposited in the Collection of Biological Photocollections; catalog number of the video: IBUNAM-CFB-80678.

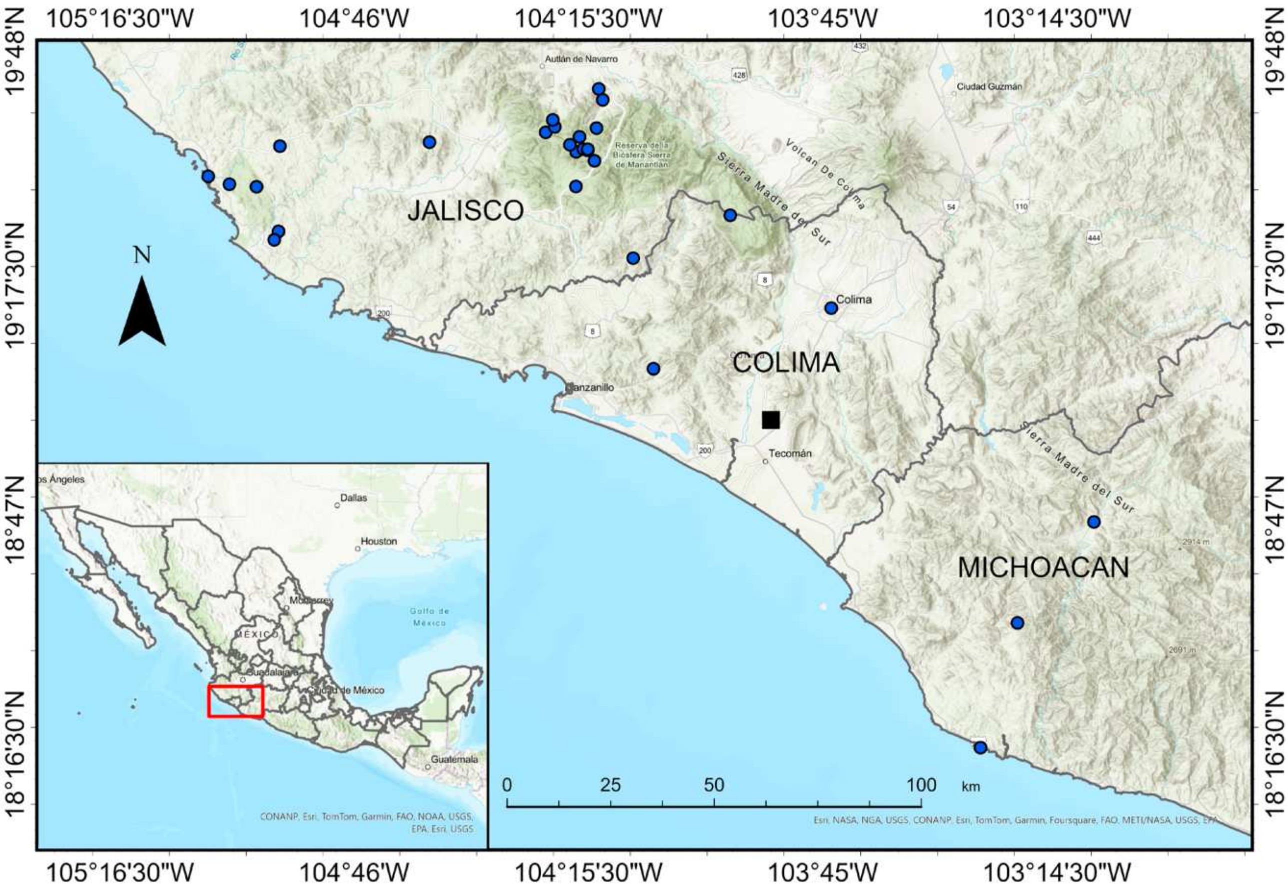

Figure 2. Historical (blue dots) and current record (this study, black square) of jaguar, *Panthera onca*, in the states of Jalisco, Colima and Michoacán, México.

operation issues, aiming not to interrupt the sampling.

As part of the database search, we surveyed the Global Biodiversity Information Facility database platforms (GBIF 2024), the Specimen Records of the National Biodiversity Information System (CONABIO 2024), and iNaturalistaMX (iNaturalistaMX 2024). Jaguar records were reviewed for the state of Colima, and none were found for the municipality of Tecomán, nor for the nearby municipalities of Armería and Coquimatlán.

A total sampling effort of 16,056 trap-days was carried out considering the 12 camera trap stations; it returned an updated record of jaguar for the central part of the state of Colima. On 29 March 2023 at 09:29 hr, 1 adult male jaguar was recorded (18° 59′ 57.75″ N, 103° 51′ 35.61″ W, 595 m) walking along a path that crosses a patch of low deciduous forest (Figure 1). The video was deposited in the Collection of Biological Photocollection of the Institute of Biology, UNAM, with the catalog number IBUNAM-CFB-80678. This was the only record of the specimen and the species over the 44 months of monitoring.

The camera trap that recorded the jaguar also captured photographs and videos of several mammal species reported as prey of the jaguar, including white-tailed deer (*Odocoileus virginianus*), white-nosed coati (*Nasua narica*), and collared peccary (*Pecari tajacu*). Additionally, the presence of other species of carnivores, such as coyote (*Canis latrans*), puma (*Puma concolor*), and ocelot (*Leopardus pardalis*), was documented.

This record is the first evidence of jaguars for the center of the state of Colima 50 years after it was last reported in the entity. The record reported here is located 29 km east of the jaguar record reported in 1948 (Leopold 1959) and 50 km south of the records in 1968 and 1969, located in the Manantlán Biosphere Reserve, state of Colima (GBIF 2024). Other nearby records include one for the state of Michoacán, 74 km southeast of jaguar records in Coalcomán (Brand 1961) and 130 km southeast of the records in Arteaga reported in 2010 (Charre-Medellín *et al.* 2013; Figure 2).

This latest jaguar record underscores the need to conduct additional studies on this species to know its current distribution and the conservation status of its populations in the state of Colima. This state has 5 federal has 5 federal protected natural areas: Manantlán Biosphere Reserve, El Jabalí Flora and Fauna Protection Area, La Huerta Natural Resources Protection Area, Nevado de Colima Volcano National Park and the Canoas Flora and Fauna Protection Area. Together, these areas protect 4.1 % (22,483 ha) of the state's surface, with a particular focus on temperate forest conservation (CONABIO 2016), which is not necessarily the optimum habitat for the jaguar. It is recommended to promote studies in conserved tropical environments and their remnants, as well as in areas subjected to conservation schemes, such as Wildlife Management Units, Areas Voluntarily Dedicated for Conservation, and areas subject to Payment for Environmental Services. By maintaining conserved environments, these areas can potentially function as biological corridors between the neighboring states of Michoacán and Jalisco, which still maintain relatively well-preserved forest areas in their mountain ranges and thus facilitate the movement of jaguars along the Pacific coast.

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First record of predation of the lizard rainbow ameiva (*Holcosus gaigeae*) by a jaguarundi (*Puma yagouaroundi*)

Primer registro de depredación de la lagartija ameiva arcoíris (*Holcosus gaigeae*) por un jaguarundi (*Puma yagouaroundi*)

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To date, there have been few studies on the dietary composition of the jaguarundi (*Puma yagouaroundi*). Previous studies mention that reptiles constitute a relatively minor component of the jaguarundi's diet, and in most cases, they are only identified to the family level due to the high degree of degradation of the remains observed in feces or stomach contents. However, in this paper we report the discovery of the remains of two specimens of the rainbow ameiva (*Holcosus gaigeae*) in the stomach contents of a jaguarundi that was roadkill in the south of the state of Quintana Roo, Mexico. Identification was made possible due to the good state of preservation of the remains and the size and scale pattern of the forelimbs, which could be compared with specimens from the Herpetological Collection of the Zoology Museum of El Colegio de la Frontera Sur, Unidad Chetumal. These findings are significant in that they facilitate a deeper understanding of the trophic relationships that exist between the diverse species of the Selva Maya.

Keywords: Diet; feline; lizard; Selva Maya; trophic relationship.

Hasta la fecha, los estudios sobre la composición de la dieta del jaguarundi (*Puma yagouaroundi*) han sido escasos. En estudios previos se menciona que los reptiles son uno de los componentes menos frecuentes de la dieta del jaguarundi, y en la mayoría de los casos solamente son identificados hasta el nivel de familia debido al alto grado de degradación de los restos encontrados en las heces o en los contenidos estomacales. Sin embargo, en este manuscrito reportamos el hallazgo de los restos de dos ejemplares de ameiva arcoíris (*Holcosus gaigeae*) en el contenido estomacal de un jaguarundi atropellado en el sur del estado de Quintana Roo, México. La identificación fue posible gracias al buen estado de conservación de los restos y al tamaño y patrón de escamas de los miembros anteriores, que pudieron ser comparados con ejemplares de la Colección Herpetológica del Museo de Zoología de El Colegio de la Frontera Sur, Unidad Chetumal. Estos hallazgos son significativos en la medida en que facilitan una comprensión más profunda de las relaciones tróficas que existen entre las diversas especies de la Selva Maya.

Palabras clave: Dieta; felino; lagartija; relación trófica; Selva Maya.

The Yucatan Peninsula hosts five of Mexico's six wild cat species: jaguar (*Panthera onca*), puma (*Puma concolor*), ocelot (*Leopardus pardalis*), margay (*Leopardus wiedii*) and jaguarundi (*Puma yagouaroundi*) (Clavijo and Ramírez 2009). The latter is likely the least researched of these species. The jaguarundi is listed in the Norma Oficial Mexicana NOM-059-SEMARNAT-2010 (SEMARNAT 2010) as a threatened species and is classified as least concern by the International Union for Conservation of Nature (IUCN; Caso *et al.* 2015). This feline species is distributed over a broad range, extending from the US-Mexico border to southern Argentina (de Oliveira 1998), and due to the adaptability of this feline species, it inhabits a diverse array of habitats, including savannah, scrub, tropical rainforest, deciduous forest, dense chaparral, thickets and potentially agricultural areas (Giordano 2016; Harmsen et al. 2024).

The jaguarundi is a small felid, measuring between 60 and 100 cm in length and weighing between 4 and 9 kg. The elongated body and tail, coupled with the relatively short legs in relation to the body, are distinctive features of this species. In terms of size, females are smaller than males (de Oliveira 1998). The jaguarundi exhibits three color morphs: chocolate brown (the most common), greyish silver and reddish brown (less common; Giordano 2016). It has been proposed that the morphology and pelage of this species may provide a competitive edge over other mesocarnivores, as it favors habitats devoid of arboreal vegetation, including grasslands, savannahs, scrublands,

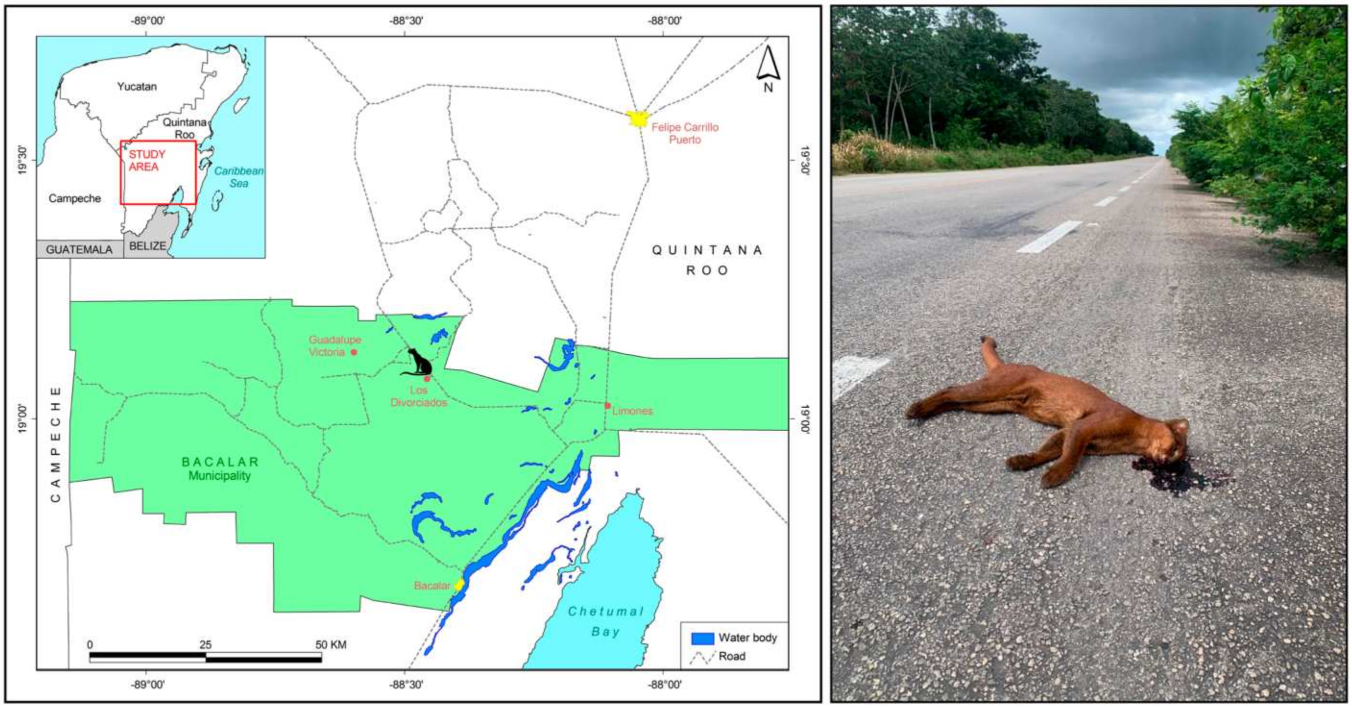

Figure 1. Location of the road-killed jaguarundi, *Puma yagouaroundi* near the community (ejido) Los Divorciados (image of the jaguarundi) in the municipality of Bacalar, Quintana Roo, Mexico.

and agricultural areas (Harmsen *et al.* 2024), where it is more likely to encounter its primary prey (Giordano 2016).

In contrast to other small wildcats in southeastern Mexico, the jaguarundi exhibits a diurnal activity pattern (Konecny 1989) and extensive home ranges, with females occupying areas up to 20 km^2 and males up to 100 km^2 (Konecny 1989). The diet of jaguarundi is influenced by these traits, comprising a variety of species including birds, mammals, reptiles, invertebrates, plant matter and fish (de Oliveira 1998; Rocha-Mendes *et al.* 2010; Bianchi *et al.* 2011; Gómez-Ortíz *et al.* 2015; Giordano 2016; Alanis-Hernández *et al.* 2024). It is therefore crucial to accurately identify the species preyed upon by the jaguarundi, as this will assist in the understanding of interspecific trophic relationships and in developing conservation strategies that will help protect both prey and predator. Therefore, our aim is to report the predation of two rainbow ameivas (*Holcosus gaigeae*) by a jaguarundi in Quintana Roo, Mexico.

The rainbow ameiva is a medium-sized terrestrial lizard (length of the snout to cloaca 80-130 mm) with a robust body and short muscular limbs (Ramírez-Bautista 1977). These lizards feed mainly on insects, other small lizards and eggs (Schwartz and Henderson 1991; Meza-Lázaro 2015). They are active foragers during the day and seek shelter in leaf litter and burrows at night (Macip-Ríos et al. 2013; Ramírez-Bautista *et al.* 2014). This species is not listed in the Norma Oficial Mexicana NOM-059-SEMARNAT-2010 and has not been assessed by the International Union for Conservation of Nature (IUCN).

In Mexico, rainbow ameivas have several predators including spiders (genus: *Lycosa*), snakes (genera: *Clelia*, *Conophis*, *Drymarchon*, *Lampropeltis*, *Mastigodryas*, *Masticophis*, *Micrurus*, *Agkistrodon*, *Bothriechis*, *Bothrops*, *Porthidium*), lizards (genus: *Xenosaurus*), amphibians (genus: *Dermophis*), birds of prey (genus: *Buteo*), and the domestic cat (*Felis catus*), the only previously documented mammal predator in Mexico (see in detail Meza-Lázaro and Nieto-Montes de Oca 2015; Nahuat-Cervera *et al.* 2020; Nahuat-Cervera and Pérez-Martínez 2021). Accordingly, we propose that our finding would be the first record of a wild mammal in Mexico preying on a rainbow ameiva.

On September 16, 2024, a reddish-brown adult male was found roadkilled on Federal Highway 293 (known as Vía Corta Mérida-Chetumal) in the south of the state of Quintana Roo, Mexico. The incident occurred 2.2 km north from the community (ejido) Los Divorciados (19º 05' 51.7" N, 88º 27' 30.1" W) in the municipality of Bacalar (Figure 1). The animal had been deceased for only a few hours, hence exhibiting no autolytic alterations. The jaguarundi was retrieved, refrigerated by the environmental authorities (Instituto de Biodiversidad y Áreas Naturales Protegidas del Estado de Quintana Roo [IBANQROO] and Procuraduria Federal de Protección al Ambiente [PROFEPA]), and later conveyed to the laboratory of El Colegio de la Frontera Sur, Unidad Chetumal, for necropsy the following day.

The necropsy was conducted with meticulous care and precision. Upon examining the gastric contents, we noted the presence of bones, four forelimbs, and the remnants of the hind limb digits of an unnamed lizard species that had not yet been fully digested (Figure 2a). The remains were subsequently washed with distilled water and preserved in 96% alcohol for later identification. Once fixed in alcohol, the four forelimbs and several toes of the hind limbs were subject to analysis as they exhibited the least damage.

Figure 2. Stomach contents of a road-killed jaguarundi (*Puma yagouaroundi*): a) Remains of bones, forelimbs and hindlimbs of a rainbow ameiva (*Holcosus gaigeae*); b) Comparison of the found remains with one of the specimens of the Herpetological Collection of the Zoology Museum of El Colegio de la Frontera Sur, Unidad Chetumal.

The number of forelimbs found (4) suggests that the jaguarundi preyed on two individuals of the same species. The scale pattern, shape and length of the digits were compared between three species of lizards inhabiting the region that may have been similar in size at some stage in their life cycle: the brown basilisk (*Basiliscus vittatus*), the Yucatan whiptail (*Aspidoscelis angusticeps*) and the rainbow ameiva (Figure 3). All these specimens belong to the Herpetological Collection of the Zoological Museum (ECO-CH-H), Unidad Chetumal. The dorsal and ventral forelimb scale patterns and toe shape (forelimb and hindlimb) were identical to those of the rainbow ameiva (Figure 2b).

We hypothesise that predation on these reptiles may have occurred due to the diurnal activity patterns of both species, which may have resulted in more frequent encounters. During the day, ameivas leaves from their shelters to bask in the sun (to absorb heat and maintain their optimal body temperature; Vitt and Caldwell 2013), which would expose them to predation. Ameivas are more prevalent in ecosystems that are subject to moderate human disturbance (Macip-Ríos et al. 2013), habitats in which the jaguarundi is well adapted (Coronado-Quibrera *et al.* 2019). Consequently, predatory interactions between both species may be more frequent than previously thought. Furthermore, the discovery of the remains of two ameivas indicates that if they were a female and a male (some ameivas reproduce during the rainy season; Savage 2002), these individuals were engaged in either courtship or mating behavior, or alternatively, if they were both males, in a territorial dispute.

Recent reviews of jaguarundi dietary components have documented that reptiles are a relatively minor component of their diet (9-12%) compared to mammals (59%), invertebrates (21-27%), birds (7-11%), plants and fruits (6%) and fish (1%) (Giordano 2016; Alanis-Hernández *et al.* 2024). In Venezuela, lizards can represent up to 35% of the diet of the jaguarundi (de Oliveira 1998), while in Mexico the only study reports 0.89% (Guerrero *et al.* 2002). Among the main reptiles that make up the jaguarundi's diet are lizards (diplogossids, iguanids, phrynosomatids, theiids and tropidurids) and several species of snakes (colubrids, viperids; Giordano 2016; Alanis-Hernández *et al.* 2024). Our findings are significant, as in the Selva Maya and several other regions of Mexico where the jaguarundi is present, there is no information related to the composition of their diet. It is our hope that this note will serve to encourage further studies on the diet and feeding habits of the small wild felids of southeastern Mexico (margay, ocelot and jaguarundi), given that past and current conservation efforts appear to focus exclusively on the jaguar, without sufficient consideration of the differing conservation strategies that may be required for these other feline species and their prey.

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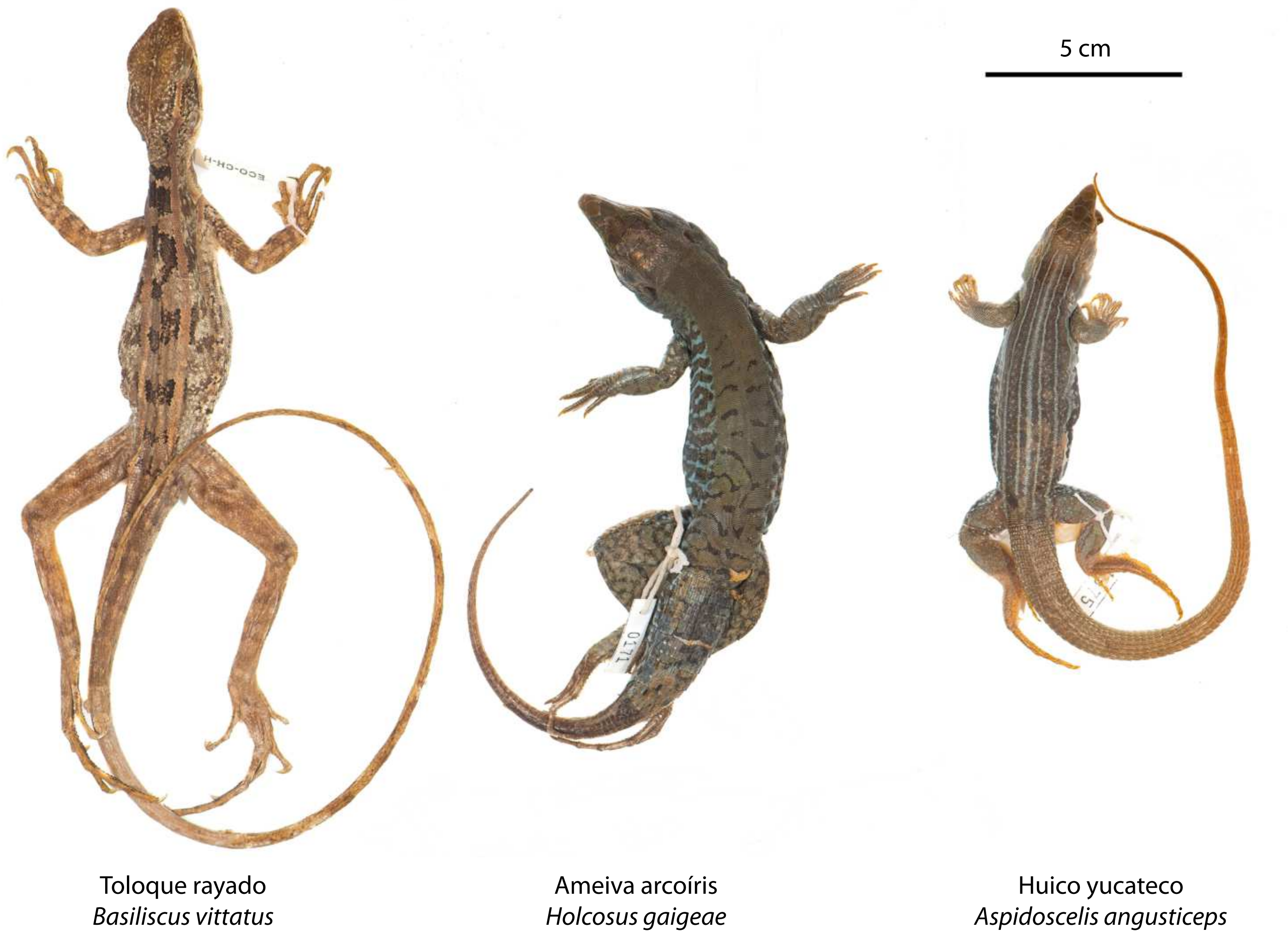

Figure 3. The three species of lizards inhabiting southern Quintana Roo, Mexico, that were compared to identify the remains of rainbow ameiva (*Holcosus gaigeae*).

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New localities in the geographical distribution of *Diaemus youngii* and *Macrophyllum macrophyllum* in the Mexican Pacific slope

Nuevas localidades en la distribución geográfica de *Diaemus youngii* y *Macrophyllum macrophyllum* en la vertiente del Pacífico Mexicano

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Diaemus youngii and *Macrophyllum macrophyllum* are two species of bats that live in Mexico for which records in collections are scarce. This study aimed to expand the geographical distribution of *D. youngii* for the Mexican Pacific slope in Chiapas and to add records of *M. macrophyllum* in this area. Sampling was carried out in the Municipality of Villa Comaltitlán, Chiapas, in three seven-night periods: December 2020, May 2021, and July 2022. Three mist nets were installed among vegetation near the Papagayo River inside an oil palm plantation. A sampling effort of 6216 net meter-hours yielded 386 records of bats belonging to 12 species, including *D. youngii* and *M. macrophyllum*. One adult male of *D. youngii* and 4 of *M. macrophyllum* were recorded. A fifth record of *M. macrophyllum* was accidentally obtained on the Pijijiapan-Tonalá highway, with a roadkilled individual. The record of *D. youngii* is the first for the Pacific coast of Chiapas. This record is located more than 197 km straight from the nearest capture site, the Montes Azules Biosphere Reserve. The new records of *D. youngii* and *M. macrophyllum* are valuable to advance our knowledge of the distribution of these species.

Key words: Chiapas Coast; Chiroptera; oil palm; Phyllostomid bats.

Diaemus youngii y *Macrophyllum macrophyllum* son dos especies de murciélagos que habitan en México, pero cuentan con pocos registros en colecciones. El objetivo de este estudio es presentar datos que amplían la distribución geográfica de *D. youngii* para la vertiente del Pacífico mexicano en Chiapas y añadir registros de *M. macrophyllum* en esta región. Los muestreos se llevaron a cabo en tres periodos con una duración de siete noches: diciembre de 2020, mayo de 2021 y julio de 2022 en Villa Comaltitlán, Chiapas. Se usaron tres redes de niebla, colocadas dentro de la vegetación cercana al río Papagayo e inmersas en una plantación de palma de aceite. Con un esfuerzo de 6,216 m x hr de muestreo se obtuvieron 386 registros de murciélagos pertenecientes a 12 especies, incluyendo a *D. youngii* y *M. macrophyllum*. Se capturó 1 macho adulto de *D. youngii* y 4 de *M. macrophyllum*. Un quinto registro de *M. macrophyllum* ocurrió de manera fortuita en la carretera Pijijiapan - Tonalá, con un individuo atropellado. El registro de *D. youngii* es el primero para la costa del Pacífico de Chiapas, ya que el registro más cercano se encuentra a 197 km en línea recta del sitio de captura, en la Reserva de la Biosfera Montes Azules. Los registros de *M. macrophyllum* complementan los datos previos en la vertiente del Pacífico. La aportación de los nuevos registros de *D. youngii* y *M. macrophyllum* es valiosa para complementar el conocimiento de su distribución.

Palabras clave: Costa de Chiapas; murciélagos filostómidos; palma de aceite; quirópteros.

