THERYA NOTES 2026, Vol. 7:30-37 DOI: 10.12933/therya_notes-25-228 ISSN 2954-3614

New bat (Mammalia: Chiroptera) records from Nicaragua: First records of *Pteronotus psilotis*, *Dermanura azteca* and *Uroderma davisi*

Nuevos registros de murciélagos (Mammalia: Chiroptera) en Nicaragua: Primer registro de *Pteronotus psilotis*, *Dermanura azteca* y *Uroderma davisi*

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Understanding species distributions is key for conservation and management, as well as necessary to examine their ecological associations. In recent decades, the increasing survey efforts across Nicaragua have expanded the known ranges of many Mesoamerican bat species. Here we aim to fill gaps in known distribution of bat species across their distribution in Nicaragua and Central America. We used single and triple high nets to capture bats in different vegetation formations across Nicaragua. We measured and identified each individual bat and compared their location to previously known localities available in international repositories. We provide the first record of *Pteronotus psilotis* (Dobson 1878), *Dermanura azteca* K. Andersen 1909, and *Uroderma davisi* R. J. Baker and McDaniel 1972. We also provide new records of *Centronycteris centralis* Thomas 1912, and *Artibeus inopinatus* Davis and Carter 1964. Our findings fill important gaps in the known distribution of the species. With our current additions, this elevates the number of bat species recorded in Nicaragua to 116. We recommend more capture and acoustic sampling efforts, specifically in areas near the north and southern borders of the country that have been historically underrepresented in surveys.

Key words: Aztec fruit-eating bat; Central America; *Centronycteris*; Davis's tent-making bat; *Dermanura*; Honduran fruit-eating bat; range extension.

El conocimiento de la distribución de las especies es primordial para la conservación, el manejo de las especies y para examinar sus asociaciones ecológicas. En las últimas décadas, el incremento de muestreo en Nicaragua ha permitido expandir el rango conocido de muchas especies de murciélagos. Aquí proveemos nuevos registros expandiendo el rango conocido de la distribución de murciélagos en Nicaragua y Centroamérica. Con el uso de redes de niebla, capturamos murciélagos en diferentes formaciones vegetativas en Nicaragua. Cada uno de los individuos fue procesado y comparamos sus localidades con otras previamente conocidas y disponibles en repositorios internacionales. Proveemos los primeros registros de *Pteronotus psilotis* (Dobson 1878), *Dermanura azteca* K. Andersen 1909 y *Uroderma davisi* R. J. Baker and McDaniel 1972 para Nicaragua. Adicionalmente, proveemos dos nuevas localidades para *Centronycteris centralis* Thomas 1912 y *Artibeus inopinatus* Davis and Carter 1964. Nuestros registros ayudan llenar vacíos en la distribución conocida de las especies. Estos registros elevan el número de especies de murciélagos en Nicaragua a 116. Recomendamos un mayor esfuerzo de muestreo con redes y acústica, en especial en las zonas fronterizas del país, las cuales han sido históricamente han sido subrepresentadas en los inventarios.

Palabras Clave: America Central*; Centronycteris; Dermanura*; extensión de rango; murciélago frutero azteca; murciélago frutero de Davis; murciélago frutero hondureño.

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Nicaragua has faced many socio-economic challenges that have hindered the pace of scientific research in its territory (Medina-Fitoria and Martínez-Fonseca 2019; Martínez-Fonseca *et al.* 2024a). However, increased collaboration, enhanced local capacity, and improved access to previously inaccessible regions have led to a more comprehensive documentation of the country´s biodiversity (Medina-Fitoria and Martínez-Fonseca 2019).

Recent changes in taxonomy, driven by the combined use of morphological and genetic data, have elevated many bat subspecies to full species status (Mantilla-Meluk 2014, Pavan and Marroig 2016). Despite recent surveys extending the known range of bat species into Nicaragua, (Medina-Fitoria *et al.* 2015; Loza *et al.* 2018; Saldaña-Tapia *et al.* 2020), the geographic boundaries for many other species are still unclear (Baker and McDaniel 1972; Arias-Aguilar and Ramos-Pereira 2022). Here we present notable records from the country that both extend and fill gaps in the known distributions of five bat species, and include the first confirmed records for three species. This information highlights the need for more research and supports ongoing efforts to make specimens and genetic material from Nicaragua more accessible.

Our study areas are located in the Nicaraguan departments of Chinandega, Estelí, León, and Río San Juan (Figure 1). Sites in Rodeo Grande (Chinandega), Tolapa, El Sauce, and Nagarote (León), as well as San Juan de Limay (Estelí) are composed of lowland dry and arid forests with annual precipitations of ~1000 mm (Holdridge 1967; Martínez-Fonseca *et al.* 2024b). Miraflor (Estelí) is dominated by premontane moist forests of broadleaf, pine (mostly *Pinus oocarpa*) and oaks (*Quercus* spp.), with ~2000 mm of annual precipitation (Incer 1975). Finally, Refugio Bartola (Rio San Juan) contains lowland moist and wet forest with annual precipitation >4000 mm. Refugio Bartola was surrounded by a mix of pasture areas in the west and the Indio-Maíz Biosphere Reserve to the east (Medina-Fitoria *et al.* 2015; Martínez-Fonseca *et al.* 2024b).