The state of Chiapas, in Mexico, has a high richness of bat species, with 108 species (Lorenzo *et al.* 2017). There are previous lists of species (Alvarez-Castañeda and Alvarez 1991; Alvarez-Castañeda 1993; Medellín 1993) and contributions of new records (Polaco 1987; Medellín 1983; Medellín *et al.* 1986; Alvarez and Alvarez-Castañeda 1990; Hernández-Mijangos *et al.* 2008), which have led to the update of the species list in Chiapas (Retana and Lorenzo, 2002; Lorenzo *et al.* 2017). However, there are still underexplored regions with gaps in information on species richness, the number of records, and ecological aspects of the local fauna (Lorenzo *et al.* 2017; Retana and Lorenzo 2002). One of these areas is the Pacific coastal plain, which has recorded 47 species of bats (Alvarez-Castañeda 1993).

Diaemus youngii (white-winged vampire bat) is one of the three species of hematophagous bats present in Mexico. Its coloration is light brown or dark cinnamon, with white wing tips. The body length is between 83 mm and 84 mm, and weighs between 31 g and 38 g. The eyes are relatively larger than those of other bats of similar body size (Greenhall and Schutt 1996). Additionally, *D. youngii* has a short thumb and a single callosity, contrasting with

Desmodus. The uropatagium is more developed, and its legs are more robust than those of *Desmodus* and *Diphylla* (Scheffer *et al.* 2015). Another distinctive feature of *D. youngii* is the presence of scent glands inside the mouth (Medellín *et al.* 1997). Individuals of *D. youngii* rest in caves, tree hollows, and on long leaves of banana plants. Its distribution is discontinuous from Tamaulipas, Mexico, to Argentina, and it mainly inhabits humid and dry tropical forests (Greenhall and Schutt 1996; Barquez *et al.* 2015). In Chiapas, it has been recorded in the Sierra Lacandona subprovince (Alvarez-Castañeda and Alvarez 1991).

Macrophyllum macrophyllum (Long-legged bat) measures between 41 mm and 53 mm and weighs between 7 g and 10 g. The fur is brown, and the ears are separated and slightly larger than the head. Its limbs are long (Harrison 1975), and the uropatagium has a fringe of hair along the edge (Medellín *et al.* 1997). This bat inhabits humid and dry tropical forests, mainly in areas associated with water bodies. Its shelters include caves, sewers, and under bridges. It is distributed from southern Mexico to Argentina (Harrison 1975). In Chiapas, it has been recorded in the Sierra Lacandona subprovince (Alvarez-Castañeda and Alvarez 1991) and the La Encrucijada Biosphere Reserve in the Pacific coastal plain (Hernández-Mijangos *et al.* 2008).

Both species have a marginal distribution in Mexico, being considered rare or uncommon, with incidental captures in few localities (Harrison 1975; Seymour and Dickerman 1982; Greenhall and Schutt 1996) and scarce records in biological collections in Mexico (Kraker *et al.* 2021; CONABIO 2024). Therefore, the contribution of new localities for both species is valuable to advance our knowledge of their geographical distribution, particularly in areas that are under-explored and with increasing changes in land use, such as the Pacific coastal plain of Chiapas (Lorenzo *et al.* 2017).

The presence of *D. youngii* and *M. macrophyllum* was documented during the project "Flora and fauna characterization and monitoring in the Maragato and Papagayo oil palm estates, municipality of Villa Comaltitlán, Chiapas," which aimed to sample regional flora and fauna. The objective of the present study was to provide information on these two species, expand the geographical distribution of *D. youngii* to the Mexican Pacific slope in Chiapas, and add records of *M. macrophyllum* for this area.

The sampling was conducted at the Papagayo plantation, Municipality of Villa Comaltitlán, Chiapas, in December 2020, May 2021, and July 2022. This municipality comprises the following types of vegetation: tular (20 %), high tropical forest (7 %), mangrove forest (5 %), and secondary vegetation and popal in smaller proportions (5 %). The region also includes agricultural areas (32 %) and pastures (31 %; INEGI 2010). The local climate is warm and humid, with abundant summer rainfall. The rainy season spans from May to October and ranges between 1500 mm and 4000 mm annually (INEGI 2010). The study area is located within an oil palm plantation (*Elaeis guineensis*; 15°12'2" N, 92°34'43" W) on the banks of the Papagayo River.

Since the project aimed to prepare an inventory of species, the collection of specimens and their inclusion in biological collections were not considered. It is worth noting that the sampling design (duration and schedule) for bats was adjusted to the sampling of other terrestrial vertebrate species. In particular, bats were sampled in an ecotone between poplar groves and secondary vegetation. To this end, three mist nets measuring 12 m long × 3 m wide were installed for 7 nights per sampling event. The nets were placed at different heights above the ground, from 0.3 m to 3.5 m, separated from each other by 100 m. The nets were active from 20:00 h to 24:00 h and were checked every 30–40 minutes. The sampling effort was quantified as the product of the total net length, in meters, by the total number of installed hours (Medellín 1993).

The captured specimens were removed from the nets using leather gloves and placed in cloth bags for identification. We recorded some somatic measurements (total length, tail length, forearm length, and weight), age category, reproductive status, and sex, minimizing the handling and photographing time to reduce stress. Subsequently, each individual was photographed and released in the capture area. Species were taxonomically determined using the field guide by Medellín *et al.* (1997), and the taxonomic classification followed Ramírez-Pulido *et al.* (2014). The photographic records are deposited in the image bank of Conservación de la Biodiversidad del Usumacinta A. C. (COBIUS A. C.).

Table 1. Records of *Diaemus youngii* and *Macrophyllum macrophyllum* in Villa Comaltitlán, Chiapas, Mexico. TL = Total length; Tl = Tail length; Fl = forearm length; El = Ear length; W = weight. Measurements are expressed in millimeters and the weight is expressed in grams.

Date	Time	Species	Locality	Municipality	Coordinates		Sex	Reproductive status	TL	Tl	Fl	El	W
12/13/2020	20:30	*D. youngii*	Papagayo plantation	Villa Comaltitlán	92°34'44" W	15°12'07" N	Male	Non- reproductive	82	-	51.7	-	34
04/16/2021	20:30	*M. macrophyllum*	Papagayo plantation	Villa Comaltitlán	92°34'44" W	15°12'07" N	-	-	38	-	34	-	7
07/15/2022	-	*M. macrophyllum*	Pijijiapan-Tonalá highway	Pijijiapan	93°12'26" W	15°41'45" N	Male	-	32		32		5
07/15/2022	22:20	*M. macrophyllum*	Papagayo plantation	Villa Comaltitlán	92°34'44" W	15°12'18" N	Female	Lactating	34	38	32	11	6
07/16/2022	21:40	*M. macrophyllum*	Papagayo plantation	Villa Comaltitlán	92°34'44" W	15°12'02" N	Male	Non- reproductive	34	-	34	14	7
07/17/2022	21:15	*M. macrophyllum*	Papagayo plantation	Villa Comaltitlán	92°34'53" W	15°12'05" N	Male	Non- reproductive	34	-	32	12	6

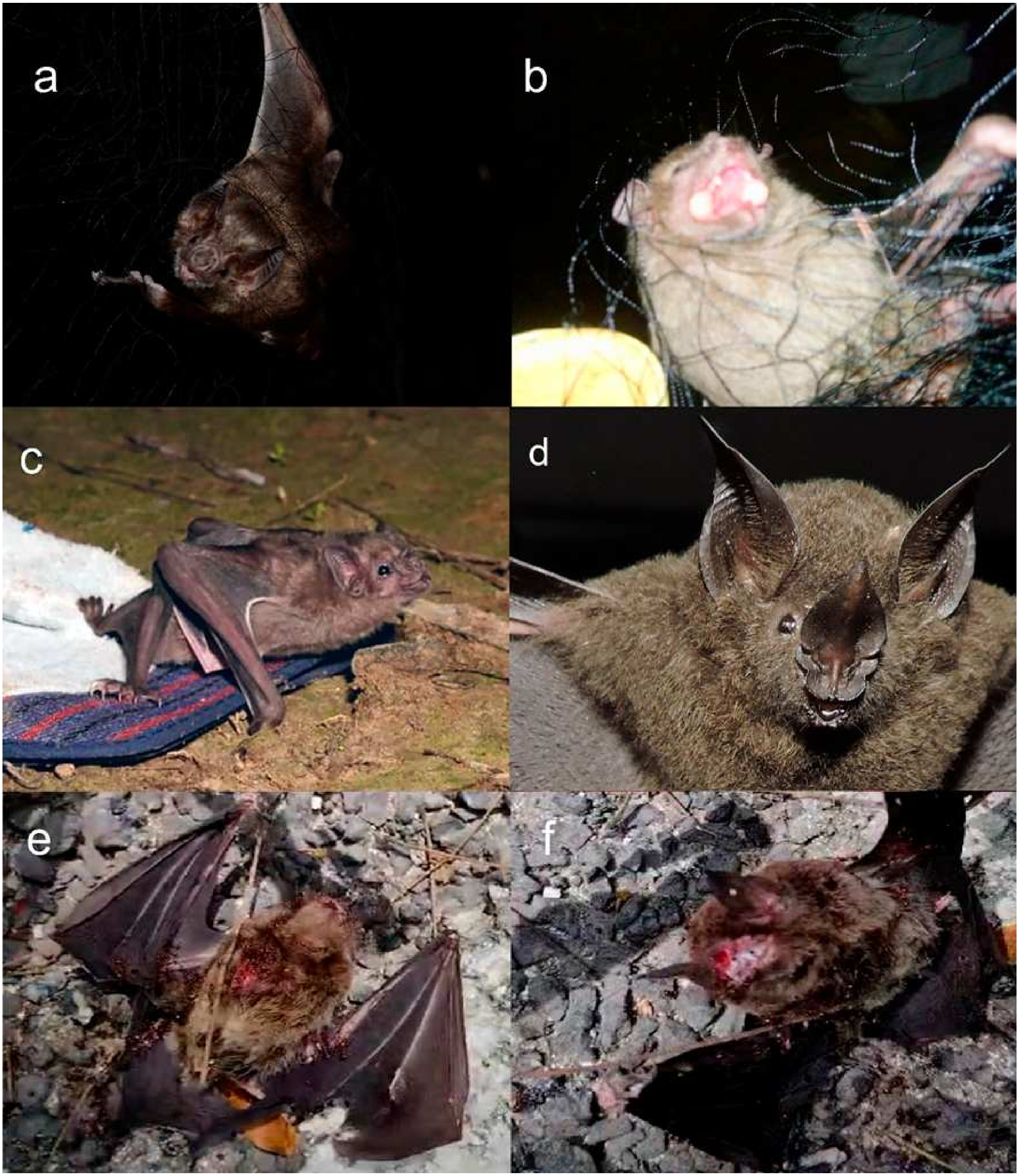

Figure 1. Photographic records of *Diaemus youngii* (a, b, and c) and *Macrophyllum macrophyllum* (d, e, and f) documented in Villa Comaltitlán, Chiapas, Mexico. *D. youngii*, shows the scent glands inside the mouth and the white wing edges. Photos: Image Bank of COBIUS A.C. - Arturo Candelaria Peña.

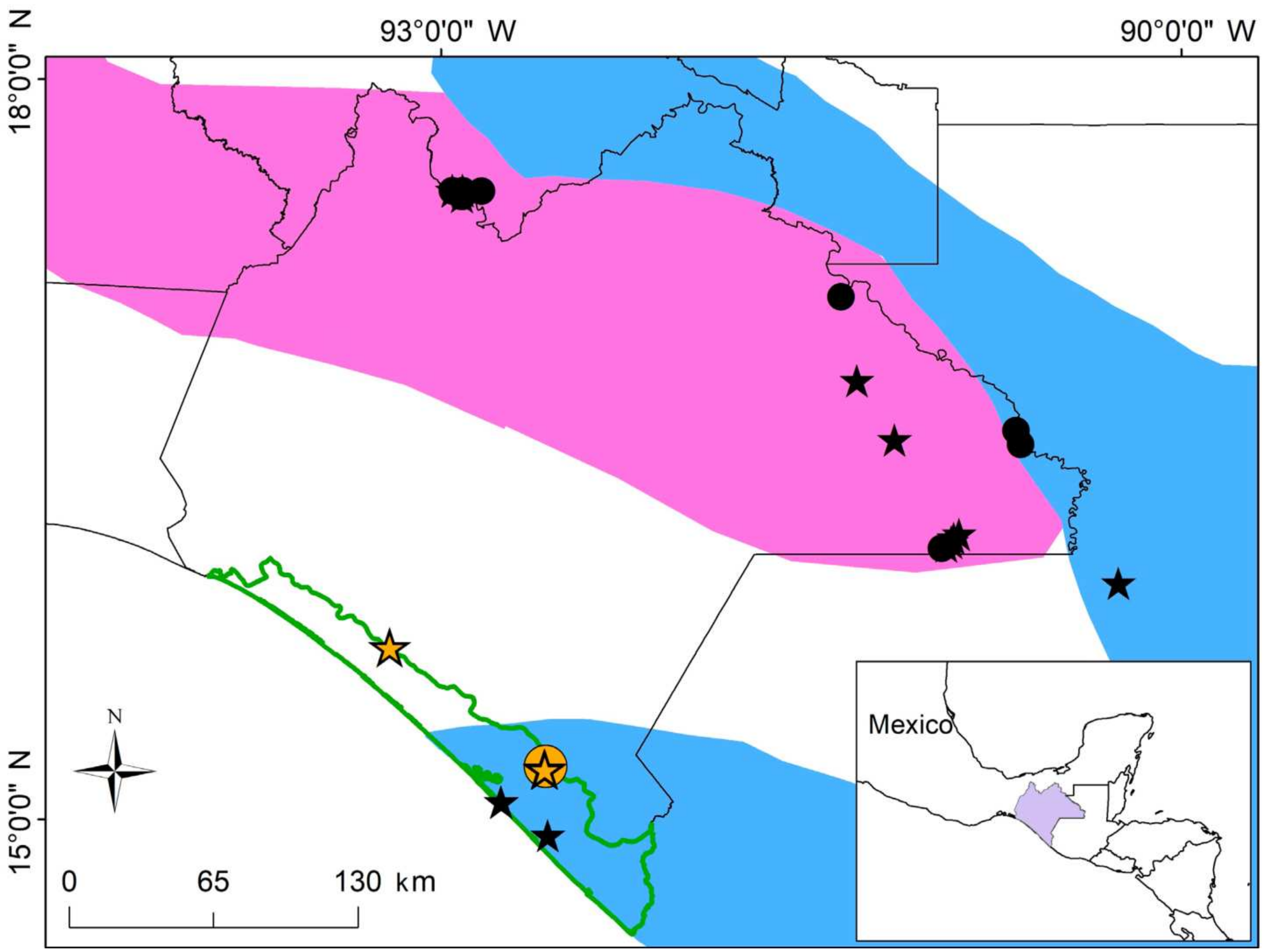

Figure 2. Historical records (black symbols) and new records (orange symbols) of *Diaemus youngii* (circles) and *Macrophyllum macrophyllum* (stars) in the coastal plain of Chiapas, Mexico (green line polygon), and nearby areas. The blue area is the current distribution range of *M. macrophyllum* and the pink area is the distribution range of *D. youngii*, both according to the IUCN.

The sampling effort was 6216 net-hours, which yielded 386 bats belonging to 12 species. *Artibeus jamaicensis* (n = 139), *Sturnira parvidens* (n = 126), and *A. lituratus* (n = 37) were the species with the greatest number of captured specimens.

On December 13, 2020, *D. youngii* was recorded in an ecotone near the Papagayo River surrounded by an oil palm plantation (Table 1, Figure 1a, b, and c). The individual exhibited the scent glands inside the mouth and the white wing edges, which are distinctive traits of the species (Figure 1b and c).

Four individuals of *M. macrophyllum* were recorded in the study area in 2021 and 2022 (Table 1). The fur coloration and the tail extending to the edge of the uropatagium of the captured organisms match the description in the identification guide (Figure 1d), and the measurements are consistent with those reported for the species (Medellín 2005; Hernández-Mijangos *et al.* 2008). An additional record was obtained incidentally on July 15, 2022, outside the sampling period, on the Pijijiapan-Tonalá road in the peri-urban area of Pijijiapan, 86 km from the previous record in Villa Comaltitlán. One roadkilled specimen was observed; it was decomposing, so some somatic measurements were not recorded (Table 1, Figures 1e and f).

Diaemus youngii and *M. macrophyllum* have been listed in bats of Chiapas for several decades (Alvarez-Castañeda and Alvarez 1991; Lorenzo *et al.* 2017; Retana and Lorenzo 2002; Muñoz-Alonso and March-Mifsut 2003). The record of *D. youngii* in this study is the first for the Pacific coast of the state of Chiapas. There are previous records of *D. youngii* in the ejido Benemérito de las Américas (Alvarez-Castañeda and Alvarez 1991), in areas near the Usumacinta River in the Lacandon tropical forest (CONABIO 2024), and in the vicinity of the Montes Azules Biosphere Reserve (GBIF 2024), all corresponding to the Sierra Lacandona subprovince (Alvarez-Castañeda 1993; Lorenzo *et al.* 2017; Kraker *et al.* 2021). In nearby areas outside of Chiapas, it has been recorded in Teapa, Tabasco (CONABIO 2024, Figure 2).

The new record of *D. youngii* is located more than 197 km straight from the nearest capture site near the

Figure 3. Vegetation in the study area on the banks of the Papagayo River (a, b, c) and the surrounding plantations in Villa Comaltitlán, Chiapas, Mexico.

Montes Azules Biosphere Reserve and outside the species distribution polygon described in the International Union for Conservation of Nature, IUCN (Figure 2; Barquez et al. 2015). This new record was obtained in an ecotone of popal and secondary vegetation 60 m from the Papagayo River (Figure 3). *D. youngii* thrives in several types of vegetation, such as low tropical forest, high tropical forest, grasslands, as well as ecotones, secondary vegetation, forest edges, and human settlements (Greenhall and Schutt 1996; Costa *et al.* 2008; Pedroso *et al.* 2018), so the new record matches the observed habitat. Additionally, the present study recorded *D. youngii* in the rainy season, consistent with previous reports (Greenhall and Schutt 1996). However, it is unknown whether the periodicity of precipitation influences the detection of this species (Scheffer *et al.* 2015). The recent record of the species in the study area is probably a consequence of the scarce studies on biodiversity in the coastal plain, a fact that has hindered its previous detection. Additionally, changes in land use, expanding human settlements, and the presence of domestic livestock in the area favor the presence of *D. youngii* due to its preference to feed on the blood of domestic animals, particularly poultry (Scheffer *et al.* 2015).

The records of *M. macrophyllum* supplement previous data for the Pacific slope of Chiapas (Hernández-Mijangos *et al.* 2008; iNaturalistMX 2022). In Chiapas, this species has also been documented in Arroyo San Pablo, Chajul, and Arroyo José, in the Montes Azules Biosphere Reserve (Alvarez-Castañeda and Alvarez 1991); outside of Chiapas, it has been recorded in Teapa, Tabasco (CONABIO 2024).

Four of the five new records reported in the present study were located 60 m from the Papagayo River, which offers favorable conditions for various species of aquatic insects, the main food source for *M. macrophyllum* (Figure 3; Harrison 1975; Weinbeer *et al.* 2013). This bat species is found in caves or logs near the coast, streams, or rivers that run through various vegetation types, including humid and dry tropical forests (Seymour and Dickerman 1982; Weinbeer *et al.* 2013).

Although the records obtained during the fauna sampling in the study area were not deposited in a Mexican scientific collection, the information is valuable and can be verified through photographic records (Figure 1). In other similar cases, the information provided from citizen science data has proven its value in expanding our knowledge of wild species, supplementing geographical, biological, ecological, and risk information, particularly for poorly sampled areas (Díaz-Segura *et al.* 2021; Castro-Bastidas and Serrano-Serrano 2022).

Although both species are listed as Least Concern in the IUCN Red List (Barquez *et al.* 2015; Rodríguez and Pineda 2015), *D. youngii* is in the Special Protection category and *M. macrophyllum* is in the Threatened Category in the Mexican Official Standard 059 (SEMARNAT 2010). Both species have their northernmost distribution limit in Mexico, probably with small populations (Scheffer *et al.* 2015; Hernández-Mijangos *et al.* 2008). Therefore, anthropogenic impacts on their habitats (*e.g.*, pollution of water bodies, introduction of domestic species, changes in land use) could lead to local changes in their populations and distribution (Scheffer *et al.* 2015).

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First records of hypopigmentation of Tayra *Eira barbara* in Colombia
Primeros registros de hipopigmentación en la taira *Eira barbara* en Colombia

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Leucism, xanthism, and piebaldism are genetic conditions that generate deficiency in animal melanin deposits or hypopigmentation, which can manifest in the total or partial absence of pigmentation in the integumentary tissue. In Colombia, there are few records of this condition in mammals such as bats and rodents. Nevertheless, this condition also occurs in mustelids, and the information is scarce for any biogeographic region of Colombia. We used data derived from different surveys with camera trap studies across 5 departments in 2 biogeographic regions in Colombia (Andean and Orinoco). The species was identified by external characteristics and the color aberrations following specialized literature. With a sampling effort of 11,015 camera/days, and one ad libitum observation, we described 10 independent records of hypopigmentation in tayras which might be related to leucism, xanthism, and piebaldism. In addition, other abnormalities such as taillessness and light gray coloration were found. Our records constitute the first documented cases of hypopigmentation of tayras in Colombia and analyzed evidence of potential anomalies in wild populations living in transformed habitats. We intended to highlight these particular colors of the phenotypes in the species as a possible consequence of genetic mutations and environmental pressures. Finally, we also complement some aspects of their natural history.

Key words: Andean; camera traps; color aberration; Neotropical mammals; Orinoco.

El leucismo, xantismo y piebaldismo son condiciones genéticas que generan deficiencia en el depósito de melanina o hipopigmentación en animales, manifestándose en la ausencia total o parcial de pigmentación en el tejido tegumentario. En Colombia hay pocos registros de esta condición en especies de mamíferos como murciélagos y roedores. Sin embargo, esta condición también se presenta en mustélidos, y la información es escasa para cualquier región biogeográfica de Colombia. Usamos datos derivados de diferentes muestreos con cámaras trampa en 5 departamentos de 2 regiones biogeográficas de Colombia (Andes y Orinoquia). La especie fue identificada por características externas y las aberraciones de color siguiendo literatura especializada. Con un esfuerzo de muestreo de 11,015 días/cámara y una observación *ad libitum*, describimos 10 registros independientes de hipogimentación en tayras relacionadas con leucismo, xantismo y piebaldismo. Adicionalmente, fueron encontradas otras anormalidades como la cola corta y coloración gris clara. Estos registros constituyen los primeros casos documentados de hipopigmentación en Colombia y analiza evidencias de potenciales anomalías de poblaciones silvestres en hábitats transformados. Se destacan estas coloraciones particulares en los fenotipos de la especie como consecuencia de mutaciones genéticas y presiones ambientales. Por último, se complementan algunos aspectos sobre su historia natural.

Palabras clave: Andes; aberración cromática; cámara trampa; mamíferos neotropicales; Orinoquia.

Despite the hypopigmentation disorders are considered rare, the information on pigmentation anomalies in Neotropical mammals has increased considerably (García *et al.* 2020). According to Olson (2019), after birds, mammals are the vertebrate class with the highest number of leucism records reported, within this class, the orders Eulipotyphla and Carnivora have the most reported cases. Among carnivores, most of the records come from the Mustelidae family and within this family, the tayra (*Eira barbara*) predominates with cases reported in Bolivia (Tarifa *et al.* 2001), Guyana (Presley 2000; Villafañe-Trujillo *et al.* 2018), and Brazil (Tortato and Althoff 2007; Aximoff and Rocha 2016; Sobroza *et al.* 2016; Talamoni *et al.* 2017; Scrich *et al.* 2019).

The tayra is a medium-sized mustelid with a weight ranging from 2.7 to 7 kg. It has an elongated and slender body of 559-712 mm with a long tail of 365-460 mm, strong claws, and small-rounded ears. Its coat is short and smooth, the back, limbs, and tail are brown or black contrasting with the light coloration of the head and neck which is grayish to yellow (Presley 2000). On the underside of the neck, it has a light-colored irregular spot (yellowish-whitish) that even has potential for identification of individuals (Villafañe-Trujillo *et al*. 2018). According to Presley (2000) the albinism and melanism in *E. barbara* is more common than in other mustelid species.

Chromatic diversity is mainly caused by pigments such as melanin, which, based on their body presence, quantity, and locations determine the color of structures such as the skin, coat, and eyes (Eizirik and Trindade 2021). Abnormalities in coloration occur when complex biological factors such as genetic mutations alter the production and availability of melanin, causing changes in the coloration of the individual. These abnormalities include melanism, albinism, piebaldism, xanthism, and leucism (Cotts *et al*. 2023; Tenorio-Rodríguez *et al*. 2024). Melanism is an excess of dark pigmentation, while albinism implies a reduction or total absence of pigment, including the skin and eyes. Piebaldism is an absence of melanocytes in one or more parts of the body that causes white spots on the skin and hair of the affected individual (Lucati and López-Baucells 2017). On the other hand, xanthism or xanthochromism is a condition that causes yellow or orange-yellow colorations due to increased fixation of pigments such as xanthine and pheomelanin in tissues. Finally, leucism causes white or yellowish-white colorations in its carrier, except in its eyes, claws, and skin (Cotts *et al*. 2023; Hernández-Aguilar 2023). Reporting the presence of chromatic anomalies in wildlife species contributes to the understanding of this phenomenon, including possible causes that provoke it and its effects on the carrier individuals (Leandro-Silva *et al*. 2022; Hernández-Aguilar 2023). The objective of this study is to document the first cases of chromatic aberrations in tayras in Colombia.

During 2018, 2022, 2023, and 2024, we conducted 6 different camera trap surveys with a total sampling effort of 11,015 days/camera in 3 localities of the Orinoco region and 2 localities of the Andean region of Colombia. Cameras were primarily targeted at medium and large mammals, not only focused on *E. barbara*. The study area encompasses 5 departments, two of this at Andean region such as Antioquia (Buriticá) and Norte de Santander (Área Natural Única Los Estoraques), and other three in Orinoco region such as Meta (Puerto Gaitán), Casanare (Mani and Tauramena), and

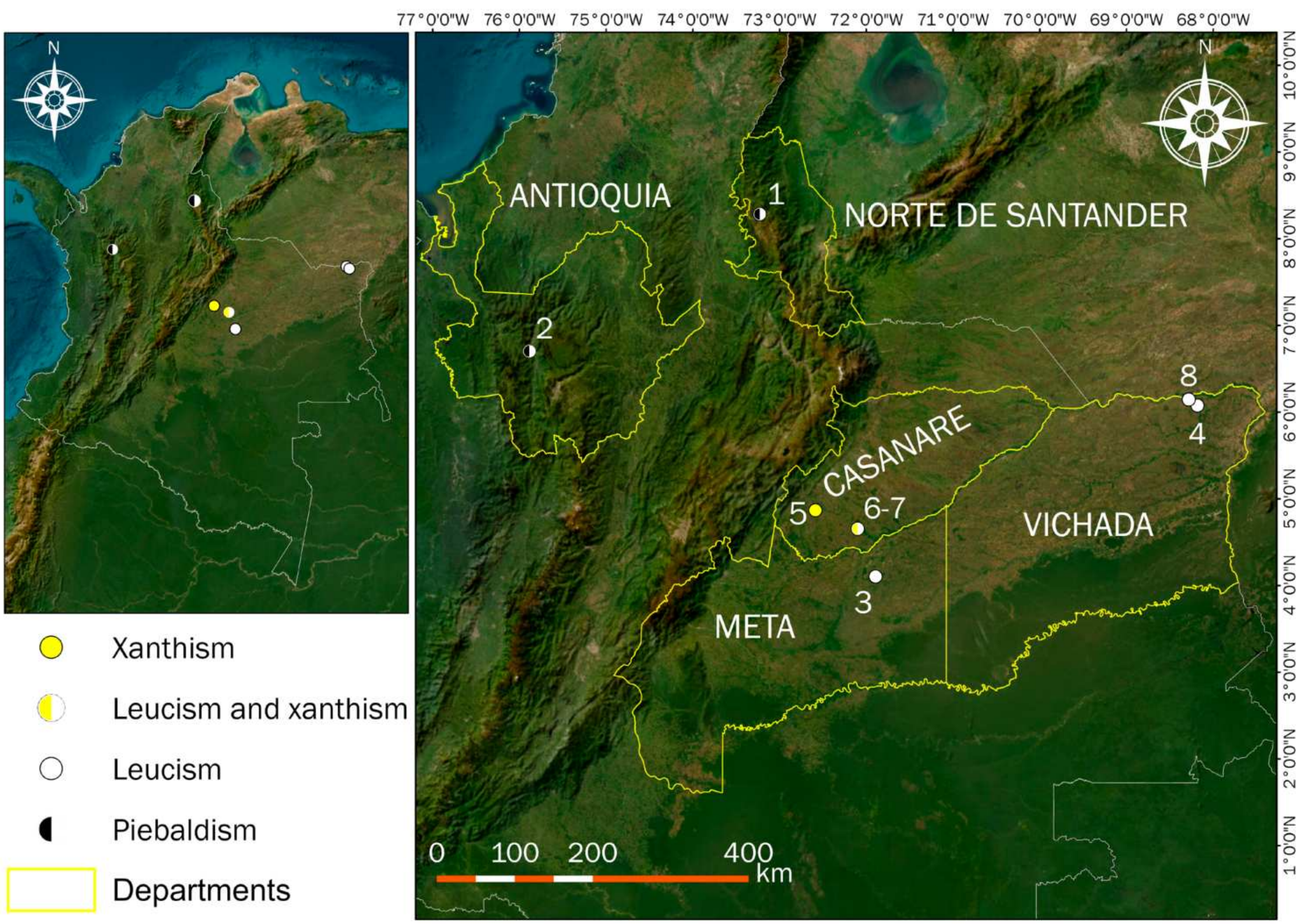

Figure 1. Location of study sites and cases of tayra (*Eira barbara*) with hypopigmentation in the departments of Colombia. Capital letters represent cases in chronological order.

Figure 2. Figure 2. Photographic records of tayra (*Eira barbara*) with hypopigmentation present in the Orinoco and Andes regions, Colombia. (a), (b), and (**d**), represent leucism. (c), (e), and (f) represent xanthism. (g) represent an individual with light coloration. (h) and (i) represent dorsal white spotting or piebaldism.

Vichada (Puerto Carreño). The places in the Orinoco region included productive lands such as cattle ranches, oil palm plantations, and commercial tree plantations. While, in the Andes region, one study site corresponded to a protected area and another to a gold mine area. Nevertheless, all areas have some degree of anthropic intervention (Figure 1).

The identification of the species was carried out following the external characteristics mentioned by the field guide of carnivores by Suárez-Castro and Ramírez-Chaves (2015). For record of individual with yellowish-white colorations in its carrier, except in its eyes, claws, and skin we follow the category leucism used by (Cotts *et al*. 2023), for the records of individuals with the predominance of beige and yellow color in the coat, we follow the category xanthochromism used by Cotts *et al*. (2023) and for the records of individuals with white spots in the fur we follow the category piebaldism based on Lamoreux *et al*. (2010).

A total of 97 records of *E. barbara* were obtained in all study sites, of this, 10 records/individuals with anomaly colorations. Of the total number of records, 3 presented colorations that correspond to leucism (*i.e*., predominantly white color throughout the body), 2 presented xanthochromism with a predominant yellow coloration, 4 presented piebaldism with white spots in the fur, and 1 showed atypical light gray colorations.

The Andean region, presented the total records of piebaldism (4). The Orinoco region presented the total records of leucism (3), xantism (2) and the only one record of light gray coloration. Each case of non-albinism hypopigmentation in tayras is described below in chronological order and grouped in two biogeographical regions.

Andes region cases. Case 1: 3 different individuals were recorded on August 1, 2018 (14:15 hr), February 2, 2018 (13:25 hr), and April 19, 2018, (13:54 hr) in the forest of Los Estoraques Unique Natural Area (8º 12'41.072" N, 73º.16' 38.15" W), with a sampling effort of 2,770 camera/days, all with white spots or piebaldism represented by a small white portion of the hair in the upper neck and dorsum, this part has an irregular form (Figure 2h).

Case 2: On July 25, 2024 (13:54 hr) in the gold mine of Buriticá, Antioquia (6º 42' 5.544" N, 75º 53' 9.852" W) and with a sampling effort of 2,176 camera/days, one adult individual with white spots or piebaldism was recorded, represented by a small white portion of the hair in the upper neck and dorsum, this part has an irregular form (Figure 2i).

Orinoco region cases. Case 3: On October 6, 2022 (11:45 hr) inside the oil palm plantation cover of Palmera Sillatava S. A., located in the Alto Manacacías, Puerto Gaitán, Meta (4º 6' 19.415" N, O71º.53' 43.216" W), an adult male was observed with leucism, with a predominantly white coloration on the body except in the distal third of the tail, with a light yellow tone, this individual was being chased by a domestic dog that had already caused wounds on his neck, limiting his mobility (Figure 2a).

Case 4: On March 12, 2023 (15:12 hr), in a native forest of the commercial tree plantation Forest First Colombia in department of Vichada (6º 4' 37.366" N, 68º.10' 58.191" W), with a sampling effort of 809 camera/days, an adult female with leucism was recorded, with white coloration throughout her fur (Figure 2b).

Case 5: On October 3, 2023 (09:17 hr) at Hato Ganadero Barley, Tauramena, Casanare (4º 52' 5.04" N, 72º.35' 20.089" W), with a sampling effort of 40 camera/days, an adult female with xanthism was recorded (Figure 2c).

Case 6: On October 07 and 08, 2023 at 17:49 and 8:34 hours respectively, in a native forest of the oil palm plantation and cattle producing property El Corozito, Maní, Casanare (4º 39' 19.19" N, 72º.5' 59.999" W), with a sampling effort of 180 camera/days, a female with leucism was recorded (Figure 2d).

Case 7: On October 29, 2023, at 9:07 and 16:47 hr at the same sampling station and with the same sampling effort as case 6, an adult male with xanthism was recorded, in addition to a reduced tail, which is atypical for the species (Figure 2e and f).

Case 8: On November 21, 2023 (7:08 hr), in a native forest of the commercial tree plantation Forest First Colombia in Puerto Carreño, Vichada (6º 8' 42.9" N, O68º.16' 58.439" W), with a sampling effort of 5040 camera/days, an adult with a clear coloration was recorded, with light gray coloration in the dorsal part of the body from the neck to tail base. The legs and tail with black coloration. This individual was recorded in a social group with another two individuals of the normal coloration (Figure 2g).

Currently, chromatic anomalies reported in tayras include leucism (Mendes-Pontes *et al*. 2020) in the Guyana Shield, and albinism (Aximoff and da Rocha 2016) in the Atlantic Forest of Brazil. In this study, we report new cases of hypopigmentation for the first time in the Orinoco and Andes regions of Colombia, including leucism and the first known records of xanthism and piebaldism. Although recent records of chromatic anomalies are published in different species and regions of the world, there are still gaps in information about this phenomenon. For instance, the implications it has on its carriers, and even its classification, since most of the records lack biological material that can be analyzed to determine the possible causes of this phenomenon. For these reasons, the classification of chromatic aberrations reported in this study was based only on the external morphological aspects of each individual. Since all the records were obtained by direct and indirect observations, this issue hinders the possibility of establishing a more accurate classification of chromatic aberrations.

Although the implications of leucism and other atypical colorations on the ecology of Tayras are still unknown, some authors suggest that chromatic aberrations such as leucism may promote changes in intraspecific relationships, as well as predation risk, increased difficulty in hunting, anemia, poor eyesight, low fertility, immune deficiency, and sensory or nerve defects (Miller 2005; Acevedo and Aguayo 2008; Sobroza *et al*. 2016; Ortiz-Hoyos *et al*. 2020; Gallo *et al*. 2023; Tenorio-Rodríguez *et al*. 2024). This might be related to the fact that lighter coloration makes camouflage more difficult, making carriers of conditions such as leucism more easily perceived by their prey or predators (*e.g*., case 3), and consequently less favored by natural selection. This could explain why the records of chromatic aberrations such as leucism are considered unusual (Caro and Mallarino 2020; Hernández-Aguilar 2023). Therefore, intraspecific and interspecific interactions as well as the survival of leucistic tayras may be compromised, since they are not always solitary, and their diet includes other animals. In addition, their distribution overlaps with that of potential predators such as ocelots, pumas, and jaguars (de Oliveira and Pereira 2014), but it is unclear whether a leucistic condition alters that predator-prey relationship (Scrich *et al*. 2019). In our case, we observed domestic dogs attacking a leucistic tayra, and we hypothesize that was caused by its greater exposure compared to normally colored tayras. The impact of dogs as potential competitors of tayras has been suggested before (Lessa *et al*. 2016; Bianchi *et al*. 2021), and recent evidence points to dogs killing tayras in agricultural landscapes (Pereira *et al*. 2019). However, groups of tayras with leucistic members have been recorded performing positive intraspecific interactions, suggesting that leucism does not negatively affect its carriers, which may also benefit from the absence of large carnivores in the area (Sobroza *et al*.

2016; Mendes-Pontes *et al*. 2020). Despite this, the effects of leucism on the ecology of the tayra are still unclear and require more studies that corroborate whether leucism has positive, negative, or no impacts on its carriers (Sobroza *et al*. 2016; Talamoni *et al*. 2017; Scrich *et al*. 2019; Mendes-Pontes *et al*. 2020).

The frequency of hypopigmentation has been related to inbreeding (Olson 2019), but also to environmental factors such as nuclear pollution that may increase mutation rates (Møller and Mousseau 2001). According to Melo-Dias *et al*. (2022) in the Atlantic Forest, Brazil, a high number of cases of hypopigmentation has been reported and it is considered that it could be associated to historical processes of landscape fragmentation. This could also apply to the Llanos in Colombia which has experienced an accelerated growth of different types of agricultural activities (e.g., rice, oil palm, soybean, corn, tree plantations, extensive cattle ranching, among others). The atypical coloration is not the only characteristic found in the phenotype of individuals that live in landscapes with certain anthropogenic interventions. In fact, individuals with congenital short tails and leucism are examples of other conditions. We do not consider the reductions of the tail in the individual of case 7 was caused by mechanical forces and hypothesize that it could be related to the Manx gen, according to Robinson (1993) taillessness is one of the vertebral column mutations occasioned by this gene in domestic cats. Nevertheless, genetic analysis is necessary to confirm this hypothesis. Other explanations for this phenomenon can be related to the development of anthropogenic activities that depend of the intensive and indiscriminate use of pesticides and genetically modified species, which if not properly managed can affect non-target species (Eslava-Mocha 2015), for instance, *E. barbara*. Tayras are known to ingest large amounts of pesticides from various food sources, their omnivorous diet, and this could generate changes in the typical coloration of individuals, since most pesticides are compounds created based on sulfur (Griffith *et al*. 2015), an element that can favor pheomelanogenesis (Galván *et al*. 2019) and therefore, the production of lighter colorations than usual in species such as *E. barbara*.

Finally, given that all the records of tayras with abnormal colorations corresponded to adult individuals, it is possible that these conditions do not affect intraspecific relationships or the survival of their carriers. According to Acevedo and Aguayo (2008) and Piaguaje *et al*. (2021), publishing records of chromatic aberrations in wildlife species is fundamental to understanding the frequency, genetic, physiological, and ecological implications of hypopigmentation and other coloration phenomena in their carriers. We recommend advancing in the analysis of the genetic variability of the populations mentioned in the study areas. In turn, the occurrence of a polymorphic color phenotype in tayras, its suggested to study the fixation of recessive characteristics and the evaluation of the possible adaptive advantages/disadvantages of these phenotypes at the population level.

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First record of folivory in *Artibeus lituratus* (Chiroptera: Phyllostomidae) from an urban protected area in Guatemala

Primer registro de folivoría en *Artibeus lituratus* (Chiroptera: Phyllostomidae) en un área protegida urbana de Guatemala

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Artibeus lituratus is primarily frugivorous, although it has been documented to supplement its diet with leaves. Leaf consumption may occur through fractionation or direct ingestion of the leaf lamina. However, observations are limited, mostly anecdotal, and there are few detailed descriptions available. We document, for the first time in Guatemala, leaf consumption by the frugivorous bat *A. lituratus*. This folivorous behavior was observed at feeding perches in Parque Nacional Naciones Unidas, in central Guatemala. Using fecal samples, fruit remains, seeds, and nibbled leaves collected from September to December 2023, we documented the consumed food resources. We identified fruits from 15 plant species and leaves from 9 species. Leaf consumption was documented from September to November, with no evidence of leaves being consumed in December. The most frequently consumed fruit genera were *Ficus*, *Solanum*, and *Spondias*, while the most common leaves belonged to the genera *Sinclairia* and *Solanum*. Leaf consumption patterns varied across different sections of the leaf (basal, apical, edge, apical-basal, vein). Basal consumption was the most frequent, with typically more than 50% of the leaf lamina consumed.

Key words: Feeding habits; fruit bats; leaf consumption; resource availability; Stenodermatinae.

Artibeus lituratus es una especie principalmente frugívora, aunque se ha documentado que complementa su dieta con hojas. El consumo de hojas puede ocurrir a través de fraccionamiento o la ingestión directa de la lámina foliar. Sin embargo, las observaciones son limitadas, mayormente anecdóticas, y hay pocas descripciones detalladas disponibles. Documentamos, por primera vez, el consumo de hojas por parte del murciélago frugívoro *A. lituratus* en Guatemala. Este comportamiento de folivoría fue observado en perchas de alimentación en el Parque Nacional Naciones Unidas, en el centro de Guatemala. Utilizando muestras fecales, restos de frutas, semillas y hojas mordisqueadas recolectadas entre septiembre y diciembre de 2023, documentamos los recursos alimenticios consumidos. Identificamos frutos de 15 especies y hojas 9 especies. El consumo de hojas se documentó de septiembre a noviembre, sin evidencia de que se consumieran hojas en diciembre. Los géneros de frutos más consumidos fueron *Ficus*, *Solanum* y *Spondias*, mientras que las hojas más comunes pertenecían a los géneros *Sinclairia* y *Solanum*. Los patrones de consumo de hojas variaron según las diferentes secciones de la hoja (basal, apical, borde, apical-basal, nervadura). El consumo basal fue el más frecuente, con típicamente más del 50% de la lámina de la hoja consumida.

Palabras clave: Consumo de hojas; disponibilidad de recursos; hábitos alimenticios; murciélagos frugivoros; Stenodermatinae.

Neotropical bats are trophically diverse, including species that feed on arthropods, fruits, nectar, leaves, seeds, vertebrates, and blood (Fenton *et al.* 1992; Simmons and Conway 2003; Kunz *et al.* 2011). The use of most of these resources has been extensively documented, varying according to species-specific feeding behaviors (Patterson *et al.* 2003; Simmons and Conway 2003); however, resources such as seeds and leaves have been less studied, with limited evidence supporting their consumption (Kunz and Ingalls 1994; Kunz and Díaz 1995; Nelson *et al.* 2005; Bobrowiec and Matos 2010; Ruiz-Ramoni *et al.* 2011; Wagner *et al.* 2015; Cordero-Schmidt *et al.* 2016; da Rocha *et al.* 2016; Villalobos-Chaves *et al.* 2016; Pellón 2022; Trujillo *et al.* 2022; Rodrigues *et al.* 2023). In the case of leaves, their consumption has been a subject of debate, as the feeding behavior of bats does not fully align with traditional definitions of true folivory (Rodrigues *et al.* 2023; Muñoz-Romo *et al.* 2025). Bats typically chew leaf fragments to extract and ingest the juices, discarding the fibrous material (Kunz and Ingalls 1994; Kunz and Díaz 1995; Nelson *et al.* 2005; Bobrowiec and Matos 2010; Ruiz-Ramoni et al. 2011; Cordero-Schmidt *et al.* 2016; da Rocha *et al.* 2016; Rodrigues *et al.* 2023). Nevertheless, as reports of bat folivory have become more frequent, along with anecdotal observations of bats consuming mature leaves in their entirety without discarding any part; it is increasingly recognized that frugivorous bats may occasionally exhibit specific folivorous behaviors (Rodrigues *et al.* 2023; Muñoz-Romo *et al.* 2025). To date, folivory has been documented in five species within the genera *Artibeus*, *Platyrrhinus*, and *Carollia* (Rodrigues *et al.* 2023).

Folivory in Neotropical fruit bats has been documented since 1957 (Greenhall 1957) and continues to be an active area of research, with several key findings that have enhanced our understanding and led to hypotheses regarding leaf consumption (Kunz and Ingalls 1994; Kunz and Díaz 1995; Nelson *et al.* 2005; Bobrowiec and Matos 2010; Ruiz-Ramoni *et al.* 2011; Cordero-Schmidt *et al.* 2016; da Rocha *et al.* 2016; Rodrigues *et al.* 2023). Initially, evidence of leaf consumption was gathered through the analysis of discarded material, such as partially consumed leaves and oral pellets, and was further supported by direct observations of bats feeding (Zortéa & Mendes 1993; Kunz & Ingalls 1994; Kunz & Diaz 1995; Nogueira & Peracchi 2003; Ruiz-Ramoni *et al.* 2011; Cordero-Schmidt *et al.* 2016; Duque-Márquez *et al.* 2019). The use of complementary research methodologies, such as camera devices to monitor colonies and feeding roosts, has also made significant contributions to our understanding of this behavior (Silvestre *et al.* 2016; da Rocha *et al.* 2016; Pereira *et al.* 2017; Muñoz-Romo *et al.* 2025). Experimental tests have also provided additional insights into the folivorous habits of bats (Nelson *et al.* 2005).

The factors driving folivory in fruit-eating bats remain poorly understood (Rodrigues *et al.* 2023; Muñoz-Romo *et al.* 2025). Some studies suggest that nutritional needs, such as carbohydrates, proteins, and minerals lacking in fruits, may drive this behavior (Kunz and Ingalls 1994; Kunz and Díaz 1995; Nelson *et al.* 2005; Bobrowiec and Matos 2010). Other factors, including water scarcity in dry habitats (Cordero-Schmidt *et al.* 2016; Rodrigues *et al.* 2023) and fruit availability tied to plant phenology (da Rocha *et al.* 2016), have also been proposed. It is important to note that none of these factors influencing folivory in bats is mutually exclusive; rather, folivory can result from a combination of all three. However, much of the existing literature remains descriptive and lacks detail (Ruiz-Ramoni *et al.* 2011; Duque-Márquez *et al.* 2019), highlighting a significant knowledge gap that requires further investigation.

This study aims to report, for the first time, leaf consumption by *Artibeus lituratus* in Guatemala, documenting the diversity of food resources consumed at feeding perches in Parque Nacional Naciones Unidas (PNNU) in central Guatemala, a region where this behavior has not been previously recorded.

Parque Nacional Naciones Unidas (PNNU), located between the municipalities of Villa Nueva and Amatitlán in central Guatemala, spans 372 ha with elevations ranging from 1,190 to 1,330 m. The region receives annual rainfall between 1,100 and 1,349 mm, with temperatures typically ranging from 20 to 23 °C. PNNU is part of ecosystems classified as Premontane Humid Forest Ecosystem, which has predominantly pine-oak species associations (IARNA-URL 2018). The area has been significantly impacted by anthropogenic activities, leading to considerable changes in its forest structure. In most areas, native vegetation has been replaced by plantations intended for forest restoration, featuring non-native species such as cypress (*Hesperocyparis lusitanica*), eucalyptus (*Eucalyptus* sp.), casuarina (*Casuarina* sp.), pine (*Pinus* sp.), and various fruit trees and schrubs (CONAP 2005).

Figure 1. a) Feeding perches documented in Parque Nacional Naciones Unidas. b) Table placed under the feeding perch for sample collection. c) Table under the feeding perch with a plastic cover to receive samples.

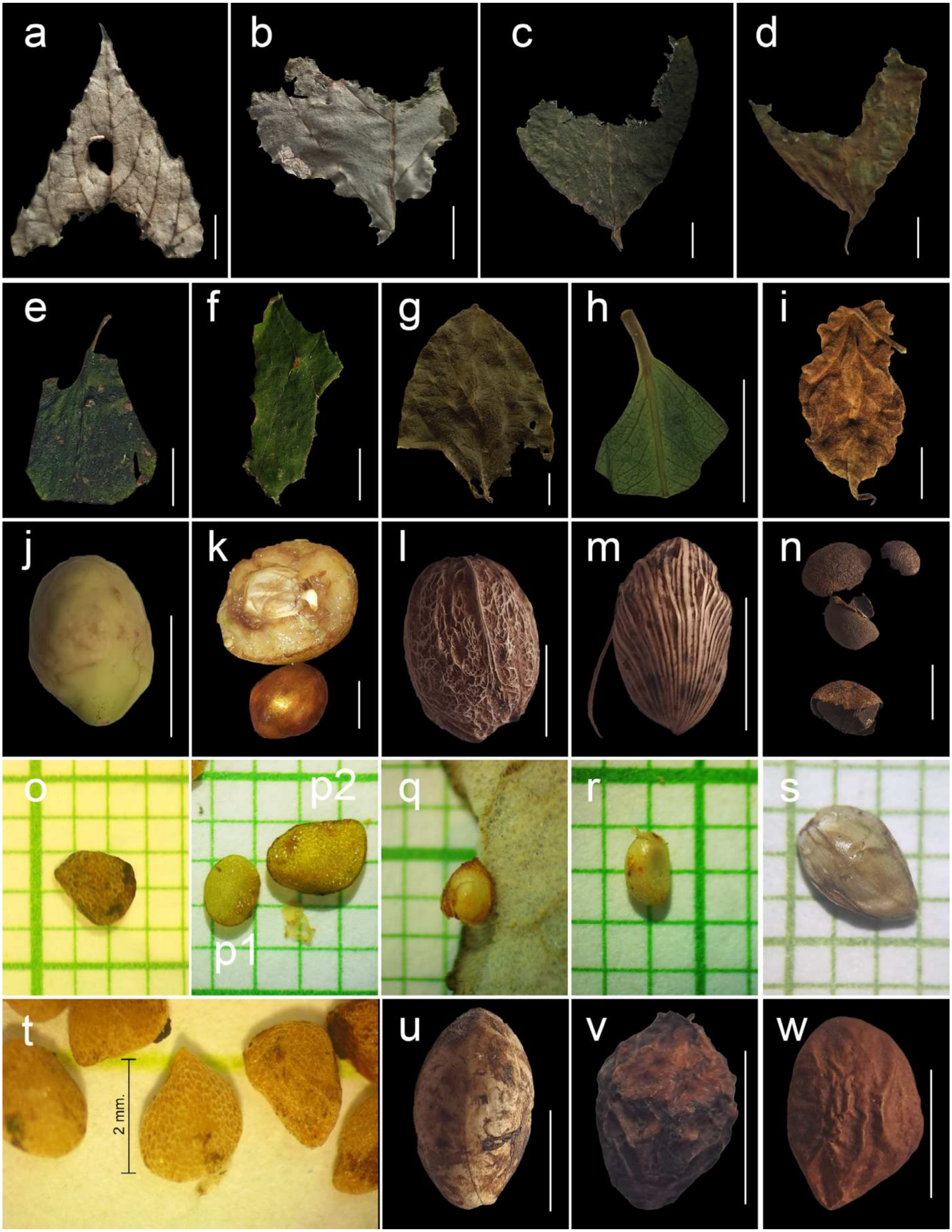


Figure 2. Items found at sampling sites throughout the study. a) *Sinclairia sublobata*, b) *Solanum* sp. 1, c) *Solanum* sp. 2, d) *Lycianthes* sp., e) Morphospecies 1, f) Morphospecies 2, g) Morphospecies 3, h) Morphospecies 4, i) Morphospecies 5. Seeds: j) *Casearia* sp., k) *R. bibas*, l) *S. purpurea*, m) *Areca* sp., n) *S. jambos*, o) *Solanum nigrum*, p1) *Solanum* sp.1 p2) *Solanum* sp.2, q) *Ficus cotinifolia*, r) *Panicum* sp., s) *Ficus costaricana*, t) *Lycianthes arrazolensis,* u) Morphospecies 1, v) Morphospecies 2, w) Morphospecies 3. Scale bar (white line): 1 cm.

Table 1. Occurrence of digested and non-digested seeds, as well as chewed leaf species, observed at feeding perches in Parque Nacional Naciones Unidas from September to December 2023. The symbol "x" denotes the record of items for each month.

	Family	Species	Sep	Oct	Nov	Dec	Native/ Introduced
Seeds							
Tree	Salicaceae	*Casearia* sp.	x				Native
	Moraceae	*Ficus cotinifolia*	x	x	x	x	Native
		Ficus costaricana	x	x	x	x	Native
	Rosaceae	*Rhaphiolepis bibas*	x	x			Introduced
	Anacardiaceae	*Spondias purpurea*	x	x	x	x	Native
	Myrtaceae	*Syzygium jambos*	x	x	x	x	Introduced
Shrub	Solanaceae	*Lycianthes arrazolencis*		x			Native
		Solanum nigrum		x	x		Native
		Solanum sp1	x	x	x		Mostly native
		Solanum sp2	x	x	x	x	Mostly native
Other	Arecaceae	*Areca* sp.	x				Introduced
	Poaceae	*Panicum* sp.	x				Mostly native
	NA	Morphospecies 1		x			NA
	NA	Morphospecies 2		x			NA
	NA	Morphospecies 3			x		NA
Leaves							
Shrub	Asteraceae	*Sinclairia sublobata*	x	x			Mostly native
	Solanaceae	*Lycianthes* sp.			x		Mostly native
		Solanum sp. 1	x	x	x		
		Solanum sp. 2	x	x			Mostly native
Other	NA	Morphospecies 1	x				NA
	NA	Morphospecies 2	x	x			NA
		Morphospecies 3	x	x			NA
	NA	Morphospecies 4			x		NA
	NA	Morphospecies 5			x		NA

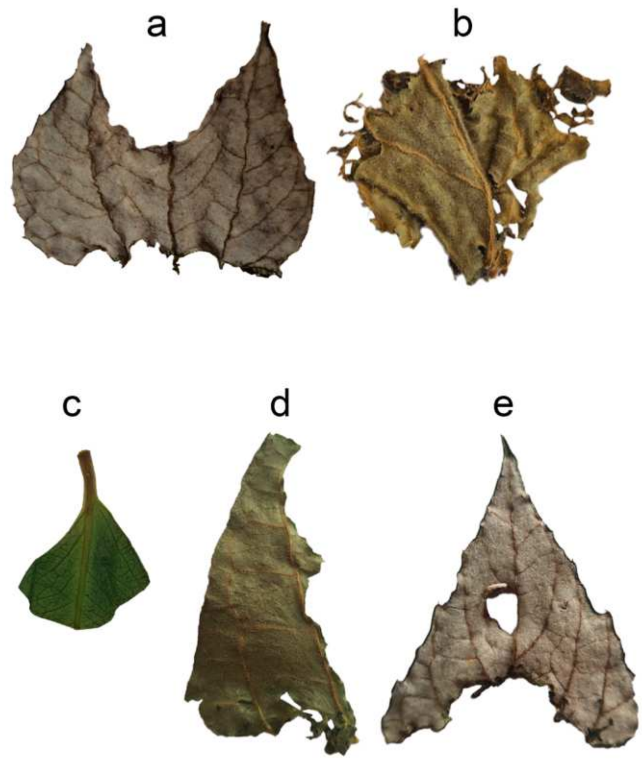


Figure 3. Leave ingestion patterns. a) Apical-basal, b) Edge, c) Apical, d) Vein, e) Basal.