We captured bats using a combination of mist nets of different lengths (6-18 m; Avinet Research Supplies, NY, USA) set at ground and canopy level. Mist nets were set across natural flyways such as riverbeds, creeks, and forest openings, as well as cave entrances following Kunz and Parsons (2009). Nets were opened just before sunset and remained open for about 6 hours.

We placed bats individually in small fabric bags and then collected morphometric data to confirm identification. Measurements included forearm (FA), ear length (E), hind foot (HF) in millimeters using a wing ruler (Avinet Inc. USA) and mass in grams (Wt) using analog scales (PESOLA Präzisionswaagen AG, Switzerland). Ear length (E, mm), hind-foot (HF, mm), and notes on coloration were also recorded whenever needed. We recorded elevation and locality (WGS84) with a handheld Garmin InReach Mini 2 (Garmin Ltd. Schaffhausen, Switzerland).

We identified all bats in the field using field keys and species descriptions (Reid 2009, Medina-Fitoria 2014; Mora 2017; York *et al.* 2019). Basic karyotypic analysis was conducted at the laboratories of the biology department at the Universidad Autónoma de Nicaragua for three samples of *Uroderma* spp., as this is the main technique to corroborate species ID (Baker and McDaniel 1972). Nomenclature and taxonomic arrangement were based on recent publications (Bonaccorso 2019; Wilson and Mittermeier 2019; Martínez-Fonseca *et al.* 2020; Ramírez-Fernández *et al.* 2023). A full list of the other species and individuals captured at each sampling site is available in Table 1. We conducted all activities under permits from the Nicaraguan Ministerio de Ambiente y Recursos Naturales (DGPNB-090622-P2491-0, DGPNB-020824-P4496-0). We handled animals following the guidelines of the American Society of Mammalogists (Sikes *et al.* 2016) and approved by the Northern Arizona University Institutional Animal Care and Use Committee. Due to the lack of a natural history museum in Nicaragua where to deposit reference material and specimens, we obtained voucher numbers for each of the new records from the Photography Collection of the Universidad de San Carlos de Guatemala (USAC 2025) and the Portal de Biodiversidad de Guatemala (https://biodiversidad.gt). Vouchered photos of the collection are also available on the Global Biodiversity Information Facility platform (GBIF.org). We include a map with localities found in GBIF by using: "Species = XXXX", "Basis of record = Preserved specimens", "Location = Including coordinates" and "Country or Area = Nicaragua" (GBIF.org 2024a, 2024b, 2025a, 2025b, 2025c). Additional localities from Martínez-Fonseca *et al.* (2020).

Centronycteris centralis Thomas 1912. On January 3, 2024, we captured a female individual (Figure 2a; USACF000020) in a mist net along a trail in Refugio Bartola, Rio San Juan department (10°58'30.72"N, 84°19'38.28"W; 51 m). The captured individual was easily identifiable by its distinctive long and shaggy yellow fur, and pointy sickle-shaped ears (Reid 2009; Medina-Fitoria 2014). It had a forearm length of 43 mm and a mass of 6 g and unlike other emballonurids in the area, lacked a pair of white longitudinal zig-zag lines on the back (Reid 2009). The uropatagium was very hairy at the base, and the wing membrane attached to the metacarpal-phalangeal joint of the toes, both of which are diagnostic characteristics (Reid 2009; Bonaccorso 2019).

Pteronotus psilotis (Dobson 1878). On August 24, 2022, we captured an adult male individual (Figure 2b; USACF000021; FA 40.5 mm; Wt 6.5 g) on a mist net set over the San José River (12°50'32.28"N, 86°31'6.96"W; 177 m) near El Sauce, León department. On March 8, 2024, we captured a second adult male (FA: 42 mm; Wt: 8 g) on a mist net set over El Gallo riverbed in Rode Grande, Chinandega department (13° 8'38.76"N, 86°48'18.36"W; 123 m). A third individual was captured on March 11, 2024, an adult female (FA 41 mm; Wt 7 g) in a mine (La Grecia) in San Juan de Limay, Estelí department (13°11'13.56"N, 86°37'26.04"W; 276 m).