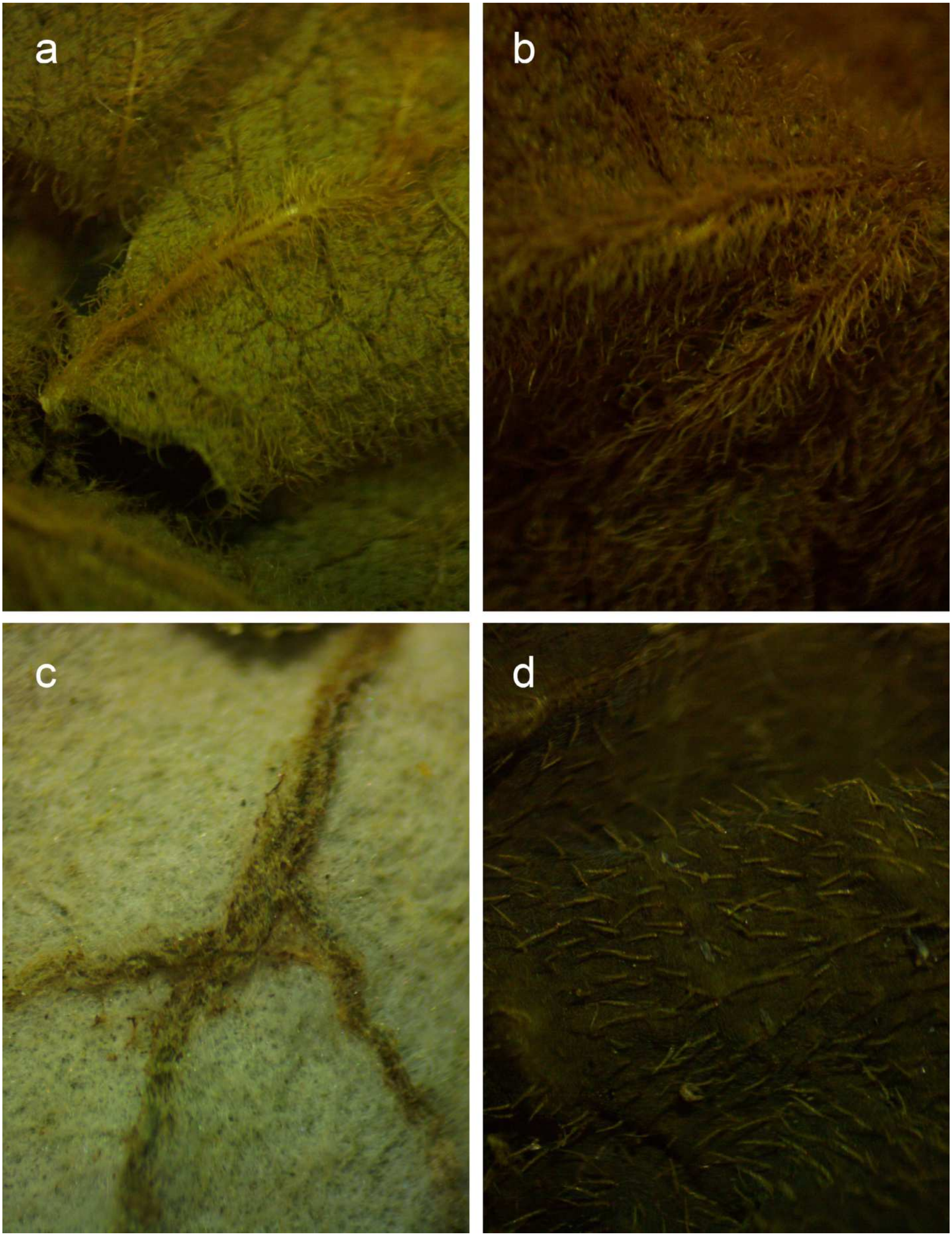
Table 2. Percentage of leaf consumed, and consumption patterns observed at feeding perches in Parque Nacional Naciones Unidas from September to December 2023.

Species	Percentage of leaves consumed	Leaves comsumption pattern	Trichomes
Liabum sp.	> 50	Apical, apical-basal, basal, edge, and midrib and others	Yes
Solanum sp. 1	> 50	Basal, edge, and midrib and others	Yes
Solanum sp. 2	< 50	Basal	Yes
Lycianthes sp.	> 50	Basal	Yes
Morphospecies 1	< 50	Basal	No
Morphospecies 2	> 50	Edge and midrib and others	Yes
Morphospecies 3	> 50	Apical, basal, edge, and midrib and others	Yes
Morphospecies 4	> 50	Apical	No
Morphospecies 5	> 50	Apical-basal	Yes

Fruit, seed, and nibbled leaf samples were collected from feeding perches frequented every night by *A. lituratus*, where evidence such as leaf and fruit pellets, seed and fruit remains, and partially nibbled leaves were found on tables below the perches (Figure 1). Sampling was conducted twice a week, early in the morning, from September to December 2023. Each sample was rinsed with water, disinfected with 70% alcohol, dried, and then placed in a waxed paper envelope for preservation (Morales-Pizarro et al. 2023).

Seed identification was conducted using the 'Index Seminum' seed reference collection from the Botanical Garden at Universidad de San Carlos de Guatemala (Portal de Biodiversidad de Guatemala 2025). For leaf identification, diurnal surveys were conducted to collect plants whose leaves were potentially consumed by the bats. Bats were identified through multiple direct observations of individuals perching on the feeding perches, which were consistently used each night. To confirm these observations, bats were also captured using mist nets set up around the feeding perches. Species identification was conducted using regional field guides (Medellín et al. 2008; Reid 2009).

To assess the diversity of fruits and leaves consumed at the feeding perches, we analyzed the collected samples, categorizing the remains of each identified food item. Leaf consumption was classified into five distinct patterns: basal, apical, edge, apical-basal, and vein. In the basal pattern,



Supplemental material 1. Leaves with trichomes. a) *Solanum* sp. 2 (lower surface), b) Morphospecies 5 (lower surface), c) *Liabum* sp., (lower surface) d) *Solanum* sp. 2 (upper surface).

bites are concentrated at or along the leaf base; in the apical pattern, bites occur at or along the leaf apex. The edge pattern involves bites along the entire leaf margin, while the apical-basal pattern features bites at both the apex and base, sparing the middle and margins. The vein pattern includes bites along the midrib and adjacent areas of the lamina. To quantify the proportion of each leaf consumed, we classified the patterns based on whether less than or greater than 50% of the leaf was consumed.

A total of 24 food items were documented at nocturnal feeding perches within PNNU, consisting of leaves of 9 species and seeds of 15 species (Table 1; Figure 2). October exhibited the highest species richness, with leaves of 7 species and seeds of 11 species, while December had the lowest diversity, with only seeds of 4 species and no leaf consumption.

Among the fruit species observed, *Spondias purpurea*, *Syzygium jambos*, *Ficus* sp., and *Solanum sp.* were consistently present across all months. *Rhaphiolepis bibas* was exclusive to September and October. Other seeds, including *Areca* sp., *Casearia* sp., *Panicum* sp., and Morphospecies 1–3, were recorded in only one month. The 9 leaf species observed included those from the genera *Sinclairia*, *Solanum* and *Lycianthes*, along with other species cataloged as Morphospecies (Morphospecies 1–5). Leaf consumption was documented from September to November, with no evidence of leaves being consumed in December. Leaves of *Solanum*, *Sinclairia* and Morphospecies 3 were the most frequently consumed (Figure 2).

The number of nibbled leaves by *A. lituratus* varied across months, with the highest number in October (n = 24), followed by September (n = 11) and November (n = 3). Five distinct leaf-ingestion patterns were identified (Figure 3), with the basal pattern being the most predominant (Table 2). The proportion of the leaf consumed varied among species, with consumption exceeding 50% in 7 of the 9 leaf species. Most of the consumed leaves shared a smooth and pubescent surface, with trichomes arranged in various configurations. Of the 9 leaf species, 7 exhibited trichomes in varying densities on both surfaces (Supplemental material 1).

This study provides novel insights into the feeding ecology of *A. lituratus* in Guatemala, highlighting its dietary plasticity and ability to exploit resources underutilized by other frugivorous bats. Notably, *Sinclairia sublobata* leaves were recorded for the first time as a dietary resource for any bat species. Furthermore, the frequent consumption of *Solanum* leaves, previously documented in the diet of *A. lituratus* (Duque-Márquez *et al.* 2019; Rodrigues *et al.* 2023), extends the knowledge of the consumption of leaf species from this genus into the region.

A distinct pattern of leaf consumption was observed, with a preference for the basal section (Figure 2 and Table 2). This is consistent with previous studies, which suggest that the higher concentrations of nutrients and water, combined with lower fiber content, make the basal portion more attractive to frugivorous bats (Zortéa and Mendes 1993; Kunz and Diaz 1995; Ruiz-Ramoni *et al.* 2011; Cordero-Schmidt 2016; Duque-Márquez *et al.* 2019). The uneven distribution of nutrients and water, typically higher at the base, likely drives this preference (Sandars et al. 2010). In the case of the 9 leaf species, 7 exhibited trichomes on both surfaces, with densities varying across species. These structures, commonly developed by some plants to prevent herbivory (São-João and Raga 2016; Karabourniotis *et al.* 2020), seem to have no effect on *A. lituratus*.

The evidence of feeding behavior by *A. lituratus* in the PNNU showed consistent fruit consumption over the four months of observation, whereas leaf consumption was observed in only three of those months. Notably, the evidence of leaf consumption indicated a gradual decline over time; however, the available observations are insufficient to establish this as a pattern. Among the fruits, species from the families Solanaceae (*Solanum* sp.), Moraceae (*Ficus* sp.), and Anacardiaceae (*Spondias purpurea*) were the most frequently consumed, while for leaves, the families Solanaceae (*Solanum* sp.) and Asteraceae (*Liabum* sp.) were the most common.

Artibeus lituratus is exploiting plant species that were once part of the restoration programs in the PNNU, including exotic plants such as *Areca* sp. (Arecaceae), *R. bibas* (Rosaceae), and *S. jambos* (Myrtaceae), which were intentionally introduced to support the park's biodiversity (CONAP 2005). The recovery zone, primarily resulting from human-mediated ecological restoration, now provides these resources. The findings from this study offer evidence of the integration of biodiversity within these restoration efforts and highlight the species' flexibility in utilizing both native and non-native resources.

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Notable records of *Galictis vittata* and *Eira barbara* (Carnivora: Mustelidae) in the Northeastern Sierra of Puebla, Mexico

Registros notables de *Galictis vittata* y *Eira barbara* (Carnivora: Mustelidae) en la Sierra Nororiental de Puebla, México

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Eira barbara and *Galictis vittata* are carnivorous mammals belonging to the family Mustelidae. In Mexico, these species are listed in a risk category; however, they are among the least studied carnivorous mammals. There are scarce records and information on different aspects of the ecology of both species. The objective of this note is to report additional records of *E. barbara* and *G. vittata* in the Northeastern Sierra of Puebla. From March to May 2023, 20 camera-trap stations were installed in natural water bodies and sites where traces of wild mammals were found. Additionally, records of individuals were obtained from international databases and published articles; a map of the potential distribution of *E. barbara* and *G. vittata* in Mexico was made. With a sampling effort of 90 trap days, 2 independent records of *E. barbara* were captured in cloud forest remnants. In addition, one record of *G. vittata* was captured in a stream running through a shaded coffee plantation. There are few documented reports of the presence of these species in the state of Puebla. The records reported here were captured in cloud forest remnants with a shaded coffee plantation, considered an agricultural activity with a minor impact on biodiversity, which has probably allowed the presence of species such as *E. barbara* and *G. vittata*. The record of these species in northern Puebla suggests that this region functions as a biological corridor for them.

Key words: Biological corridor; camera trap; habitat use; shaded coffee plantation; Sierra Madre Oriental; Zapotitlán de Méndez.

Eira barbara y *Galictis vittata* son mamíferos carnívoros pertenecientes a la familia Mustelidae. En México estas especies se encuentran en alguna categoría de riesgo; sin embargo, son de los mamíferos carnívoros menos estudiados. Existen pocos registros e información sobre diferentes aspectos de la ecología de ambas especies. El objetivo de esta nota es reportar registros adicionales de *E. barbara* y *G. vittata* en la Sierra Nororiental de Puebla. De marzo a mayo de 2023 se instalaron 20 estaciones de fototrampeo en cuerpos de agua naturales y sitios donde se detectaron rastros de mamíferos silvestres. Adicionalmente, se obtuvieron registros de individuos en bases de datos internacionales y artículos publicados; además, se realizó un mapa que incluye la distribución potencial de *E. barbara* y *G. vittata* en México. Con un esfuerzo de muestreo de 90 días-trampa, se obtuvieron 2 registros independientes de *E. barbara,* en remanentes de bosque mesófilo de montaña. Además, se obtuvo un registro de *G. vittata* al interior de arroyo en un fragmento de cafetal de sombra. Existen pocos registros de la presencia de estas especies en gran parte del estado de Puebla. Los registros se obtuvieron en remanentes de bosque mesófilo de montaña con cafetal de sombra, considerada como una actividad agropecuaria con menor impacto en la biodiversidad, lo que probablemente ha permitido la presencia de especies como *E. barbara* y *G. vittata*. Su registro al norte del estado podría indicar que esta región funciona como corredor biológico para estas especies.

Palabras clave: Cafetal bajo sombra; cámara trampa; corredor biológico; Sierra Madre Oriental; uso de hábitat; Zapotitlán de Méndez.

Mustelids comprise a diverse group of small- to medium-sized carnivores comprising 2 subfamilies, 22 genera, and 59 species (Wilson and Reeder 2005). They are widely distributed in all continents, except Antarctica and Australia, in various terrestrial and aquatic ecosystems, and even in anthropic or urban areas (Grifiths 2000; Nowak 2005; Wilson and Mittermeier 2009). They exhibit a wide range of dietary habits, ranging from omnivores to strict carnivores (Nowak 2005). The role of these carnivores in ecosystems has also been noted, where they are seed dispersers in some cases (López-Bao *et al*. 2011; González-Varo *et al.* 2015). Mexico is home to 6 species, of which *Mustela frenata* has a wide distribution; others, like *Eira barbara, Galictis vittata, Enhydra lutris*, and the otters *Lontra annectens* and *L. canadensis*, have a more restricted distribution (Ceballos and Oliva 2005). The sea otter

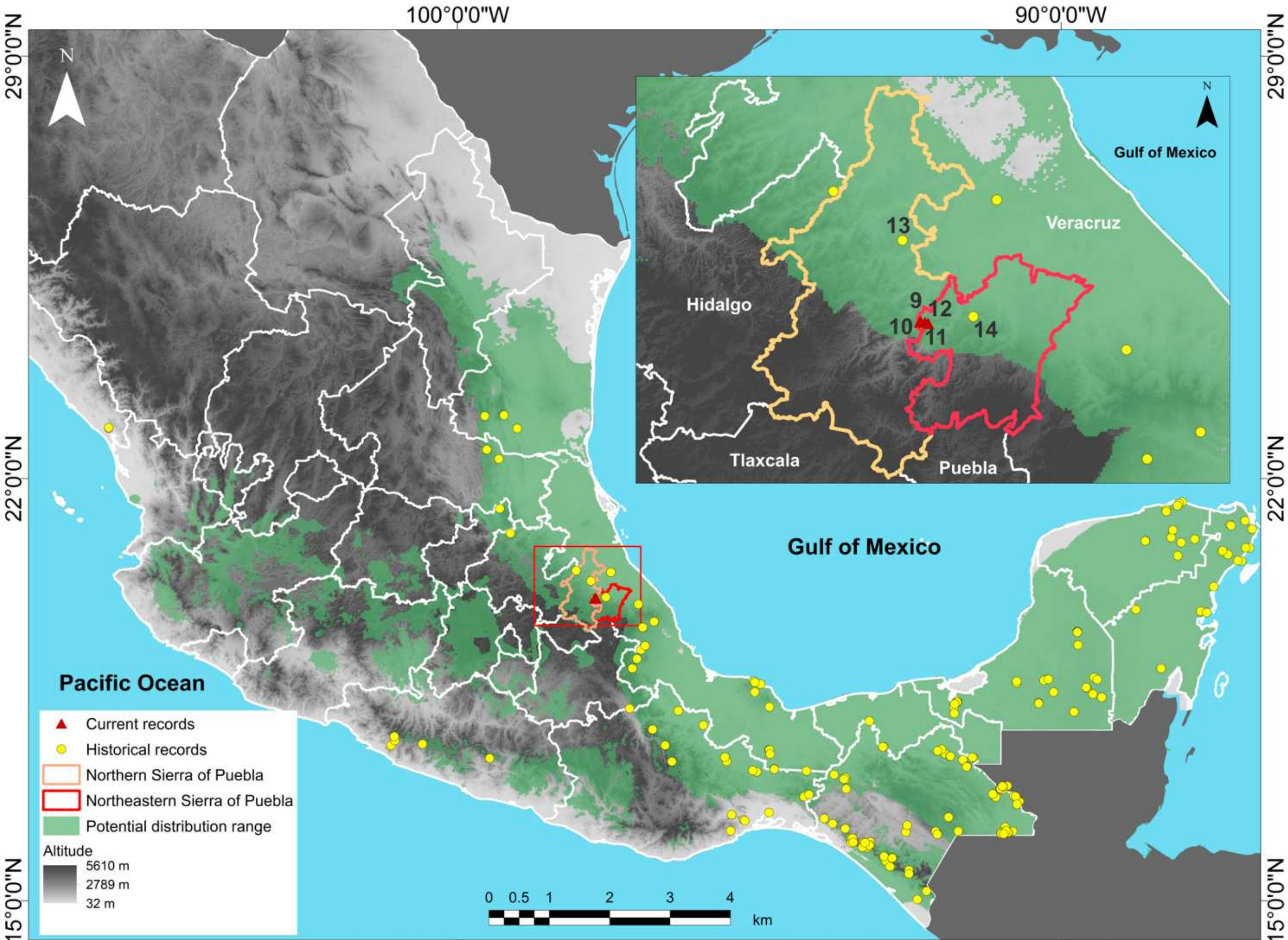

Figure 1. Potential distribution and records of *Eira barbara* in Mexico. Historical records (GIBIF 2024, Nagy-Reis *et al.* 2020) are indicated by yellow circles. The red triangles correspond to current records in the Northeastern Sierra of Puebla obtained with camera traps. Zapotitlán de Méndez (9, 10, 11, 12), Zihuateutla (13), San Miguel Tizacapan (14).

(*Enhydra lutris*), which inhabits the coasts of Baja California, is virtually extinct (Gallo-Reynoso 2013).

Eira barbara (Tayra) is a Neotropical mustelid distributed from the coasts of central Mexico to northern Argentina (Presley 2000; Larivière and Jennings 2009). It is considered an opportunistic omnivore, observed to consume a wide variety of fruits, small vertebrates, and invertebrates (Álvarez del Toro 1991; Presley 2000; Soley and Alvarado-Díaz 2011). It shows semi-arboreal habits, using both terrestrial and arboreal substrates for displacement (Álvarez del Toro 1991). This species is active day and night, with peak activity periods during the early morning and evening hours (Villafañe-Trujillo *et al.* 2021). In Mexico, there are records of *E. barbara* in the states of Yucatán (Hernández-Hernández *et al.* 2019), Quintana Roo (Chávez 2005), Chiapas (Espinosa-Medinilla *et al.* 2018), Guerrero (Ruiz-Gutiérrez *et al.* 2017), Oaxaca (Espinosa-Lucas *et al.* 2015), Veracruz (Ríos-Solís *et al.* 2021), Hidalgo (García *et al.* 2016), Puebla (Ramírez-Pulido *et al.* 2005), Querétaro (López-González and Aceves 2007), Tamaulipas (Chávez 2005), and Sinaloa (Ruiz-Gutiérrez *et al.* 2017; Figure 1). It is one of the carnivore mammals with a wide distribution in tropical forests; however, these ecosystems are undergoing the greatest loss of vegetation cover related to changes in land use (Mendoza *et al.* 2023).

Galictis vittata (Grison) is a solitary species, mainly diurnal, although it can be active at night (Sunquist *et al.* 1989; Yensen and Tarifa 2003). It has a carnivorous diet, including rodents, birds, amphibians, reptiles, and fish (Bisbal 1986; Sunquist *et al.* 1989; Roemer *et al.* 2009; Hidalgo-Mihart *et al.* 2018). It thrives in the proximity of water bodies, such as rivers and streams, where it usually swims; although it can climb, it usually forages on the ground (Álvarez del Toro 1991). The Grison is distributed from central-eastern and southeastern Mexico down through Central America to southern Brazil, Bolivia, and northern Argentina (Yensen and Tarifa 2003; Bornholdt *et al.* 2013; Jiménez-Alvarado *et al.* 2016). *G. vittata* is considered a species with low-density and stable populations (Arita *et al.* 1990; Cuarón *et al.* 2016), and its conservation status is uncertain (De la Torre *et al.* 2009; Hernández-Sánchez *et al.* 2017).

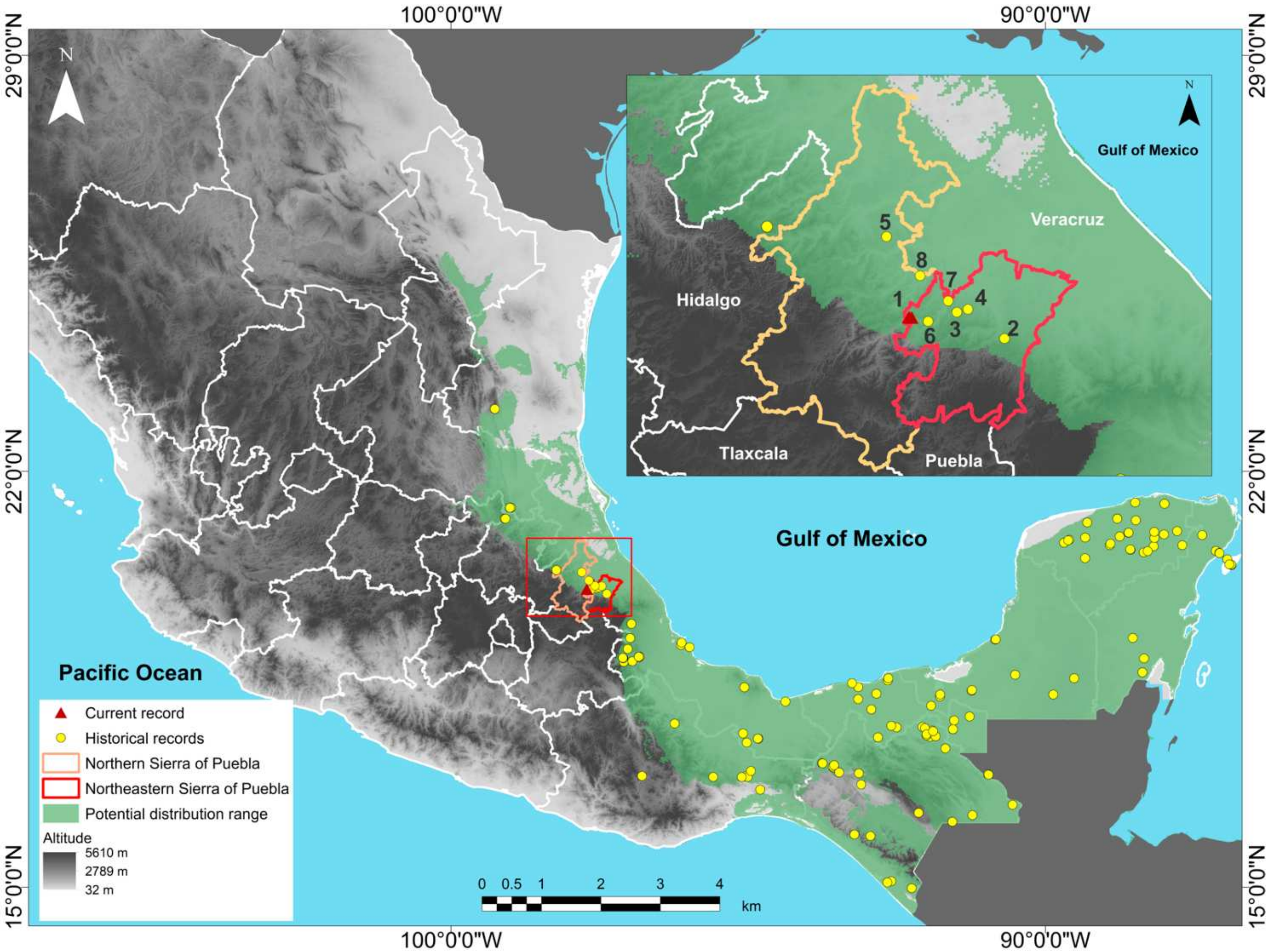

Figure 2. Potential distribution and records of *Galictis vittata* in Mexico. Historical records (GIBIF 2024, Nagy-Reis *et al.* 2020) are indicated by yellow circles. The red triangles correspond to current records in the Northeastern Sierra of Puebla obtained with camera traps. Zapotitlán de Méndez (1), Hueyapan (2), San Miguel Tizacapan (3), San Andrés Tizacapan (4), Zihuateutla (5), Tuxtla (6), Tuzamapan (7), Jopala (8).

In Mexico, *G. vittata* has been recorded on the eastern slopes of the states of Tamaulipas (Contreras-Días *et al.* 2020), Hidalgo (Mejenes-López *et al.* 2010), Veracruz (Gallina and González-Romero 2018), Puebla (Lucas-Juárez *et al.* 2021; Hernández-Hernández *et al.* 2022); southward to Oaxaca (Espinosa-Lucas *et al.* 2015), Chiapas (De la Torre *et al.* 2009), Tabasco (García-Morales and Diez de Bonilla-Cervantes 2021), Campeche (Contreras-Moreno *et al.* 2023), Yucatán (Sosa-Escalante *et al.* 2013), and Quintana Roo (Chávez-León 1987; Figure 2). This species has been recorded mainly in tropical evergreen, sub-evergreen, and sub-deciduous forests, and occasionally in mountain cloud forests (Gallina *et al.* 1996; De la Torre *et al.* 2009; Pérez-Solano *et al.* 2018). It has also been recorded in localities with secondary or modified vegetation (Hernández-Hernández *et al.* 2022; Sánchez-Brenes and Monge 2022), and even in urban and suburban areas (Contreras-Díaz *et al.* 2020; García-Morales and Diez de Bonilla-Cervantes 2021).

The Northeastern Sierra of Puebla is located in the transition zone of two physiographic units, the Sierra Madre Oriental and the Trans-Mexican Volcanic Belt. This region is covered by mountain cloud forests and tropical forests that contribute to its being considered one of the most important areas Puebla in terms of its mammal composition (CONABIO 2011). This area has recorded 17 species of carnivorous mammals (Ramírez-Bravo and Hernández-Santin 2016), considered key drivers of ecosystem dynamics (Servín 2013). Two of these species are worth mentioning: *G. vittata*, a species listed as threatened in the Mexican legislation, and *E. barbara*, listed as Endangered of Extinction (SEMARNAT 2010), due to destruction and fragmentation of their habitat as a result of conversion to agricultural land, livestock raising, and urban development (Oliveira 2009).

Galictis vittata and *E. barbara* are among the least studied carnivorous mammals in Mexico. There is insufficient information available on the ecology, distribution, and conservation status of both species in the country and at a global level (López-González and Aceves-Lara 2007; Hidalgo-Mihart *et al.* 2018; González-

Figure 3. Photographic records of *Eira barbara* (a, b) and *Galictis vittata* (c, d) in the Northeastern Sierra of Puebla, Mexico.

Maya *et al*. 2019). Since the presence of *E. barbara* and *G. vittata* was first documented in Puebla in Coxcatlán de Osorio and Zihuateutla, respectively (Ramírez-Pulido *et al.* 2005), records for this state have been scarce. For all the above, the objective of this study was to contribute to the knowledge about the presence of *G. vittata* and *E. barbara* in the Northeastern Sierra of Puebla, Mexico.

This study was carried out in the municipality of Zapotitlán de Méndez, in the Northeastern Sierra of Puebla (19º58′10″ to 20º01′36″ N; 97º38′36″ to 97º44′24″ W). The climate is temperate humid, with a mean annual temperature of 22 °C and a mean annual precipitation of 2750 mm (INEGI 2005). The local landscape comprises cloud forests at high altitudes and ravines; fragments of medium sub-evergreen forest and pine-oak forest are also present. These vegetation types are within a matrix of anthropic uses that include mainly coffee plantations and induced pastures (Evangelista-Oliva *et al*. 2010).

Systematic sampling with camera traps was carried out from March to May 2023. In each of 10 stations, a Stealth Cam camera trap (model STC-BT16) was randomly installed at 30 cm to 40 cm above the ground in sites where traces (footprints, excreta, trails) of wild mammals were found. The distance between stations was 1 km to avoid leaving large gaps unsampled. Camera traps remained in operation 24 hours a day and were set to capture one photograph and one 30-second video per event, recording the date and time of each event. A record from a trap station was considered independent when the time between two consecutive photograph records exceeded 60 minutes (Tobler *et al*. 2008; Srbek-Araujo and García Chiarello 2005). Camera traps were installed in shaded coffee plantations with remnants of mountain cloud forest.

A map was made that illustrates the potential distribution of *E. barbara* and *G. vittata* (Lavariega and Briones-Salas 2019a, b), the records of the National Biodiversity Information System (CONABIO 2020), the Global Biodiversity Information Facility (GBIF 2024), and the Neotropical Carnivores database (Nagy-Reis *et al*. 2020), as well as records published in the state of Puebla, to overlap them with the photographic records obtained in this study.

Two independent photographic records of *E. barbara* were captured with a sampling effort of 90 trap-days. These records correspond to adult females, determined by the absence of testicles. Additionally, individuals were identified based on the fur coloration showing the characteristic disruptive pattern, where the nape and head are lighter-colored than the rest of the body (Presley 2000; Matos 2018). The first record was captured on 24 March 2023 at 14:12 hr, at coordinates 20°0′8.93″ N and 97°42′51.60″ W, at 835 m (Figure 3a). The second record was captured on 2 April 2023 at 06:53 hr, at coordinates 20°0′40.84″ N and 97°42′51.60″ W, at 1011 m (Figure 3b). Both records were obtained in remnants of mountain cloud forest within a matrix of shaded coffee plantations. One photographic record of an adult of *G. vittata* was also captured on 15 April 2023 at 15:50 hr, at coordinates 20°0′43.64″ N and 97°43′10.86″ W, at 840 m in the town of Zapotitlán de Méndez, in a stream running

Table 1. Geographic location of the records (IDs) of *Galictis vittata* and *Eira barbara* in Puebla, Mexico. The new records provided in this study are shown in bold.

Species ID		Latitude	Longitude	Municipality	Type of evidence	Source
1	***G. vittata***	**20° 0′ 43.64″ N**	**97° 43′ 10.86″ W**	**Zapotitlán de Méndez**	**Photograph**	**This study**
2	*G. vittata*	19° 56′ 9.2″ N	97° 22′ 43.36″ W	Hueyapan	Photograph	Hernández-Hernández *et al*. 2022
3	*G. vittata*	20° 1′ 46.83″ N	97° 32′ 55.55″ W	San Miguel Tizacapan, Cuetzalan	Interview	Hernández-Reyes *et al*. 2017
4	*G. vittata*	20° 2′ 25.92″ N	97° 30′ 33.37″ W	San Andrés Tizacapan, Cuetzalan	Interview	Hernández-Reyes *et al*. 2017
5	*G. vittata*	20° 18′ 0″ N	97° 47′ 60″ W	Zihuateutla	Museum	Ramírez-Pulido *et al*. 2005
6	*G. vittata*	19° 59′ 49.4″ N	97° 39′ 51.5″ W	Tuxtla, Zapotitlán de Méndez	Direct observation	Lucas-Juárez *et al*. 2021
7	*G. vittata*	20° 4′ 12″ N	97° 34′ 48″ W	Tuzamapan	Direct observation	Ramírez-Bravo and Hernández-Santín 2016
8	*G. vittata*	20° 9′ 36″ N	97° 40′ 48″ W	Jopala	Direct observation	Ramírez-Bravo and Hernández-Santín 2016
9	***E. barbara***	**20° 0′ 40.84″ N**	**97° 42´ 51.60″W**	**Zapotitlán de Méndez**	**Photograph**	**This study**
10	***E. barbara***	**20° 0´ 8.93″ N**	**97°42´51.60″ W**	**Zapotitlán de Méndez**	**Photograph**	**This study**
11	***E. barbara***	**20° 0′ 43.64″ N**	**97° 43′ 10.8″ W**	**Zapotitlán de Méndez**	**Photograph**	**This study**
12	*E. barbara*	20° 0′ 8.93″ N	97° 42′ 51.6″ W	Zapotitlán de Méndez	Interview	Ramírez-Bravo 2011
13	*E. barbara*	20° 18′ 0″ N	97° 47′ 24″ W	Zihuateutla	Photograph	Ramírez-Bravo 2011
14	*E. barbara*	20° 1′ 53.36″ N	97° 32′ 26.6″ W	San Miguel Tizacapan, Cuetzalan	Photograph	Hernández-Reyes *et al*. 2017
15	*E. barbara*	18° 11′ 8.02″ N	97° 8′ 48.01″ W	Coxcatlán de Osorio	Direct observation	Ramírez-Pulido *et al*. 2005

across a shaded-coffee plantation. The photographic shot does not allow determining the sex (Figure 3c, d), but it shows the coloration pattern of the species, i.e., blackish marbled gray on the back, in addition to small limbs and a short tail (Álvarez-Castañeda and González-Ruiz 2017).

Eira barbara is included in the lists of mammals for the state of Puebla (Ramírez-Pulido *et al*. 2005; Ramírez-Bravo 2011); however, there are few documented reports of its presence in a large part of the state (Table 1). In the Northern Sierra of Puebla, Ramírez-Bravo (2011) documented the presence of *E. barbara* in fragments of tropical vegetation in the municipality of Zihuateutla. Although its presence in this region of Puebla had not been confirmed recently, this study documented *E. barbara* in a fragment of cloud forest surrounded by shaded coffee plantations.

It has been observed that *E. barbara* occurs mainly in areas with primary vegetation or, at least, with a similar structure, although it is also found in landscapes modified by anthropic activities (Dotta and Verdade 2011; Timo *et al*. 2014), including agroforestry plantations (Soley and Alvarado-Díaz 2011). However, when landscape complexity is reduced, such as in coffee plantations without tree strata or when human disturbance increases, arboreal and scansorial mammals such as *E. barbara* can be negatively affected (Gallina *et al*. 1996; Naughton-Treves *et al*. 2003; Cassano *et al*. 2014).

The record of *G. vittata* in a stream coincides with other observations of this species reported by Gallina *et al*. (1996) and Sáenz-Bolaños *et al*. (2009). These authors point out that *G. vittata* thrives on the edges of dense forests, preferably near water bodies such as rivers or streams, although it has also been observed in areas with secondary and managed vegetation (De la Torre *et al*. 2009; Lucas-Juárez *et al*. 2021; Sánchez-Brenes and Monge 2022). In the Northeastern Sierra of Puebla, the presence of Grison has been reported in shaded coffee plantations in the Tecolutla River basin (Ramírez-Pulido *et al*. 2005; Ramírez-Bravo and Hernández-Santin 2016; Hernández-Reyes *et al*. 2017; Lucas-Juárez *et al*. 2021; Hernández-Hernández *et al*. 2022; Table 1).

Some studies have been carried out that analyzed population density (Hernández-Sánchez *et al*. 2017), diversity (Hernández-Hernández and Chávez 2021), and diet (Hidalgo-Mihart *et al*. 2018), which include few records of *G. vittata*; in other studies of diversity and activity patterns, this species was not recorded in conserved areas (Ortiz-Lozada *et al*. 2017; Ríos-Solís *et al*. 2021). In this sense, it is considered that anthropic factors such as habitat destruction and collision with vehicles can affect their populations (Escobar-Lasso and Guzmán-Hernández 2013; Salcedo-Rivera *et al*. 2020; García-Morales and Diez de Bonilla-Cervantes 2021). However, García-Morales and Diez de Bonilla-Cervantes (2021) point out that *G. vittata* is highly adaptable to modified environments and has the potential to maintain breeding populations in urban areas.

This study recorded *G. vittata* and *E. barbara* in fragments of mountain cloud forest surrounded by shaded coffee plantations. It has been pointed out that diversified shaded coffee plantations are a habitat that may have less impact on biodiversity compared to other activities such as livestock raising and rainfed or permanent cultivation (Greenberg *et al*. 1997; Cruz-Lara *et al*. 2004), which has probably allowed the presence of threatened species such as *G. vittata* and *E. barbara* in the Northeastern Sierra of Puebla (Ramírez-Pulido *et al*. 2005; Ramírez-Bravo and Hernández-Santin 2016). In this region, shaded coffee plantations are the predominant livelihood in the agricultural sector (Evangelista-Oliva *et al.* 2010). In this regard, components with buffer capacity, such as shaded coffee plantations, have corridors and vegetation fragments with significant inner habitat areas (Gallina *et al.* 1996), which should be prioritized in conservation strategies because they could serve as core reserves and maintain functional connectivity of the study area. However, additional studies are needed to determine whether these species can persist in highly anthropized environments (García-Morales and Diez de Bonilla-Cervantes 2021).

The records of *E. barbara* and *G. vittata* in the Northeastern Sierra of Puebla are relevant because they allow for determining the continuity of their distribution in the Sierra Madre Oriental. Their record in the north of the state could indicate that this region functions as a biological corridor between vegetation remnants in eastern and southeastern Mexico, including the Sierra Negra in Oaxaca and Veracruz. This area was also identified as essential for the dispersal of other carnivore species (Grigione *et al.* 2009; Ramírez-Bravo *et al.* 2010; Hernández-Flores *et al.* 2013; Dueñas-López *et al.* 2015). Additionally, the records of *G. vittata* and *E. barbara* in the Northeastern Sierra of Puebla provide relevant information to advance a better understanding of the distribution of populations of these species.

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First record and detailed description of calls from the Bolivian bamboo rat *Dactylomys boliviensis* in Carrasco National Park, Bolivia

Primer registro y descripción detallada del canto de la rata de bambú boliviana *Dactylomys boliviensis* en el Parque Nacional Carrasco, Bolivia

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Sound communication among conspecific mammals is quite common and facilitates various behavioral interactions. The Bolivian bamboo rat, *Dactylomys boliviensis*, like many other mammals, uses this system to mark its territory and attract females. We occasionally recorded the complete song of this species within Carrasco National Park, an area close to the type locality, representing the first record of the species for the park. We compared our record with other calls from further northwest, near the border with Peru. The call consists of a strong staccato, is divided into 2 parts, and the dominant frequency is 1.16 kHz. Our results reveal considerable geographic variation across the species' range. The variation found may be influenced by factors such as individual size, soundscape limitations, changes in song structure due to distance, or even species differentiation. This record presents an opportunity for the scientific community to further investigate the causes of this call variation.

Key words: Bioacustics; call structure; communication; intraspecific variation; type locality.

La comunicación entre los conespecíficos mamíferos a través del sonido es bastante común, y facilita diferentes interacciones comportamentales entre ellos. La rata de bambú boliviana, *Dactylomys boliviensis*, utiliza este sistema de comunicación para delimitar su territorio y atraer a las hembras. De manera ocasional grabamos el canto completo de esta especie dentro el Parque Nacional Carrasco, cerca de la localidad tipo, constituyéndose en el primer registro de la especie para el parque. Hacemos comparaciones con otros cantos registrados mucho más al noroeste cerca la frontera con Perú, encontrando diferencias significativas en tiempos y estructura. El canto consiste en un staccato fuerte, está dividido en 2 partes, y la frecuencia dominante es 1.16 kHz. Nuestros resultados muestran una gran variación geográfica del canto entre los individuos. La variación encontrada puede estar ocasionada por diferentes razones como el tamaño de los individuos, restricciones en el paisaje sonoro, cambios en la estructura del canto debido a la distancia, o incluso una diferenciación específica. Esto abre una oportunidad a la comunidad científica para investigar con mayor profundidad las causas de esta variación en el canto.

Palabras clave: Bioacústica; comunicación; estructura del canto; localidad tipo; variación intraespecífica.

Sound is a key communication system used by mammals, playing an important role in coordinating behavioral interactions between conspecifics (Feldhamer *et al.* 2007). It is employed to transmit different messages, such as defending territory or attracting the opposite sex. These calls can range from simple sound pulses (staccato) to more complex multi-note songs. In some species, these songs may even be synchronized between males and females, resembling duets (Fitch 2006; Vanderhoff and Bernal-Hoverud 2022).

The Bolivian bamboo rat *Dactylomys boliviensis* Anthony, 1920, is a mammal known for its loud territorial calls, which can be heard from hundreds of meters away in the forest (Dunnum and Salazar-Bravo 2004). Classified as 'Least Concern' by the International Union for Conservation of Nature IUCN (Vivar 2016), it is distributed between 200 and 2,132 m on the eastern slopes of the central Andes, in the countries of Bolivia, Perú, and western Brazil (Dunnum and Salazar-Bravo 2004; Abreu-Júnior *et al.* 2016; Vivar 2016; Figure 1). Vanderhoff and Bernal-Hoverud (2022)

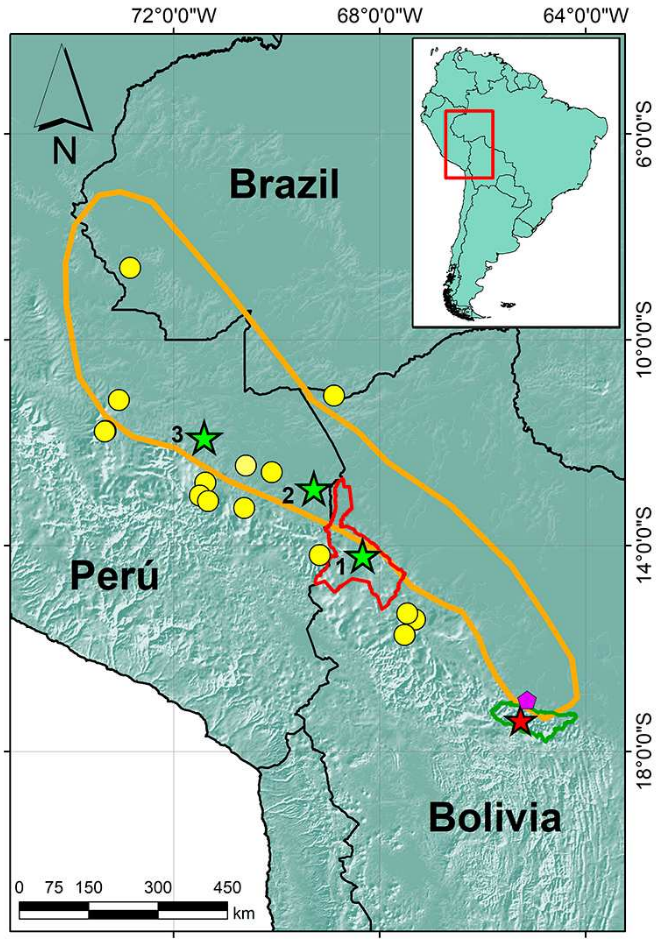

Figure 1. Known distribution of *Dactylomys boliviensis*. Purple pentagon is the type locality; red star is the record presented herein; green star 1 call reported in Madidi NP (Bolivia) by Vanderhoff and Bernal Hoverud (2022); green star 2 call reported in Laguna Chica (Perú) ML-39050 Macaulay Library; green star 3 call reported in Cocha Cashu (Perú) ML- 90231 Macaulay Library; yellow circles are records in GBIF (2024). Orange polygon is the distribution of *Dactylomys boliviensis* by IUCN (Vivar 2016); green polygon is Carrasco NP; red polygon is Madidi NP.

analyzed the vocalization of this species for the first time, using a recording from Madidi National Park and Integrated Management Natural Area (hereafter Madidi NP) in north-western Bolivia. Their analysis focused on the synchronized duet calling of the female and male, providing a general description. However, they did not conduct an in-depth analysis of the dominant frequencies, pulse timing, or interpulse intervals of the call.

During a herpetological assessment in Carrasco National Park and Integrated Management Natural Area (hereafter Carrasco NP), we occasionally recorded the calls of *D. boliviensis*. This is the first documented occurrence of this arboreal mammal in Carrasco NP (Rumiz *et al.* 1998). Furthermore, we provide the first detailed description of its calls near the type locality at Misión San Antonio, Río Chimoré (Dunnum and Salazar-Bravo 2004), which is 45 km from our recording site (Figure 1).

Carrasco NP is located in the Yungas Ecoregion, which is characterized by a humid evergreen forest, with average annual temperatures between 7-24 °C and an approximate annual precipitation between 1,500 to > 6,000 mm, thus considered the wettest area in Bolivia (Ibisch *et al.* 2003). It presents a high diversity of plant families such as Araliaceae, Bromeliaceae, Euphorbiaceae, Lauraceae, Melastomataceae, Myrtaceae, Orchidaceae, Piperaceae, Podocarpaceae, Rubiaceae, among others, and typical tree genera in the region are *Acalypha*, *Alchornea*, *Aniba*, *Cinchona*, *Cyathea*, *Ficus*, *Inga*, *Nectandra*, *Persea*, *Solanum*, and *Trichilia* (Ibisch *et al.* 2003). Figure 2 shows the characteristics of the area where the recordings of *D. boliviensis* were made, featuring typical vegetation of the Yungas ecoregion.

Calls were recorded with a SONY ICD-PX820 digital recorder, temperature and humidity were recorded with an HTC-2 digital thermohygrometer. We based our song description on the terminology used by Emmons (1981) and Angulo (2006), and the song was processed with Adobe Audition 2022. The call parameters were compared using a Kruskal-Wallis test followed by Dunn's post-hoc test with Bonferroni adjustment, using RStudio (RStudio Team 2022). Audio recordings have been uploaded to iNaturalist (https://www.inaturalist.org), and wav files are available at https://doi.org/10.5281/zenodo.15277249.

To examine potential geographic variation and understand how these calls differ across the species' range, we compared our recordings of *D. boliviensis* with the one reported by Vanderhoff and Bernal-Hoverud (2022) from Madidi NP, as well as with recordings from Laguna Chica and Cocha Cashu in Peru, deposited in the Macaulay Library at the Cornell Lab (https://www.macaulaylibrary.org).

On July 30, 2024 at 18:59 hr, we recorded an individual of *D. boliviensis* from an estimated distance of 60 m, at the coordinates 17° 23' 17.72" S, 65° 15' 37.49" W, and at an elevation of 1,099 m. The temperature was 18.3 °C, and the humidity 82 %. This recording did not have enough quality to measure the duration, period, and amplitude of each pulse; however, it was useful to observe the call structure. The recording file is deposited at https://www.inaturalist.org/observations/247818581 (wav file available at https://doi.org/10.5281/zenodo.15277249).

On July 31, 2024, at 19:29 hr, we recorded an individual of *D. boliviensis* at the coordinates 17° 23' 11.53" S, 65° 15' 36.3" W, and at an elevation of 1,055 m. This recording was of high quality and was obtained from a distance of 6 m. The temperature was 21.2 °C, and the humidity 79 %. The call was recorded in a typical *Dactylomys* habitat, a bamboo thicket of what we assume is the genus *Guadua* (Vanderhoff and Bernal-Hoverud 2022). The intervals between songs were long, approximately 1 hr, similar to those reported by Vanderhoff and Bernal-Hoverud (2022) in Madidi NP, and in some cases we could hear a reply from a second individual, with a separation of more than 190 m between them. Recording file is deposited at https://www.inaturalist.org/observations/247818583 (wav file available at https://doi.org/10.5281/zenodo.15277249).

Figure 2. General characteristics of the area in Carrasco NP where *D. boliviensis* was recorded.

The call consists of a strong staccato with 40 pulses lasting 36.99 s and is divided in 2 parts (Figure 3a). The first part is an initial call lasting 1.9 s, made up of 6 consecutive pulses. The second part lasts 34.99 s and contains 34 pulses, which are spaced much farther apart than in the first part (Figure 3a). The dominant frequency is 1.16 kHz (Figure 3b). In contrast to other recordings from farther north (Madidi NP, Laguna Chica, Cocha Cashu), these are a single continuous call with no distinguishable parts (call from Madidi NP as an example, Figure 3c and 3d). These northern recordings feature a strong staccato of 32 to 45 pulses, with a duration ranging from 8.22 to 36.50 s and a dominant frequency between 0.99 and 1.21 kHz.

There are significant differences in pulse duration between calls ($X = 96.87$; *d.f.* = 3; $P < 0.001$). The pulses in the call from Carrasco NP are the shortest, averaging 0.12 ± 0.02 s, compared to those from Laguna Chica, which average 0.35 ± 0.03 s. Both show significant differences compared to the other calls (Table 1 and Figure 4a). In all cases, the pulse duration follows a pattern of slight increase in the middle of the call, followed by a decrease toward the end (Figure 4b).

Table 1. Central tendency values showing maximum, minimum, average, and standard deviation results for call duration, intervals, and amplitude parameters across the four analyzed localities.

		Carrasco NP	Madidi NP	Laguna Chica	Cocha Cashu
Duration	Max	0.17	0.36	0.43	0.35
	Min	0.07	0.05	0.29	0.11
	Avg	0.12	0.23	0.35	0.22
	SD	± 0.02	± 0.08	± 0.03	± 0.08
Intervals	Max	1.32	2.31	1.91	1.93
	Min	0.26	0.31	0.43	0.48
	Avg	0.94	0.83	0.99	0.87
	SD	± 0.3	± 0.36	± 0.36	± 0.27
Amplitude	Max	-5.84	-9.15	-5.11	-5
	Min	-19.91	-23.56	-12.09	-17.06
	Avg	-8.82	-15.65	-8.32	-8.78
	SD	± 4.17	± 3.71	± 2.08	± 3.2

Although the intervals between pulses appear similar, there are significant differences ($X = 13.61$; *d.f.* = 3; $P < 0.01$). The pulse intervals from Madidi NP differ significantly from

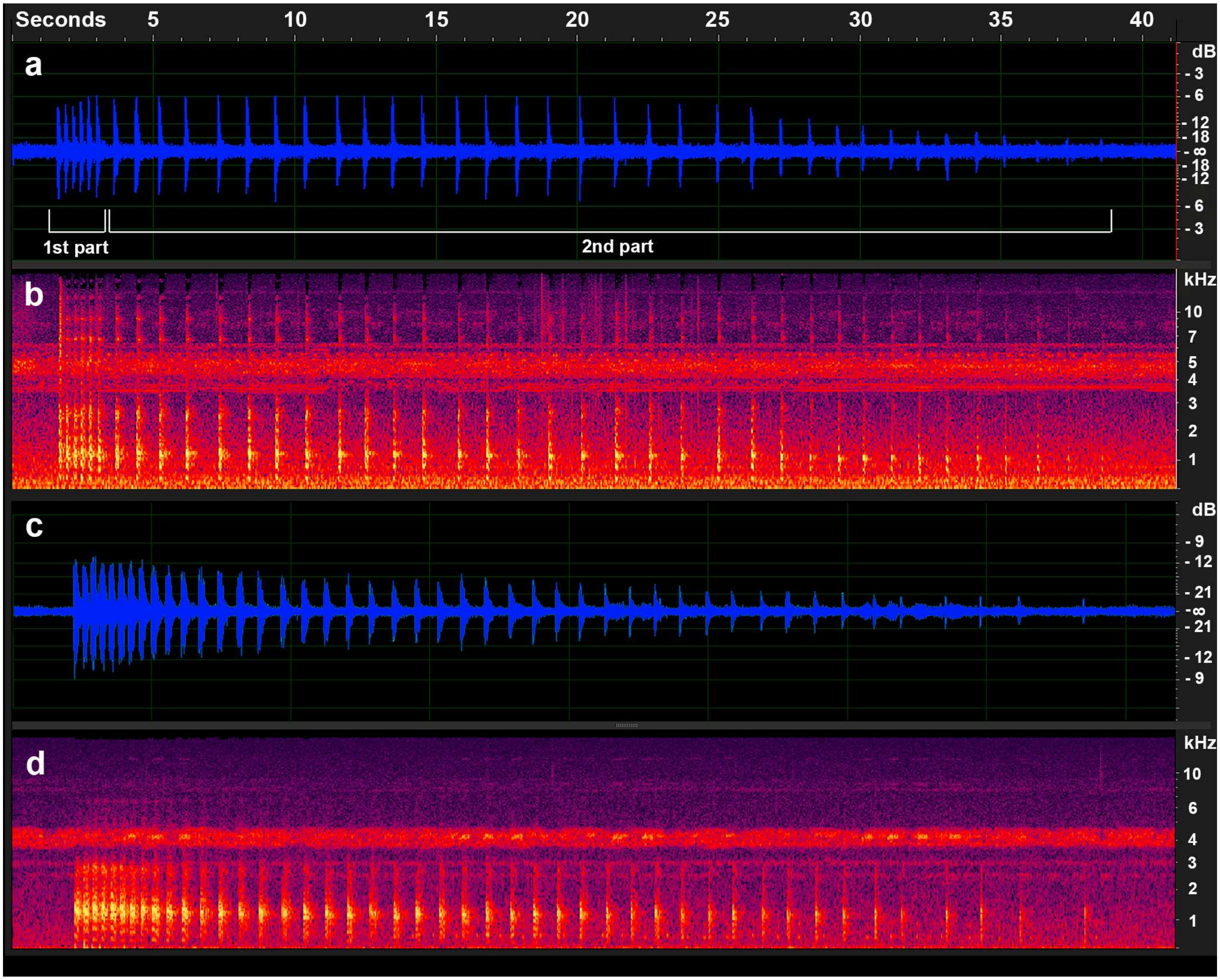

Figure 3. a) Oscillogram and b) spectrogram of *Dactylomys boliviensis* from Carrasco NP reported in this study; c) oscillogram and d) spectrogram of *D. boliviensis* from Madidi NP reported by Vanderhoff and Bernal-Hoverud (2022).

those at Carrasco NP and Laguna Chica, while the intervals at Cocha Cashu show no significant differences compared to the others (Figure 4c). With the exception of Carrasco NP, all sites exhibit increasing intervals toward the end of the call compared to the beginning (Figure 4d).

In terms of amplitude, the call from Madidi NP differs significantly from the others ($X = 65.78$; *d.f.* = 3; $P < 0.001$; Figure 4e). The call from Carrasco NP maintains a nearly consistent intensity up until pulse 23, after which it begins to decrease. In contrast, the song from Madidi NP shows a gradual decline in intensity from the very beginning (Figure 4f).

We provide a detailed description of the call of *D. boliviensis*, which is the first record of this species in Carrasco NP (Rumiz *et al.* 1998). Notably, this call was recorded very close to the species' type locality, making it an important reference for future studies on the natural history and acoustic behavior of *D. boliviensis*. We also compared it to calls recorded from the same species in Madidi NP (Bolivia), Laguna Chica (Peru), and Cocha Cashu (Peru), where we found significant differences in both timing and structure. These variations confirm that the call of *D. boliviensis* is highly variable, as previously noted by Emmons (1981). This variability may be influenced by several factors, including differences in individual size, variations in the soundscape where individuals must adapt to available frequencies, changes in song structure due to distance, or even potential species-specific differentiation (Pijanowski *et al.* 2011; Gustison and Townsend 2015).

Given the limited availability of complete song recordings for the genus *Dactylomys*, we are far from fully understanding the causes of this variation. However, the proximity of this record to the type locality adds crucial value to our knowledge of the species' vocal repertoire, underscoring the need for further attention from the scientific community.

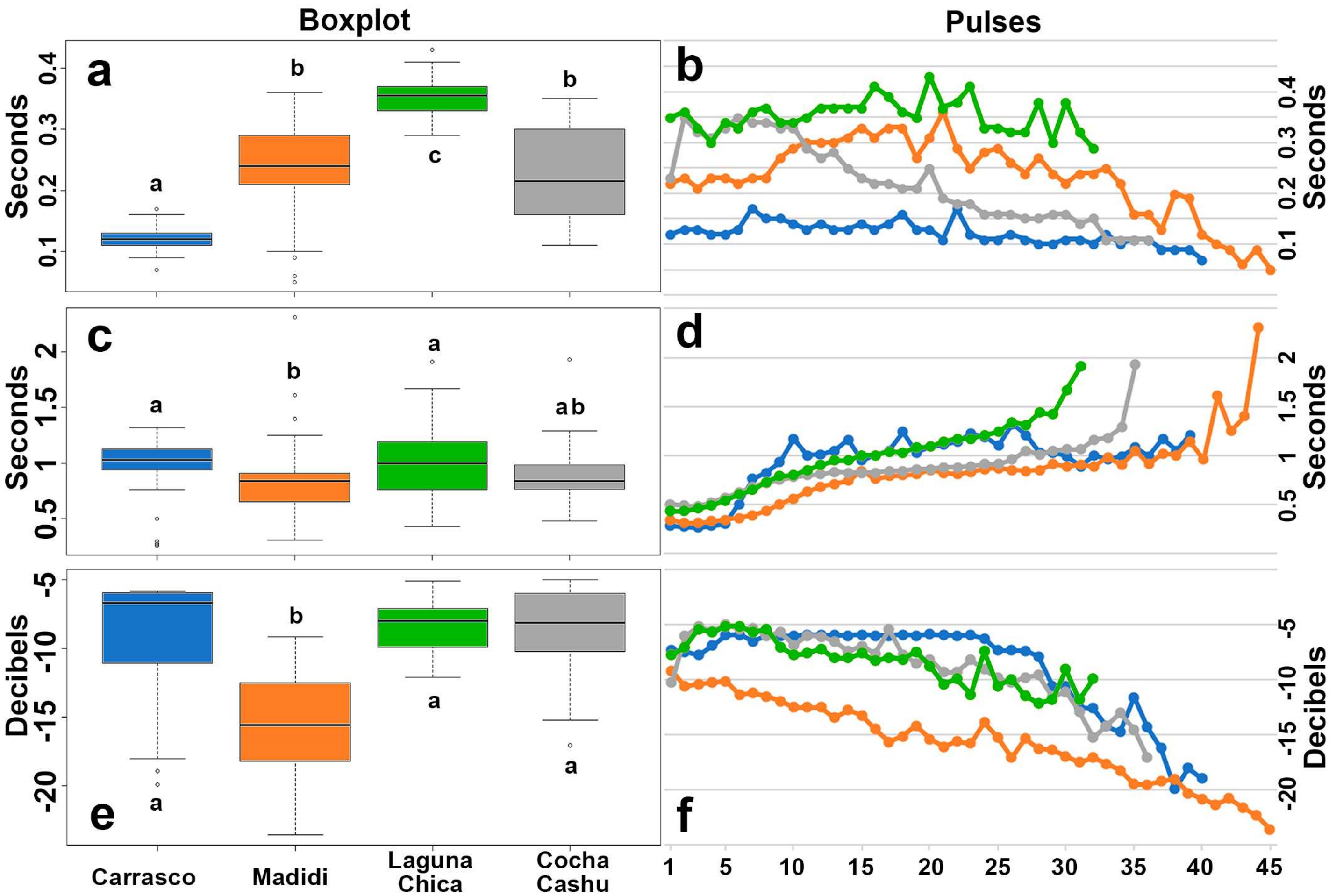

Figure 4. Parameter comparison between calls from all localities analyzed: a) boxplot of the pulse duration, b) duration of each pulse in the calls, c) boxplot of the intervals between pulses, d) interval between pulses, e) boxplot of pulse amplitude, f) amplitude of each pulse. Lowercase letters above or below each boxplot indicate statistical significance among localities: identical letters denote no significant differences, while different letters indicate significant differences according to Dunn's test.

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First case of piebaldism in black-bearded tomb bat T*aphozous melanopogon* in Goa, India

Primer caso de piebaldismo en el murciélago de tumba de barba negra *Taphozous melanopogon* en Goa, India

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Pigmentation disorders caused by melanin deficiency or excess have been reported in several vertebrate groups, including bats. Piebaldism is a condition that results in white patches in certain areas of skin due to absence of melanocytes there. Here we report the first case of piebaldism in *Taphozous melanopogon* in the world from Goa, India. During a survey to assess species diversity of bats in Goa, historic sites and places of worship were surveyed. These churches with wooden material are roosting sites for bats. Roost locations, microhabitat features, number of bats and their behaviour were noted inside the old Portuguese churches. During one field survey, a single individual of *Taphozous melanopogon* with piebaldism was seen in a church, clinging on to a wooden beam on the ceiling. The body of the individual was normal coloured but with three white patches on the dorsal side and normal coloured eyes. Piebaldism is the most common chromatic aberration reported in bats. In India, cases of chromatic aberrations in bats have been reported in 8 species. With increasing research in bat ecology, reports of pigmentation anomalies are on the rise, and such reports are critical to understanding the cost, benefits, and survival challenges of the affected individuals.

Key words: Albinism; chromatic aberration; leucism; melanin; pigmentation.

Los trastornos de pigmentación son causados por una deficiencia o exceso de melanina y se han reportado en varios grupos de vertebrados, incluidos los murciélagos. El piebaldismo es una afección que produce manchas blancas en ciertas áreas de la piel debido a la ausencia de melanocitos allí. Aquí reportamos el primer caso de piebaldismo en *Taphozous melanopogon* en el mundo en Goa, India. Durante un estudio para evaluar la diversidad de especies de murciélagos en Goa, se inspeccionaron sitios históricos y lugares de culto religioso. Estas iglesias construidas con madera son el lugar de descanso para los murciélagos. En el interior de las antiguas iglesias portuguesas se registró la ubicación de los sitios de percha, las características de los microhábitats, el número de murciélagos y sus comportamientos. Durante un estudio de campo, se vio en una iglesia un solo individuo de *Taphozous melanopogon* con piebaldismo, aferrado a una viga de madera en el techo. El cuerpo del individuo era de color normal con tres manchas blancas en el lado dorsal y ojos de color normal. El piebaldismo es la aberración cromática más común reportada en murciélagos. En la India se han reportado casos de aberraciones cromáticas en murciélagos de 8 especies. Con el aumento de la investigación sobre la ecología de los murciélagos, los reportes sobre anomalías de pigmentación van en aumento, dichos hallazgos son fundamentales para comprender los costos, los beneficios y los desafíos de supervivencia de los individuos afectados.

Palabras clave: Aberración cromática; albinismo; leucismo; melanina; pigmentación.

Chromatic aberrations such as albinism, melanism, piebaldism, hypomelanism and leucism have been described in most vertebrate groups (Uieda 2000; Lucati and Lopez-Baucells 2016). These aberrations are caused due to a deficiency or an excess of melanin, both of which result in abnormal skin coloration, fur and feathers (Abreu *et al.* 2013; Lucati and Lopez-Baucells 2016). These phenotypic changes are a consequence of genetic mutations that disrupt stages of melanogenesis, the metabolic pathway responsible for the synthesis of melanin (Slominski *et al.* 2004).

Generally, hypopigmentation cases are easily detected (Fertl and Rosel 2002). Piebaldism is a type of hypopigmentation resulting in lack of melanin in part of the skin and/or hair follicles due to the absence of melanocytes in the affected part. Piebald individuals show patchy distribution of white spots on the body but have normal coloured eyes (Lucati and Lopez-Baucells 2016). This abnormality is often confused with leucism, a condition that results from total or partial lack of pigmentation on the skin or fur of the whole body, but with normal coloured eyes. A total lack of pigmentation on the whole body is termed albinism, a condition generally characterized by a lack of melanin in the skin, coat and eyes (Montilla and Link 2022).

Chromatic disorders are the most frequent type of

Figure 1. Normal coloured individual (a) and individual with piebaldism (b) of black-bearded tomb bat *Taphozous melanopogon* photographed in Goa, India.

anomalies recorded in bats (Zalapa *et al.* 2016; Lucati and López-Baucells 2017; Mahabal *et al.* 2019). Reviews indicate chromatic aberrations have been reported from 115 species belonging to 11 families (Lucati and López-Baucells 2016), with new records being reported intermittently. In India, as of now 2 chromatic aberrations, albinism and piebaldism have been reported from 8 species of bats (Sail and Borkar 2024).

The black-bearded tomb bat *Taphozous melanopogon* (Temminck 1841) is a medium-sized, aerially foraging emballonurid. The bat has a greyish-brown body with a usually paler belly. Male has a patch of black fur like beard at throat region (Bates and Harrison 1997). This species has a distribution in south and southeast Asia (Bates and Harrison 1997; Bates *et al.* 2000). It is a highly gregarious species living in diurnal roosts in caves, ruins, and temples; with its colony size varying from 10 individuals to many hundreds (Molur *et al.* 2002). *Taphozous melanopogon* is now commonly reported from urban areas (Wei *et al.* 2008). The black-bearded tomb bat is a 'Least Concern' species on the IUCN Red List of Threatened Species (Phelps *et al.* 2019). Here we report the first case of piebaldism in the black-bearded tomb bat.

Goa, a maritime Indian state lies between latitudes 14˚ 53′ 54″ N and 15˚ 40′ 00″ N and longitudes 73° 40′ 33″ E and 74° 20′ 13″ E, covering an area of 3,701 km2 (Rangnekar *et al.* 2010). The state has a warm tropical climate with temperature ranging from 21˚C to 31˚C (Rangnekar *et al.* 2010). As part of the project to assess bat species diversity in Goa, historic sites and places of worship were surveyed. Goa was a Portuguese colony, and several Roman Catholic churches were built there around 500 years ago (de Azevedo 1956). These churches have been built using laterite, black granite and have tiled roofs (Khan and Chatterjee 2021). Their pillars and hallways are intricately carved with wooden material that extend from ground to the ceiling, providing microhabitat for bats. Some of these churches now serve as a roosting sites for *Taphozous melanopogon*.

On April 13, 2024, we observed an individual of *Taphozous melanopogon*, clinging to the wooden frame of the ceiling at the Patriarchal Seminary of Rachol, Salcete (15˚ 18′ 34.89″ N, 74° 00′ 06.73″ E). This individual had 3 discrete white patches; 2 appearing bilaterally on the dorsal lower trunk, and 1 single along the median line posteriorly, just before the uropatagium, while the rest of the body was greyish brown with normal coloured eyes (Figure 1). The individual was a male, as evident from the beard like tuft at the throat region, seen along with other conspecifics roosting across the wooden beam.

Piebaldism is perhaps the most common chromatic aberration occurring or at least reported in bats (Mora and Sánchez 2022). From a total of 109 reports in the world, 277 individuals of 73 species of bats have been reported for piebaldism (Lucati and López-Baucells 2016; Borloti *et al.* 2019; Ferreira *et al.* 2020; Mora and Sanchez 2022; Hernández-Aguilar *et al.* 2024; de Oliveira *et al.* 2024). In India, cases of chromatic aberrations in bats have been reported in 8 species. Of the 14 individuals with chromatic aberrations listed, 11 were cases of albinism and 3 of piebaldism (Sail and Borkar 2024). Senacha and Purohit (2005) had incorrectly reported 3 individuals of *Rhinopoma hardwickii* as cases of partial albinism in India, however subsequently it has been revised as piebaldism (Lucati and López-Baucells 2016; Mahabal *et* *al.* 2019). The present case is the first record of piebaldism reported for *Taphozous melanopogon* in the world. It is only the second record for piebaldism among bats in India and second chromatic aberration in bats to be reported from Goa (Sail and Borkar 2024).

In the family Emballonuridae, 4 cases of chromatic aberrations have been reported, piebaldism in *Coleura afra* (Anonymous 2014), leucism in *Taphozous georgianus* (Swanson 1980), albinism in *Taphozous* sp. (Dhanya *et al.* 2015), including this study. Eighty-seven reports have incorrectly identified piebaldism as leucism or partial albinism due to semantic confusion (Lucati and López-Baucells 2016).

Hypopigmentation is believed to be detrimental; due to assumed poor vision, greater predation risk, lower mating success and lower survival rates in affected individuals (Caro 2005; Oliveira and Aguiar 2008). However, there is no conclusive evidence of such effects influencing the survival of affected bat species (López-Baucells *et al.* 2013). Efforts at compiling systematic records of pigmentary anomalies in bats are poor, and the ecological implications of these anomalies remain unclear (Romano *et al.* 1999). However, reports of pigmentation anomalies are important to understand the evolutionary cost and benefits arising from chromatic disorders.

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Beneath umbrellas: Noteworthy records of tent-roosting bats in Guatemala's Maya Biosphere Reserve

Bajo sombrillas: registros notables de murciélagos tienderos en la Reserva de la Biosfera Maya, Guatemala

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Neotropical tent-roosting bats can modify approximately 77 species of plants as tents, most inhabiting lowland tropical forests. At least ten of the 22 known species of tent-roosting bats occur in Guatemala. Many studies have investigated their roosting ecology in Central America. Nevertheless, this behavior is still undocumented in this country. Here, we describe for the first time the use of *Sabal mauritiiformis* and *Cryosophila stauracantha* palm trees with tents occupied by *Artibeus jamaicensis* and *Dermanura* sp. in two localities of the Maya Biosphere Reserve, (MBR) Guatemala. We report a total density of 35.11 (tents/ km2) for both localities, most of them with big seeds underneath. All S. *mauritiiformis* tents presented a type of ceiling modification that had never been reported before. This study furthers our understanding of bat ecology and behavior in Central America. We expect many tent architectures to be present in the region and tents in plant species not reported before since Guatemala has a great diversity of plants that, according to the literature, are used as tents by bats in other tropical regions. We also expect that these bats will play an important role as seed dispersers in the Guatemalan forests.

Key words: *Sabal mauritiiformis*; Neotropical bats; Guatemala; tents.

Los murciélagos neotropicales que habitan en tiendas modifican aproximadamente 77 especies de plantas como refugios, la mayoría de las cuales se distribuyen en bosques tropicales de tierras bajas. Al menos diez de las 22 especies de murciélagos que ocupan estas tiendas habitan en Guatemala. Varios estudios han investigado la ecología del refugio de estas especies en Centroamérica. Sin embargo, este comportamiento aún no ha sido documentado en este país. Describimos por primera vez el uso de *Sabal mauritiiformis* y *Cryosophila stauracantha* como refugios por *Artibeus jamaicensis* y *Dermanura* sp. en dos localidades de la Reserva de la Biosfera Maya (RBM), Guatemala. Reportamos una densidad total de 35.11 (tiendas/km2) para ambas localidades, la mayoría de estas con semillas debajo. Todas las tiendas de *S. mauritiiformis* presentaban una modificación tipo "techo" nunca antes reportada.. Este estudio abre la puerta para seguir avanzando en la comprensión de la ecología y el comportamiento de los murciélagos en Centroamérica. Esperamos que una alta diversidad de arquitecturas y de especies de plantas aún no reportadas anteriormente estén presentes en esta región, ya que Guatemala cuenta con una gran diversidad de plantas que, según la literatura, son utilizadas como tiendas por murciélagos en otras regiones neotropicales. Asimismo, esperamos que estos murciélagos cumplan un papel importante como dispersores de semillas en los bosques de Guatemala.

Palabras clave: *Sabal mauritiiformis*; Murciélagos neotropicales; Guatemala; tiendas de campaña.

Guatemala is home to 105 species of bats grouped in 8 families: Phyllostomidae, Vespertilionidae, Molossidae, Emballonuridae, Mormoopidae, Noctilionidae, Natalidae, and Thyropteridae (Kraker-Castañeda *et al*. 2016; Trujillo *et al.* 2022; Trujillo *et al.* 2024). The country's great diversity of bat species and other taxonomic groups is explained by its location between North and South America and its extensive variations in altitude and precipitation, making it one of Latin America's repositories of biodiversity (Birner *et al*. 2005). Despite the richness of bat species, this group is still not well-studied as most studies have focused on their community composition level (Meachem 1968; Dickerman *et al.* 1981; Schulze *et al.* 2000), cave-dwelling species (Kraker-Castañeda *et al*. 2023; Kraker-Castañeda *et al*. 2024), infectious diseases (Ubico and McLean, 1995; Bai *et al*. 2011; Morán *et al*. 2015), and taxonomic lists (Pérez *et al*. 2012; Kraker-Castañeda *et al*. 2016).

Of the 51 species of Phyllostomidae documented in Guatemala, only ten have been confirmed to exhibit tent-roosting behavior. This group includes members of the genera *Dermanura, Artibeus*, *Uroderma,* and *Vampyressa* (Rodríguez-Herrera *et al.* 2007). Many studies

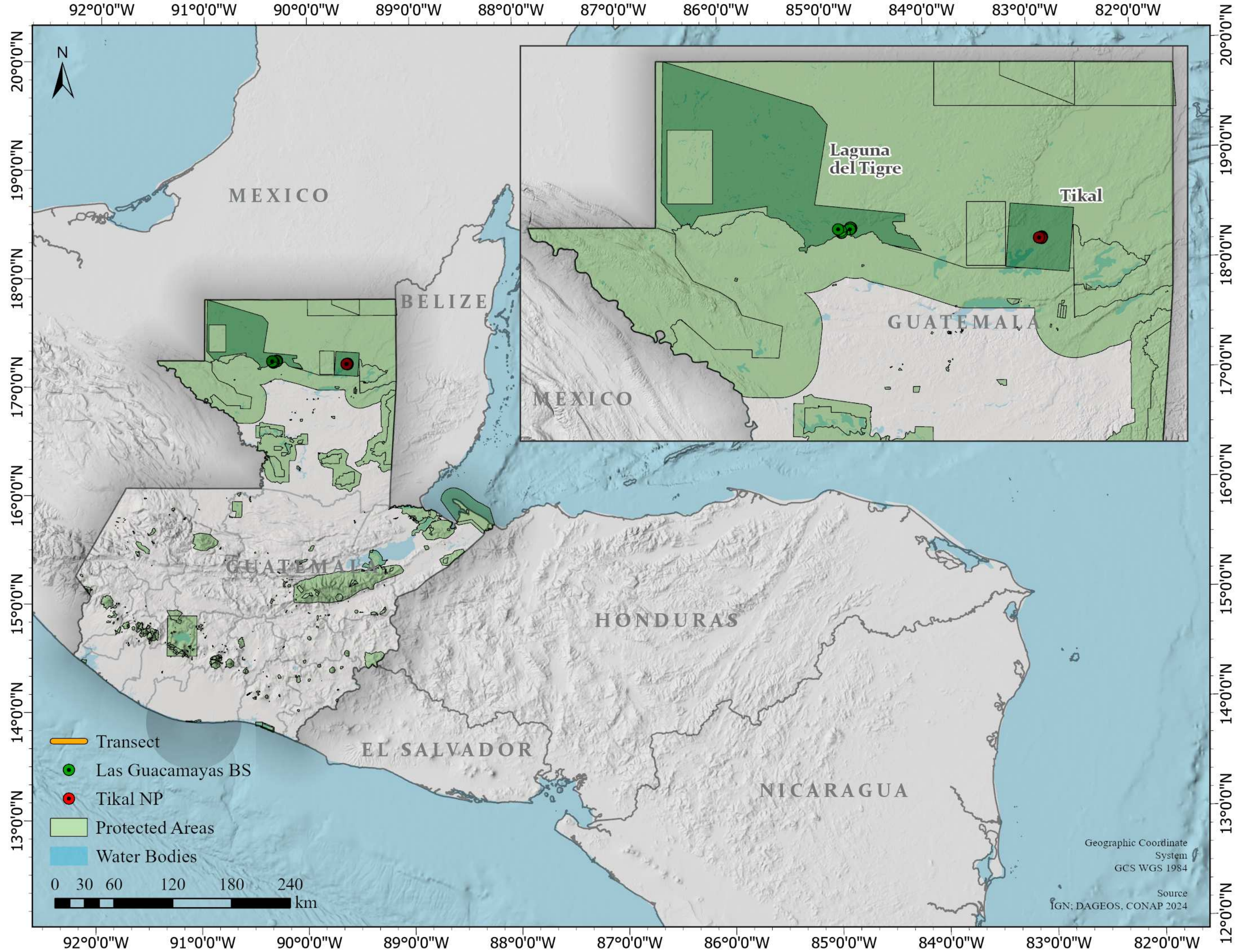

Figure 1. Study sites are represented by green polygons and sampling points by red and green circles. The Guatemalan System of Protected Areas is integrated into the main map (green polygons) (https://conap.gob.gt/direccion-de-analisis-geoespacial/) is integrated into the main map. Map elaborated by L. Trujillo.

have researched the roosting ecology of tent-roosting bats in Costa Rica (Brooke, 1897; Chaverri and Kunz, 2010; Gutiérrez-Sanabria, 2010; Rodríguez-Herrera *et al.* 2018; Rodríguez *et al.* 2021) and Panama (Choe, 1997; Lim, 1998; Cvecko, 2022); however, information on this behavior is absent in Guatemala.

In the Neotropics, around 22 species of Phyllostomidae are known to show this behavior, occurring with the greatest species diversity in Brazil, Colombia, and Perú (Tello and Velazco, 2003). These bats modify approximately 77 species of plants as tents, most inhabiting lowland tropical forests, being Arecaceae, Heliconiaceae, and Araceae, the most representative plant families, all of them present in Guatemala. Eight types of tent architecture are known to date: apical, bifid, umbrella, boat, conical, pinnate, boat-apical, and paradox (Rodríguez-Herrera *et al.* 2007). Since many of the tent-roosting bat species and their associated roosting plant species have been reported for Guatemala, we expect this behavior to be present in this country. Here, we report the tent-roosting behavior in two localities at the Maya Biosphere Reserve (MBR), Petén, Guatemala, for the first time. This report is not only the first for the study area but also for the country. It contributes to bringing attention to an understudied but important biological interaction, especially in the Central American region, and highlights the need to continue reporting these sightings.

Located in northern Guatemala, the Maya Biosphere Reserve (MBR), department of Petén, comprises Central America's largest tropical lowland forest, with a wide range of undisturbed natural habitats (Alarcón-Méndez *et al.* 2023). This region presents a medium temperature of 22 – 29° C and 1,000 mm – 1,900 mm annual precipitation (CONAP, 2016). We conducted this study in January 2024 on a short visit to Tikal National Park (17.2166, -89.6166 O) and Estación Biológica "Las Guacamayas (EBG)", Parque Nacional Laguna del Tigre (17.247216, -90.29288), both protected areas are part of the MBR (Figure 1). Tikal National Park (TNP) protects one of the largest ancient cities of the

Table 1. Number of tents registered in both study sites.

Locality	Trail (km2)	No. tents	Density (tents/km2)
EBG	0.00212	8	3.77
EBG	0.00474	29	6.11
			9.88
TNP	0.00218	32	14.67
TNP	0.00142	15	10.56
			25.23

EBG: Estación Biológica "Las Guacamayas", TNP: Tikal National Park.

Table 2. Plant species used as tents in both study sites.

Locality	Plant species	No. Tents	Architecture	Tents with seeds
EBG	*Sabal mauritiiformis*	12	Umbrella	6
	Cryosophila stauracantha	26	Umbrella	22
TNP	*Sabal mauriitiformis*	42	Umbrella	36
	Cryosophila stauracantha	5	Umbrella	2
Total		85		66

EBG: Estación Biológica "Las Guacamayas", TNP: Tikal National Park. Tents with seeds = seeds transported and consumed by bats in their roosts.

Maya Civilization, where it predominates highland forests composed of species such as *Cedrella odorata* and *Brosimum alicastrum*, among others (CONAP, 2004). At the Estación Biológica "Las Guacamayas," the dominant habitat is tropical dry forest (Murphy and Lugo 1986), mainly composed of savannas, wetlands, and highland forests (Colombo *et al.* 2015). Our study design was as simple as doing trails at least 0.5 km distance surveying for bat tents 0.02 km from the trail (wide). We surveyed a total area of 0.01046 km^2 and walked 5.23 km for both study sites, divided into shorter routes. In Estación Biológica "Las Guacamayas," we did two trails totaling 3.43 km (1.06 km and 2.37 km each x 0.02 km wide), and in Tikal National Park, we did two trails totaling 1.80 km (1.09 km and 0.71 km each x 0.02 km wide). For each route, we took the following data whenever we spotted a bat tent: 1) geographic coordinates, 2) plant species, 3) tent architecture, 4) cut shape, 5) bat species (if the tent was occupied), and 6) if there were seeds under the tent.

We found 38 tents in Estación Biológica "Las Guacamayas" and 47 tents in Tikal National Park. We report a total density of 9.88 (tents/km^2) for EBG and 25.23 (tents/km2) for TNP (Table 1). 66 of 85 tents had seeds underneath (Table 2). In both study localities, we found that *Sabal mauritiiformis* and *Cryosophila stauracantha* (Arecaceae) were used as tents in umbrella architecture and presented a heart-shaped cut. We only recorded 3 tents occupied, 2 by *Dermanura* sp. (*C. stauracantha* and *S. mauritiiformis*) and 1 *Artibeus jamaicensis* (*S. mauritiiformis*) (Table 2). All *C. stauracantha* tents presented a type of ceiling modification (Figure 2) that had never been reported before (Figure 2).

Our study is the first to report bats that use tents in the Northern Central American region, even though 10 tent-roosting bat species are reported for Guatemala. Guatemala's MBR does not count with an updated bat species list. Still, according to the species distribution and habitat requirements, only 6 tent-roosting species occur in the MBR: *Uroderma convexum, Artibeus jamaicensis, A. lituratus, Dermanura phaeotis, D. watsoni, and Vampyressa thyone* (Lou and Yurrita, 2005). These species can use up to 56 plant species and design 8 tent architectures throughout their distribution (Rodríguez-Herrera *et al.* 2007). Here, we only reported two bat species using tents (*Dermanura* sp. and *Artibeus jamaicensis*), two plant species (*Sabal mauritiiformis* and *Cryosophila stauracantha)*, and one type of architecture (umbrella), highlighting the urgent need to report this type of sightings to learn more about these species in other Central American localities.

Plant and tent architecture can change within localities, season and habitat types. Tent construction patterns (plant species and architectures) documented in this study area are quite different than those recorded in other studies. Villalobos-Chaves *et al.* (2016) reported 225 bat tents corresponding to 4 architectures and 14 plant species in 0.55 km2 of Costa Rica's rainforest (409 tents/km2 density). The number of tents available in each area and the plants used by bats to build their roosts could change in response to several factors, such as the availability of plant resources across space, time, and bat species preferences and behavioral plasticity (Choe and Timm, 1985; Chaverri and Kunz, 2006; Rodríguez-Herrera *et al.* 2007). The factors mentioned above could explain why we found a much smaller number of tents in the MBR, adding that this region is not as rainy as the region studied by Villalobos-Chaves *et al.* (2016).

All the tents we found were umbrella-type. Most tents with this type of architecture are built on species of the Arecaceae family (Herrera-Victoria *et al.* 2018), such as the two species reported here. (*S. mauritiiformis* and *C. stauracantha*). However, this architectural style is not present in all palms. The umbrella tent is the third most used by bat species in the Neotropics since four bat species construct them in around eight different plant species throughout the region (Rodríguez-Herrera *et al.* 2007). S. mauritiiformis tents presented a type of ceiling modification (Figure 2) that had never been reported before. Palms are distinguished by their costapalmate leaves, which are difficult to cut, to which we attribute the modification by bats. We observed a great abundance of *S. mauritiiformis*, especially at Estación Biológica "Las Guacamayas"; this might be due to using their leaves as roofs for traditional Maya houses since prehispanic times (Martínez-Ballesté *et al.* 2008). However, the preference for bat use for this plant species in our study localities is unclear.

About 77.6% of the bat tents, we found had large seeds underneath. Melo *et al.* (2009) state that Neotropical tent-roosting bat species can disperse around 43 species of large seeds, playing a key role in tropical forest regeneration. However, further research should focus on identifying which species of large seeds bats disperse in Guatemalan forests.

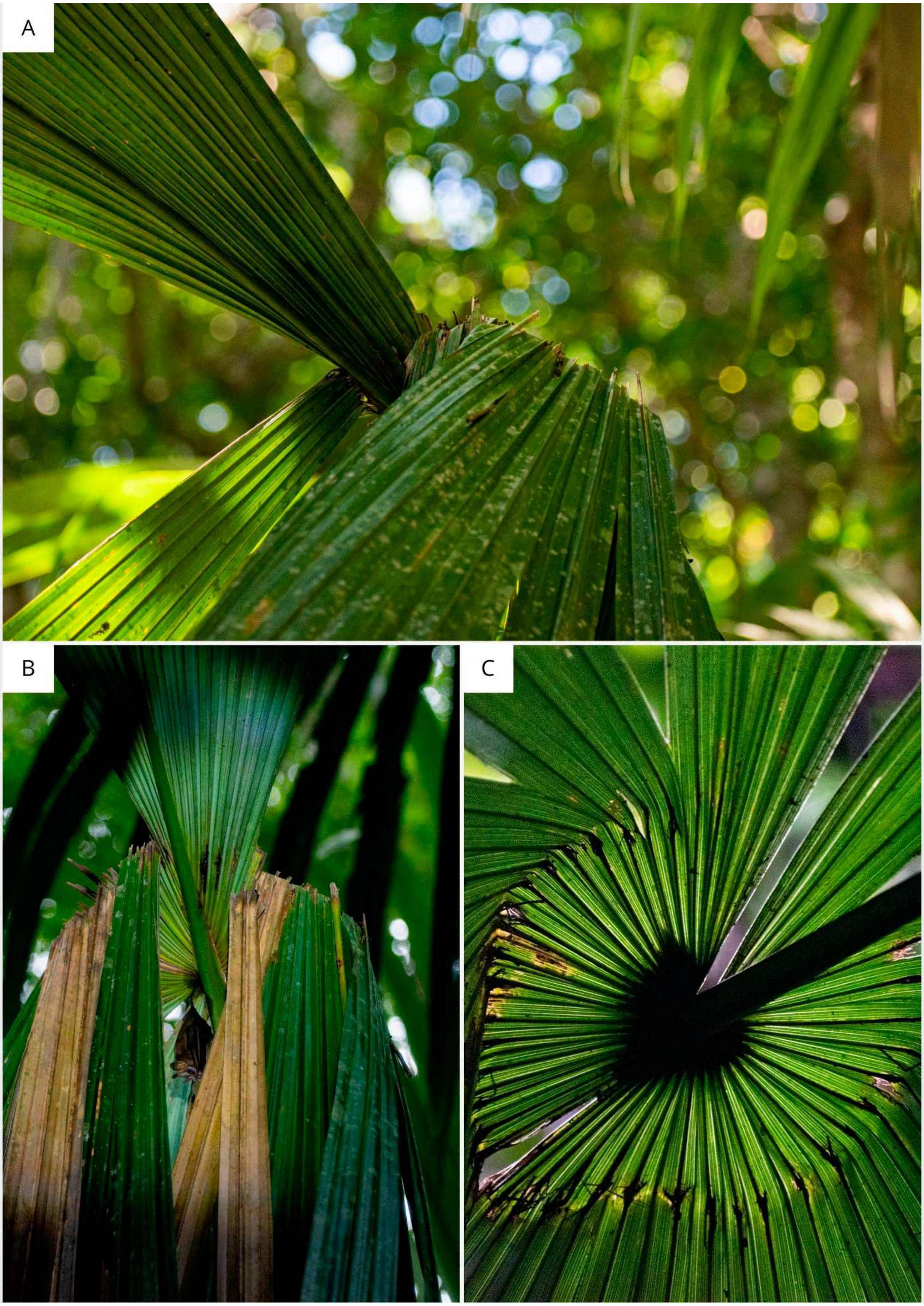

Figure 2. A) and B) *Sabal mauritiiformis* modified as tent. C) Umbrella tent of *C. stauracantha* heart-shaped cut. Photos by L. Trujillo.

Figure 3. Occupied tents registered. A) *Artibeus jamaicensis* roosting in an umbrella *S. mauritiiformis* tent. B) *Dermanura sp*. roosting in an umbrella *C. stauracantha* tent. Photos by L. Trujillo.

This study is the first report of tent-roosting behavior in Guatemala, highlighting the use of two Arecaceae species and a variant of the umbrella tent architecture for the first time. These results highlight the importance of studying tent roosting behavior in data-deficient areas, and It's the first step in continuing to look for this behavior in the species mentioned above. Further research in Guatemala should focus on tent-roosting behavior. As the literature indicates for other Neotropical areas such as Costa Rica and South America, we expect many architectures in the region and tents in plant species not reported before (Rodríguez-Herrera, 2009). Furthermore, tent-making bats are important seed dispersers in rainforests (Melo *et al.* 2009), and further research will document the scale and scope of this ecosystem service for Guatemalan forests.

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Road-killed leucistic opossum (*Didelphis virginiana* Kerr 1792) in the municipality of Lázaro Cardenas, Quintana Roo, México

Tlacuache de virginia (*Didelphis virginiana* Kerr 1792) con leucismo, atropellado en Lázaro Cárdenas, Quintana Roo, México

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Hypopigmentation, including albinism, leucism, piebaldism, and flavism, has been reported across all vertebrate groups. In the case of opossums of the genus *Didelphis*, hypopigmentation has been documented in the United States, Mexico, Colombia, Panama, and Brazil. We conducted a photo-trapping monitoring associated with the Nuevo Xcan–Playa del Carmen highway (July 2016–July 2017) crossing structures, together with opportunistic roadkill surveys as an additional source of information for the project. On March 11, 2017, at 15:44 h, between the towns of Agua Azul and Juárez (20°50'18.36" N / 87°19'30.75" W) in the municipality of Lázaro Cárdenas, Quintana Roo, Mexico, we found a road-killed adult male opossum (*Didelphis virginiana*) with leucistic coloration. This record adds to the other hypopigmented opossums reported for the Yucatan Peninsula in Mexico. Survival of hypopigmented individuals may be related to the whitish karstic soil (sascab in Maya), which could make their coloration less deleterious than in more contrasting environments. Chromatic disorders such as leucism are rare in wild populations and are often considered deleterious. However, depending on the environmental context, they may not entail significant disadvantages.

Key words: Chromatic disorder; highway; hypopigmentation; leucism; Yucatán Peninsula.

La deficiencia de melanina conocida como hipopigmentación puede causar desórdenes cromáticos como albinismo, leucismo, piebaldismo e hipomelanismo, todos reportados en los distintos grupos de vertebrados. En el caso de tlacuaches del género *Didelphis*, la hipopigmentación ha sido reportada en EUA, México, Colombia, Panamá y Brasil. Se llevo a cabo un monitoreo de mamíferos silvestres mediante la técnica de foto-trampeo (Julio 2016 a Julio 2017) y monitoreo carretero no sistemático para evaluar el uso de estructuras de paso de fauna y atropellamiento asociado a la autopista Nuevo Xcan-Playa del Carmen. Un macho adulto de tlacuache de virginia (*Didelphis virginiana*) con leucismo fue encontrado el 11 de marzo de 2017 a las 15:44 hr, atropellado entre los poblados de Agua Azul y Juárez (20° 50' 18.36" N / 87° 19' 30.75" W), municipio de Lázaro Cárdenas, Quintana Roo, México. Este registro se agrega a otros desórdenes cromáticos reportados en tlacuaches para la Península de Yucatán en México. La sobrevivencia de animales hipopigmentados puede estar vinculada a las condiciones del suelo kárstico (sascab en maya), que es de color blanquecino, por lo que les resulta menos deletéreo que en otros entornos más contrastantes. Los desórdenes cromáticos como el leucismo son algo poco común en las poblaciones silvestres y pueden representar algo deletéreo o no, dependiendo del contexto en el que ocurran.

Palabra clave: Carretera; Desorden cromático; hipopigmentación; leucismo; Península de Yucatán.

Mammalian coloration is far from a trivial trait. To date, camouflage appears to be the primary explanation for overall coloration, whereas localized patches of colored fur are generally associated with intraspecific signaling (Caro 2005). Background matching may account for the white pelage, while black-and-white combinations are often associated with aposematism and conspecific signaling. Contrasting coloration can play a significant role in crypsis, mainly through mechanisms such as pattern blending and disruptive coloration, among other functions (Caro 2009). Additionally, Gloger's ecogeographical rule associates darker coloration with more humid environments. As Delhey (2019) points out, the two most plausible mechanisms underlying this pattern are camouflage and protection against parasites or pathogens, with the latter potentially involving pleiotropic effects on the immune system.

Chromatic disorders in mammals result from either excess (hyperpigmentation or melanism) or a deficiency (hypopigmentation) of melanin (Abreu *et al.* 2013). Hypopigmentation disorders include albinism, leucism, piebaldism, and hypomelanism (such as flavism, erythrism, and rufism). Albinism is an inherited condition characterized by a complete lack of melanin due to the absence of enzyme tyrosinase. Leucism is a condition characterized by a total or partial loss of pigmentation throughout the body, resulting in a white, whitish, or yellowish appearance. This condition is caused by a recessive gene that inhibits melanin synthesis, although it rarely affects hairless areas, such as the nose, feet, and other exposed skin, and it never alters the pigmentation of the iris (Miller, 2005). As a result, the eyes and/or extremities may retain their original coloration (Fertl and Rosel 2002; Miller 2005; Acevedo and Aguayo 2008). Piebaldism is characterized by localized areas of depigmentation resulting from the absence of melanocytes in affected skin and hair follicles, typically caused by mutations in several genes (Lamoreux *et al.* 2010). Hypomelanism results in hair varying shades of red or yellow, while eye coloration remains unchanged. This condition is linked to the synthesis of pheomelanin and may be caused by mutations that affect melanin biosynthesis, pigment granule trafficking, or membrane sorting (Lucati and López-Baucells, 2017).

These conditions are generally considered rare in wild populations (Abreu *et al.* 2013), as they are often associated with various pathologies, including visual (Pérez-Carpinell *et al.* 1992; Grant *et al.* 2001; Garipis and Hoffmann 2003) and immunological defects (Carretero *et al.* 2009; Summers 2009). Hypopigmentation may increase an individual's conspicuousness, thereby raising susceptibility to predation (Krecsák 2008). Conversely, in some cases, it may reduce predation risk if predators exhibit neophobia, or fear novel stimuli (Mappes *et al.* 2005)

Hypopigmentation conditions have been documented across all major vertebrate groups in the Neotropics (Abreu *et al.* 2013), including fish (e.g., Wakida-Kusunoki *et al.* 2022; Paschoal *et al.* 2024), amphibians (e.g., Sanabria *et al.* 2010; Valdez-Villavicencio and Peralta-García 2014), reptiles (e.g., Silva *et al.* 2010; de Noronha *et al.* 2013; Sosa-Cornejo *et al.* 2022), birds (e.g., Ayala-Pérez *et al.* 2013; Reséndiz-Cruz and Caballero-Jiménez 2016; Palacios-Vázquez 2016; Salgado-Flores and Rodríguez-Ruiz 2022), and mammals (e.g., López-González 2011; Camargo *et al.* 2014; Arriaga-Flores *et al.* 2016; Lucati and López-Baucells 2017; Ramos-Luna *et al.* 2022). In Mexico, several cases have been reported in bats (see Uieda 2000), including albinism in the common vampire bat (*Desmodus rotundus*, Uieda 2001; Ramírez *et al.* 2010), piebaldism in the common fruit bat (*Artibeus jamaicensis*, Sánchez-Hernández *et al.* 2010), and leucism in Waterhouse's leaf-nosed bat (*Macrotus waterhousii*), the free-tailed bat (*Tadarida brasiliensis*), the common fruit bat (*A. jamaicensis*, Sánchez-Hernández *et al.* 2012), and the ghost-faced bat (*Mormoops megalophylla*, Hernández-Aguilar and Santos-Moreno 2018). Other documented cases in carnivores include the coyote (*Canis latrans*, López-González 2011) and the neotropical otter (*Lontra longicaudis annectens*, Arriaga-Flores *et al.* 2016), as well as in primates such as howler monkeys (Ramos-Luna *et al.* 2022) and marine mammals like dolphins (Ortega-Ortiz *et al.* 2022), to name a few.

In opossums (order Didelphimorphia), hypopig-0mentation has been reported in Brazil (*Didelphis marsupialis*, Abreu *et al.* 2013), Colombia (*D. marsupialis*, Hoyos et al. 2020), Panama (*Caluromys derbianus*, Fuentes *et al.* 2024), and Mexico. In Mexico, cases have only been documented on the Yucatán Peninsula, including an albino *D. virginiana* (Cuxim-Koyoc *et al.* 2020) and a case of flavism (characterized by cinnamon-colored fur in *Didelphis* sp.; Tenorio-Rodríguez *et al.* 2024). This is particularly notable given that opossums (genus *Didelphis*, Linnaeus, 1758) are widespread and relatively common across Mexico, occurring in nearly all states except for the Baja California Peninsula and some arid regions bordering the United States and the Central Plateau (Ceballos *et al.* 2002; Gardner and Sunquist 2003). On the Yucatán Peninsula, *Didelphis* is represented by two sympatric species, *D. marsupialis* and *D. virginiana*, with populations of *D. virginiana* appearing to dominate the northern region over *D. marsupialis* (Jones *et al.* 1974; Ruiz-Piña and Cruz-Reyes 2002).

Populations of *D. virginiana* in the Peninsula may correspond to the subspecies *D. v. yucatanensis* (Gardner 1973; MacManus 1974), which is reportedly smaller than *D. v. californica*, although both subspecies share the same coloration pattern (Gardner 1973): dichromatic, with a common dark phase characterized by black legs, feet, and ears; extensive black pigmentation on the tail; dark body coloration extending forward over the top of the head forming a wedge between the eyes; darker sides of the head and neck; and a prominent ocular stripe extending from in front of the eye to a pale spot at the base of the ear, distinctly outlining the white cheek area. If local populations are small, isolated, and subject to inbreeding, we might expect an increased frequency of developmental abnormalities, including coloration disorders (MacManus 1974).

Here, we presented the first documented case of leucism in *Didelphis virginiana* and the third recorded case of hypopigmentation for this species in the Yucatán Peninsula.

We conducted a photo-trapping survey targeting medium- to large-sized mammals associated with the wildlife crossing structures (pipes, box culverts, and wildlife underpasses) along the Nuevo Xcan–Playa del Carmen Highway, located in the municipalities of Solidaridad and Lázaro Cárdenas, Quintana Roo, Mexico. The region is predominantly flat, with an elevation ranging from 5 to 10 meters above sea level. The climate is warm and sub-humid, with annual mean temperatures ranging from 26°C to 33°C, and an average annual precipitation of approximately 1,300 mm, concentrated primarily between June and October (INEGI 2017). The natural vegetation in the area consists of subperennial evergreen forest at various stages of succession (Rzedowski 2006).

We set up 28 monitoring stations that continuously operated from July 2016 to July 2017. Cameras were placed approximately 50cm above the ground in the middle section inside the crossing structure, perpendicular to

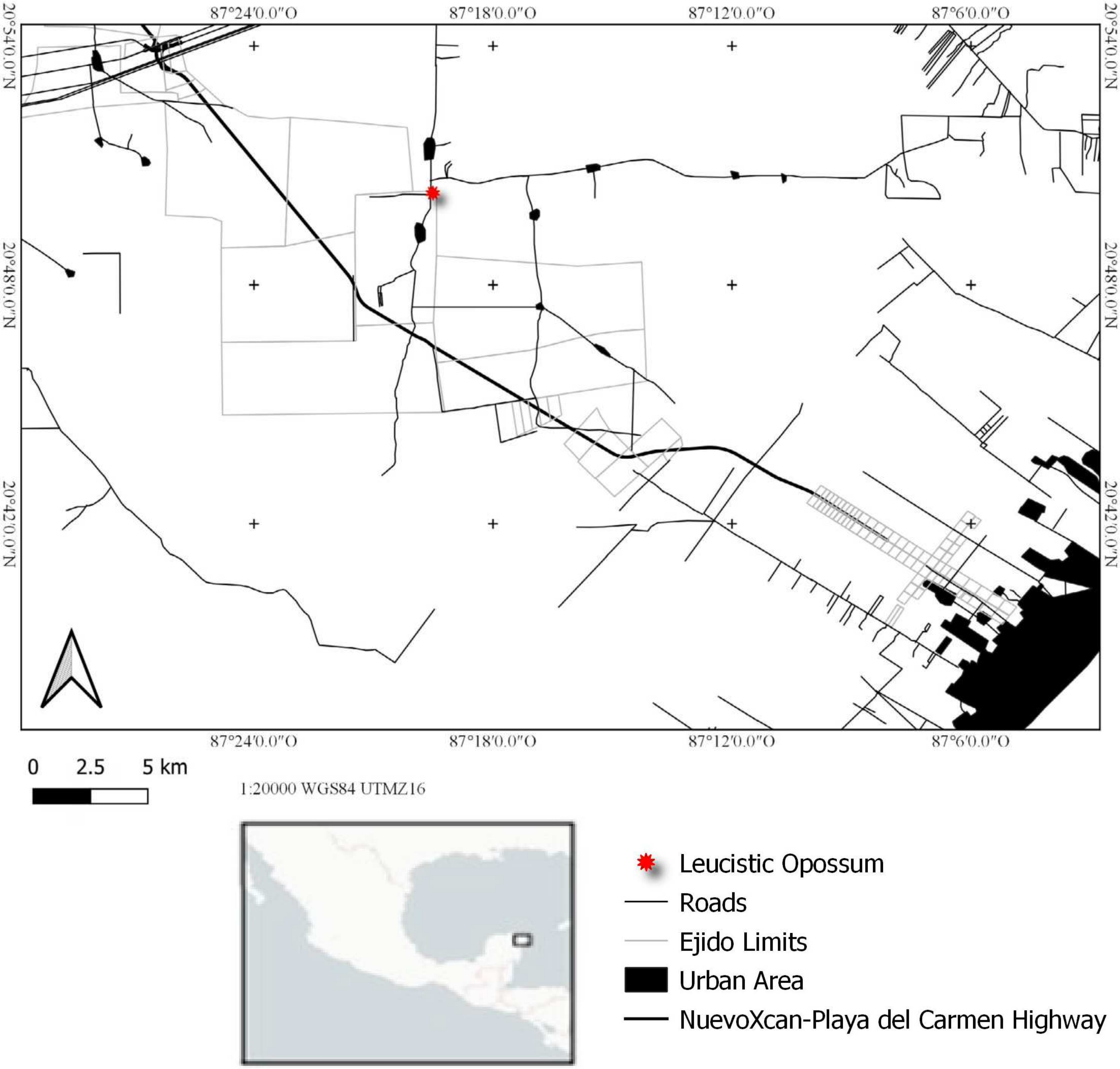

Figure 1. Location of the roadkilled leucistic opossum (*Didelphis virginiana*) in the municipality of Lázaro Cárdenas State of Quintana Roo, México.

the entrance aimed at photographing all passing animals (González-Gallina *et al*. 2018). We considered a camera night a 24-hour period during which the camera was operating. Sampling effort per station was obtained by counting the days the camera was active subtracting days when the camera was not functioning and total sampling effort as the added number of camera nights for each station (Ramesh and Downs 2015).

As part of the project, we also recorded opportunistic observations of road-killed animals encountered while traveling between photo-trapping stations by vehicle. When the condition of the carcasses permitted, individuals were identified to species level using specialized field guides (Reid 2009). To differentiate *Didelphis virginiana* from *D. marsupialis*, we relied on diagnostic features such as cheek coloration, whisker color on the muzzle and cheeks, tail length, and the proportion of the tail covered in dark pigmentation. For each observation, we recorded the GPS location and took reference photographs. In the case of photo-trapping data, individuals of the genus *Didelphis* (*D. marsupialis* and *D. virginiana*) were grouped into a single category, as distinguishing between the two species was not feasible in most photographs.

On March 11, 2017, at 15:44 h, we documented a road-

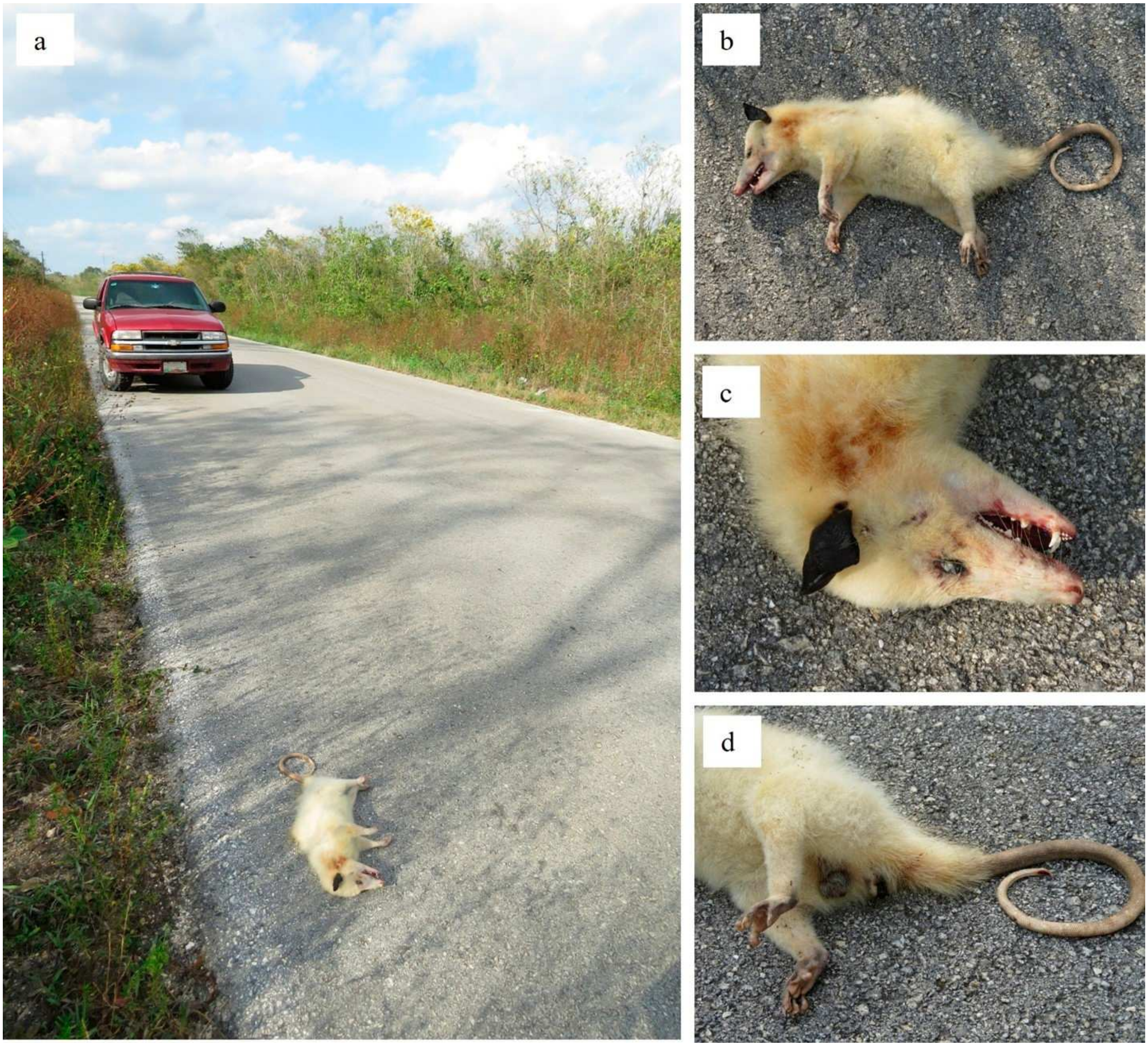

Figure 2. a) Photograph of the leucistic male opossum (*Didelphis virginiana*) that was found road-killed between the towns of Agua Azul and Juárez, in the municipality of Lázaro Cárdenas, Quintana Roo. The surrounding vegetation consisted of secondary growth from subperennial evergreen forest. Close-up images include b) the entire body, c) the head, which allows for observation of the uniformly colored whiskers and dark ears—traits indicative of an adult—and d) the tail, which exhibits a more significant proportion of dark coloration than white and is shorter than the body length, a diagnostic feature distinguishing *D. virginiana* from *D. marsupialis*. The presence of testicles confirms that the specimen is male.

killed adult male opossum (*Didelphis virginiana*) with leucistic coloration along the highway connecting the Mérida–Cancún freeway with the town of Juárez, between the villages of Agua Azul and Juárez (20°50'18.36" N / 87°19'30.75" W) (Figure 1). While traveling this route, we encountered the specimen and examined it for diagnostic characteristics to distinguish between *Didelphis* species. These included uniformly white whiskers and a tail shorter than the body length, with the dark portion of the tail longer than the white portion—though in this individual, the contrast was less conspicuous (Figure 2)—allowing for identification as *D. virginiana*. The specimen appeared relatively fresh and based on the degree of rigor mortis and overall condition, we estimated that it had likely died during the night of March 10 because of a vehicle collision. This was the only individual exhibiting abnormal coloration that we encountered during our entire photo-trapping survey in the area.

In addition to this observation, during the survey, we recorded other roadkill specimens, including two opossums (*Didelphis marsupialis*), two gray foxes (*Urocyon cinereoargenteus*), two coatis (*Nasua narica*), and one Yucatán squirrel (*Sciurus yucatanensis*).

Throughout 10,166 camera trap nights, we obtained 33 records of *Didelphis* spp. using underpass structures to cross the highway. Of these, nine were inside wildlife-specific crossing structures, 19 utilized box culverts, and five employed concrete pipes.

Pigmentation anomalies in natural populations of Neotropical mammals have been considered rare (Abreu *et al.* 2013). To provide local context, from November 2012 to July 2013, the consultancy SEGA S.A. de C.V. conducted biological monitoring along the Nuevo Xcan–Playa del Carmen highway (Hidalgo-Mihart *et al.* 2013). This effort involved 54 camera traps across 81 photo-trapping stations, resulting in a total of 7,937 trap-nights. Opossums (*Didelphis* spp., as the species are difficult to distinguish in photographs) emerged as a dominant species, with 325 independent records. Also, González-Gallina *et al.* (2018) reported an additional 36 records of *Didelphis*. Across both monitoring efforts—361 total records—only a single case of color abnormality was detected within the genus. This single record of a pigmentation anomaly through roadkill rather than photo-trapping shows that opportunistic highway surveys can yield important complementary records (González-Gallina *et al.* 2016).

Hypopigmented animals are generally more susceptible to fitness declines compared to hyperpigmented (melanic) individuals. The occurrence of hypopigmented wild mammals appears to be more frequent in areas with high levels of human activity, where fragmented populations are more prone to environmental stress and inbreeding (Guestalla *et al.* 2021; Cotts *et al.* 2024). This pattern may reflect underlying environmental conditions in the Yucatán Peninsula, as all reported cases of hypopigmentation in *Didelphis* from Mexico originate from this region. However, in our study area, low population, isolation and inbreeding are unlikely explanations, as *Didelphis* (including both *virginiana* and *marsupialis*) was the most abundant species recorded (Hidalgo-Mihart *et al.* 2013). Still, these genetic disorders are naturally occurring (sometimes by random mutations) but rare (Abreu *et al.* 2013) as in this case this record represents 0.28 of all records.

If white pelage is better explained by background matching (Caro 2009), we propose that the light-colored karstic substrate that characterizes much of the Yucatán Peninsula (Bautista *et al.* 2015) may play a role in the survival of these hypopigmented individuals. The local soil type, known as *sascab* (meaning "white dirt" in Maya), could favor them by reducing their detectability to predators, thus mitigating the fitness costs often associated with conspicuous coloration. In this context, the cryptic advantage provided by *sascab* may reduce the non-physiological (e.g., predation-related) adverse effects of hypopigmentation observed in other environments.

This could help explain how the albino opossum reported by Cuxim-Koyoc *et al.* (2020) reached adulthood despite likely visual impairments—limitations not typically present in leucistic individuals such as the one we report here. It might also account for our observation of a leucistic female great curassow (*Crax rubra*) captured during photo trapping in the same locality (Hidalgo-Mihart *et al.* 2013).

We suspect that color patterns in mammals may be influenced by both habitat characteristics and human-induced factors (Ausband and Krohner 2022). Further research is necessary to better understand how selective pressures related to habitat, life history, developmental stage, and season contribute to the evolutionary mechanisms underlying external coloration. To advance this understanding, it is necessary to compile enough records of chromatic disorders across a wide range of species and taxonomic groups worldwide. This would allow us to begin identifying potential environmental patterns and, importantly, to determine which variables may promote the occurrence of such chromatic anomalies in wild populations.

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Maximum weight record of fruit carried by *Artibeus fraterculus*

Registro máximo de carga de fruto por *Artibeus fraterculus*

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Artibeus fraterculus Anthony, 1924 is a fruit bat of the family Phyllostomidae. It feeds primarily on soft fruits, including both native and cultivated species, although its feeding behavior remains poorly understood. This study was carried out in 2 localities of Cajamarca, Matibamba and Cangrejo, in the Seasonally Dry Forest of the Marañón, in the region of Cajamarca, Peru. Their feeding behavior was documented and fruits found in natural feeding (night) roosts were analyzed. During the observations, the bats consumed fruits such as guava (*Psidium guajava*), loquat (*Eriobotrya japonica*), plum (*Spondias purpurea*) and mango (*Mangifera indica*). Notably, an individual was observed carrying a guava fruit whose weight was estimated to be 105.88 % of the bat's body weight. These observations suggest that *A. fraterculus* plays a crucial role as a seed disperser of economically important and relatively large fruit, especially in disturbed landscapes. This work also expands existing knowledge on the diet of this species with the addition of *S. purpurea* and describes specific foraging behaviors at feeding (night) roosts. Insights gained from this work highlight how direct observations and analysis of fruits at feeding sites complements other approaches such as fecal analysis, providing valuable information on the feeding ecology and activity patterns of *A. fraterculus*.

Key words: Cajamarca; diet; feeding behavior; Marañón dry forest; Stenodermatinae.

Artibeus fraterculus Anthony, 1924 es un murciélago frugívoro de la familia Phyllostomidae, endémica de la región tumbesina en Ecuador y Perú. Este estudio se llevó a cabo en 2 localidades de Cajamarca, Matibamba y Cangrejo, en el Bosque Estacionalmente Seco del Marañón, en la región de Cajamarca, Perú. Se documentó su comportamiento alimenticio y se analizaron frutos encontrados en comederos naturales. Durante las observaciones, los murciélagos consumieron frutos como guayaba (*Psidium guajava*), níspero (*Eriobotrya japonica*), ciruela (*Spondias purpurea*) y mango (*Mangifera indica*); y en particular se observó a un individuo cargando un fruto de guayaba cuyo peso se estima representaría el 105.88 % del peso corporal del murciélago. Las observaciones sugieren que *A. fraterculus* juega un papel crucial como dispersor de semillas de especies de importancia económica y de tamaño relativamente grande, especialmente en paisajes perturbados. Este trabajo también amplía el conocimiento sobre la dieta de esta especie al incluir *S. purpurea*, una especie de importancia económica, y describe comportamientos específicos de forrajeo en relación con comederos. Finalmente, se destaca que las observaciones directas y análisis de frutos en comederos, complementa otros enfoques como el análisis de heces, proporcionando información valiosa sobre la ecología alimenticia y los patrones de actividad de *A. fraterculus*.

Palabras clave: Bosque Seco del Marañón; Cajamarca; comportamiento alimentario; dieta; Stenodermatinae.

Plant and animal interactions play an essential role in the ecology and evolution of species and the preservation and restoration of balanced ecosystems (Kunz *et al.* 2011; Sil *et al.* 2023). Mammals such as bats (Order Chiroptera) are fundamental in agricultural ecosystems, where they fulfill essential ecological roles such as pest control, plant pollination, and seed dispersal (Laurindo *et al.* 2020; Ocampo-Ariza *et al.* 2022). Fruit bats in particular consume fruits completely or partially, allowing the seeds to pass through their digestive system and be dispersed through their feces (Voigt *et al.* 2009). For fruits with seeds too large for bats to consume, dispersal occurs as bats move between the food source and place of consumption, often roosts (Melo *et al.* 2009). In both ways, bats contribute to the regeneration and propagation of plants with morphologically distinct fruits (Melo *et al.* 2009).

Several studies have documented the ability of species in the genus *Artibeus* to transport fruits weighing comparable to, or even greater than, their own body mass. Individuals of *A. jamaicensis* and *A. lituratus* have been reported transporting or consuming guava (*Psidium guajava*) fruits weighing up to 50 g, and even avocado (*Persea americana*) fruits weighing an estimated 71.7 g (Gardner 1977; Hernández-Mijangos and Medellín 2009; Duque-Márquez and Muñoz-Romo 2015). The transportation of whole fruits in the mouth, without being completely ingested, is known

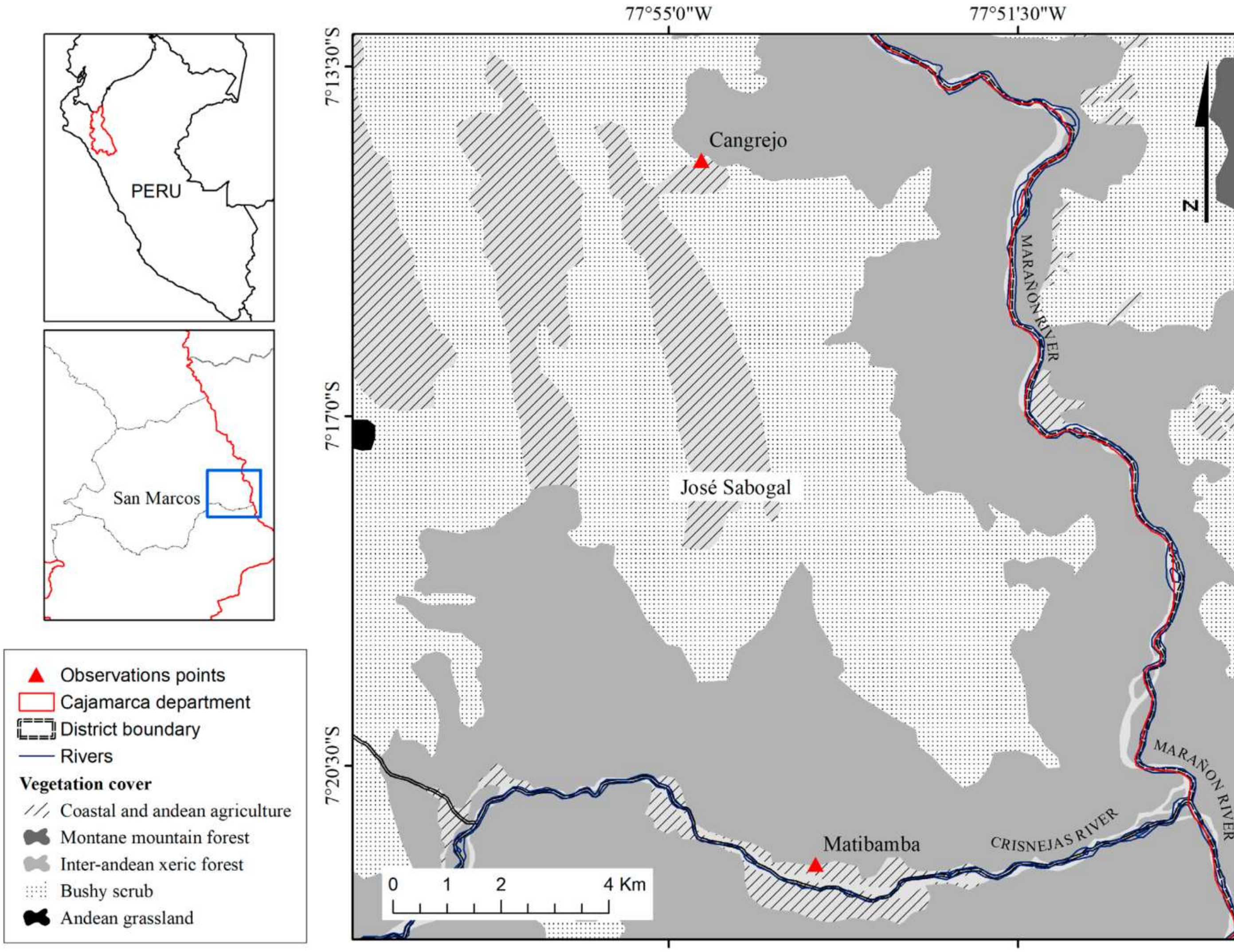

Figure 1. Geographic location of the observed night feeding roosts of *Artibeus fraterculus* in the localities of Matibamba and Cangrejo, Cajamarca, Peru.

as stomatochory (McConkey *et al.* 2024). This seed dispersal mechanism moves fruits or seeds from the source plant to a consumption or resting site, promoting plant regeneration at a distance (McConkey *et al.* 2024).

Artibeus fraterculus is a species of bat in the Phyllostomidae family (Subfamily Stenodermatinae) endemic to the Tumbes region of Peru and Ecuador (Marques-Aguiar 2008; Salas *et al.* 2018). In Peru, it has been reported along the Pacific coast from Tumbes to Ica, in the Andes, and in arid ecosystems in the Amazon basin in the Cajamarca and Amazonas regions (Ortiz de la Puente 1951; Tuttle 1970; Koopman 1978; Pacheco *et al.* 2007; Salas *et al.* 2018). In Ecuador, it has been reported in the central and southern coast from 0 to 1,600 m, with one report in an area of humid montane scrubland (Salas *et al.* 2018).

In situ and field observations remain important for understanding the biology and natural history of bats (Hernández-Mijangos and Medellín 2009; Carrasco-Escudero and Hughes 2025). For example, information on folivory in *A. fraterculus* has been reported primarily from observations in roosts or mist nets at the time of capture (Ruiz-Ramoni *et al.* 2011; Duque-Márquez *et al.* 2019; Arias and Aguirre 2022).

There are several studies on the diet of *A. fraterculus* (Novoa *et al.* 2011; Pinto *et al.* 2013); however, very little or nothing is known about its feeding behavior despite the implications for seed dispersal and intraspecific interactions (Salas *et al.* 2018). In *Artibeus lituratus,* males defend their roosts while conducting short foraging sessions to consume food in the roost itself. In contrast, females travel to more remote foraging locations and are not observed feeding at or near roosts (Muñoz-Romo and Herrera 2010). Furthermore, there are no dietary studies of fruit bats in the Marañón Valley, a region with a climate and botanical diversity distinct from those of the coast (Marcelo-Peña *et al.* 2016).

The main objective of this study is to report the maximum recorded fruit weight carried by the fraternal fruit bat *A. fraterculus.* In addition, we report for the first time the location of a foraging roost and the fruits consumed on the eastern slope of the Andes in two locations in the department of Cajamarca.

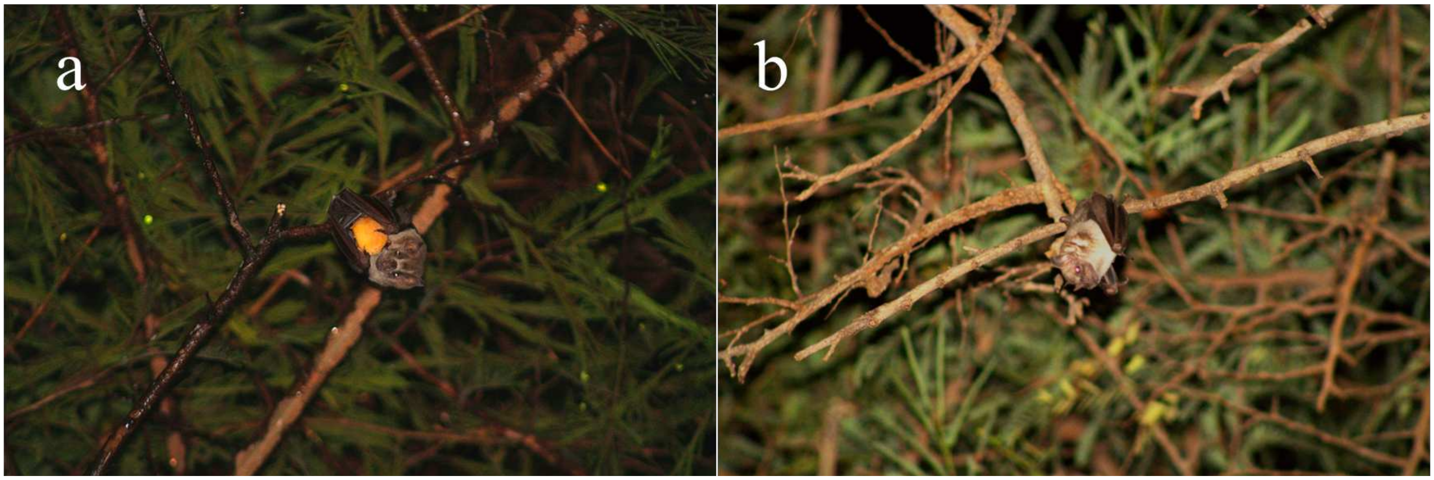

Figure 2. a). An individual of *A. fraterculus* perched and feeding on loquat (*Eriobotrya japonica*) in the locality of Cangrejo, Peru; b). An individual of Artibeus fraterculus perched on a tamarind tree (*Tamarindus indica*) in the locality of Matibamba

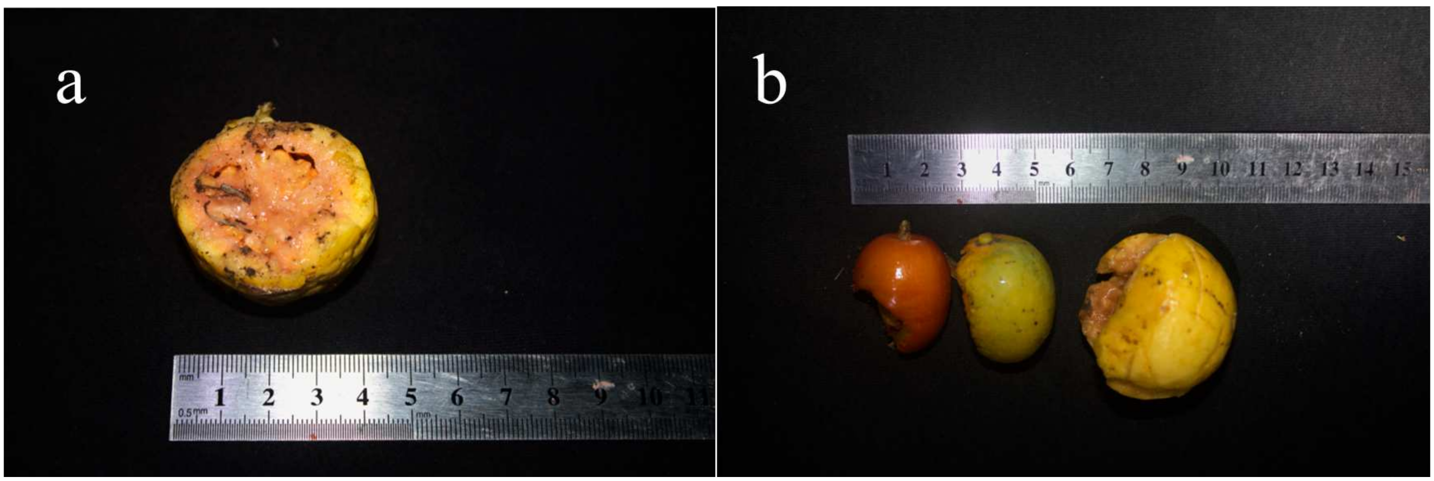

Figure 3. a). Guava (*Psidium guajava*) fruit dropped by an individual of *Artibeus fraterculus* after feeding; b). Remains of fruit partially consumed by *Artibeus fraterculus* at the night feeding roost, including, from left to right, *Spondias purpurea* (plum), *Mangifera indica* (mango), and *Psidium guajava* (guava), recorded in the locality of Matibamba, Peru.

Observations were made at two locations in the José Sabogal district, San Marcos province, Cajamarca region (Figure 1). The first, Matibamba (07° 21′29″ S, 77° 53′32″ W), is a populated center located in the extreme southeast of the district, with an average altitude of 1,160 m and an annual rainfall of approximately 670 mm (Gobierno Regional de Cajamarca [GRC] 2020; Fick and Hijmans 2017). The second, Cangrejo (07° 14′ 26″ S, 77° 54′ 40″ W), is a populated center located 13.2 km north of Matibamba with an average altitude of 2,000 m and an annual rainfall of approximately 750 mm (Fick and Hijmans 2017).

Both locations are within the Marañón Seasonally Dry Forest ecosystem, characterized by a sub-humid and semi-warm climate, seasonally deciduous vegetation, and columnar cacti (Ministry of the Environment [MINAM] 2018; GRC 2020; Linares-Palomino *et al.* 2022). The average canopy height varies between both locations due to climate as well as current and historical land use. Canopy height averaged 13 meters in height in Matibamba and 27 meters in Cangrejo (data extracted from Potapov *et al.* 2022). Agricultural production in these areas includes coca, rice, cassava, corn, and beans, as well as fruit trees such as mango, lemon, banana, plum, orange, and cocoa (GRC 2020).

During bat mist-net surveys at both locations, several individuals of the fraternal fruit bat (*A. fraterculus*) were observed perched on tree branches while feeding. These observations occurred coincidentally during the capture work and were documented using a handheld flashlight and camera. *A. fraterculus* is easily distinguished from other *Artibeus* species due to their faint facial lines, an overall grayish coloration with a paler ventral region, and a smaller size than other species in the *Artibeu*s genus (Tirira 2017; Salas *et al.* 2018). At these locations, *A. lituratus* and *A. planirostris* are the most similar species to *A. fraterculus. A. lituratus* is distiguishable by their larger size, more pronounced facial lines, and an overall browner coloration (Tirira 2017); while *A. planirostris* is more robust, and its facial lines may be less evident (Hollis 2005).

Additionally, we weighted fruits taken from the areas used as feeding grounds. For partially consumed *Psidium guajava* fruit, the missing portion was visually estimated by comparing its shape and volume with the expected morphology of a whole fruit of the same species in order to estimate the original weight (Duque-Márquez and Muñoz-Romo 2015). Fruit was weighed using a Pesola Lightline dynamometer with a maximum capacity of 100 g to ensure accurate measurements.

On February 1, 2024, at 10:30 p.m., in the Cangrejo locality, individuals of *A. fraterculus* were observed perching and feeding on *Eriobotrya japonica* (loquat, Figure 2a) fruits. The fruits consumed had an average weight of 7.3 g ± 1.58 g. Individuals were perched 4 to 10 m from the nearest *E. japonica* tree.

In Matibamba, on February 8, 2024, at midnight, one *A. fraterculus* individual was observed perching on the branch of a tamarind tree (*Tamarindus indica*; Figure 2b), feeding on a guava (*Psidium guajava*) fruit. We observed the individual drop the fruit after feeding on it. The fruit displayed bite marks, and its weight was recorded at 31 g. It is estimated that approximately one-third of the fruit had been consumed (Figure 3a). Based on this estimate, the original fruit weight was calculated at 45 g. Weights of *A. fraterculus* range from 30 to 55 g (Salas *et al.* 2018), with the median weight of 42.5 g used as a reference here. Thus, the weight of the consumed fruit would represent approximately 105.88 % of the estimated average body weight for the species.

Additionally, at the Matibamba location, remains of other fruits showing signs of having been consumed by bats were found, including *Spondias purpurea* (plum, 9 g), *Mangifera indica* (mango, 14 g), and P. *guajava* (guava, 26 g; Figure 3b). These findings indicate a diverse frugivorous diet for *A. fraterculus* at the Matibamba locality and may indicate a partial dependence on agricultural species.

Other bat species were captured at each location on the same night. Individuals of *Sturnira giannae, A. planirostris, Promops davisoni, Glossophaga valens*, and *Carollia perspicillata* were recorded at Matibamba. At Cangrejo, *G. valens, C. perspicillata,* and *A. planirostris* were captured. Individuals of *Carollia sp*. and *A. fraterculus* were observed sharing a branch to feed.

Several species of the genus *Artibeus* have been documented to be able to carry fruit that, in some cases, is comparable to their own body mass. For example, Gardner (1977) reported an individual of *A. jamaicensis* in Colombia carrying a guava fruit weighing 50 g. Similarly, Hernández-Mijangos and Medellín (2009) observed an individual of *A. lituratus* feeding on a guava fruit weighing approximately 50 g, while Duque-Márquez and Muñoz-Romo (2015) reported an individual of *A. lituratus* consuming a *Persea americana* (avocado) fruit with an estimated weight of 71.7 g. In addition, diameter measurements have been recorded on transported fruits including by Tuttle (1970) in Peru, where a female *A. jamaicensis* was carrying a fig fruit approximately 30 mm in diameter. These studies highlight that transported fruits can represent a weight equivalent to the bat's body mass (Duque-Márquez and Muñoz-Romo 2015). This behavior could reduce the frequency with which bats need to forage, optimizing their energy expenditure (Fleming 1982).

In this context, our study reveals that *A. fraterculus*, one of the smallest species in the large *Artibeus* group (Salas *et al.* 2018), could be capable of carrying fruits equivalent to 1.05 times its body mass, demonstrating its remarkable carrying capacity relative to its size. Furthermore, this species plays an important role in the dispersal of large seeds such as *S. purpurea* and *M. indica* through stomatochory (McConkey *et al.* 2024; Sánchez-Calderón *et al.* 2025). The ability of *A. fraterculus* to transport fruits to feeding (night) and day roosts, and to expel undigested seeds in different locations, promotes the connectivity of fragmented habitats. This is especially valuable in tropical ecosystems, where the natural regeneration of native fruit trees may depend on species such as *A. fraterculus* among others.

The role of fruit bats as dispersers of large seeds has significant implications for ecosystem regeneration (Fleming and Heithaus 1981; Heithaus 1982). Many tree species that produce large-seeded fruits, such as *S. purpurea* and *M. indica,* might rely on fruit bats for dispersal. For native species such as *P. guajava,* this behavior may be crucial for their reestablishment in disturbed landscapes, where plants face greater difficulties in dispersal by birds, rodents, or other mammals due to the loss of dispersing fauna and the tendency of these groups to avoid open areas (Gardner 1977; Kunz *et al.* 2011; Brändel *et al*. 2020). For non-native species such as *M. indica,* this behavior may increase the risk of their naturalization, posing a threat to native species in areas with high endemism (Jiang *et al.* 2022). However, since these non-native plants can provide alternative food sources for wildlife during the recovery period of native forest diversity, the risk of naturalization must be assessed on a case-by-case basis, considering the area's management objectives. These complex interactions between agriculture and native biodiversity highlight the importance of promoting collaborative discussions and developing integrated management plans for communities located within and near protected areas. These observations are consistent with the documented tendency of this species to feed on fruits available in each location, even if they are non-native or agricultural species (Salas *et al.* 2018).

Dietary studies of *A. fraterculus* have been conducted primarily through the analysis of fecal samples (Novoa *et al.* 2011) or fruits and seeds collected from shelters (Pinto *et al.* 2013). In this study, we collected large-seeded fruits from feeding (night) roosts, which may be too heavy to be transported to their shelters and, due to their seed size, may not be entirely ingestible. These fruits would not be reported through seed analysis in fecal samples.

Based on the observations and descriptions of *A. lituratus* by Muñoz-Romo and Herrera (2010), *A. fraterculus* would be expected to display sex-specific foraging behavior, with males making short flights to return to their shelter to feed and defend it; while females forage farther away. If true, we would expect feeding (night) roosts to be utilized disproportionately by females while males are feeding in and near permanent day roosts. In the town of Matibamba, 1 km to the northwest, we found a cave inhabited by *A. fraterculus*. Fruit and seed remains of *S. purpurea* and *M. indica*, as well as leaf debris, were observed here, supporting the observations detailed here. However, additional studies to delve deeper into these behaviors are needed to fill the current gaps in knowledge about the natural history of *A. fraterculus*.

This information contributes to our understanding of the trophic ecology of fruit bats and provides evidence of how fruits with large seeds, which cannot be digested by bats, such as loquat, mango, and plum, can be dispersed by this taxa through stomatochory (McConkey *et al.* 2024; Novoa *et al.* 2011; Pinto *et al.* 2013). This could also occur with fruits of similar or larger size in environments not disturbed by human presence. The coexistence between human crops and native flora could benefit from the presence of *A. fraterculus,* reinforcing its role as a key seed disperser in tropical ecosystems including those subject to extensive fragmention and agricultural development.

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