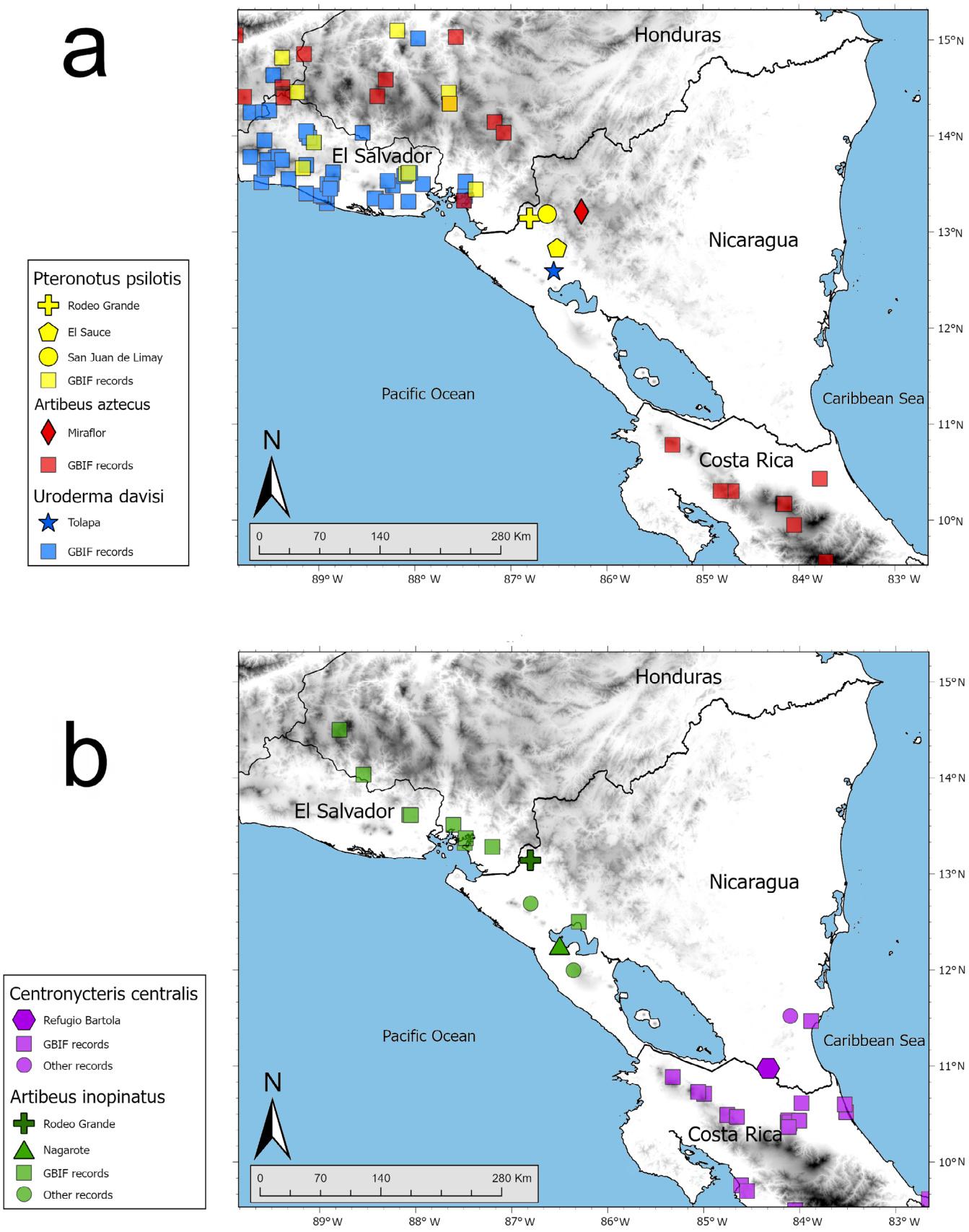

Figure 1. New bat localities in Nicaragua **a.** New localities for *Pteronotus psilotis* (Dobson 1878), *Dermanura azteca* K. Andersen 1909, and *Uroderma davisi* R. J. Baker and McDaniel 1972 in Nicaragua. **b.** New localities within Nicaragua for *Centronycteris centralis* Thomas 1912 and *Artibeus inopinatus* Davis and Carter 1964. Reference occurrence localities outside Nicaragua are based on museum specimen data available on the Global Biodiversity Information Facility (GBIF.org). Other records within Nicaragua are based on Martínez-Fonseca *et al.* (2020).

Table 1. Total bat captures per species in new localities for *Centronycteris centralis* Thomas 1912, *Pteronotus psilotis* (Dobson 1878), *Artibeus inopinatus* Davis and Carter 1964, *Dermanura azteca* K. Andersen 1909, and *Uroderma davisi* R. J. Baker and McDaniel 1972 in Nicaragua. Sites correspond to the departments of Chinandega (Rodeo Grande), Estelí (San Juan de Limay -Mina La Grecia and Miraflor-Finca Beylla Vista), León (El Sauce, Nagarote, and Tolapa), Rio San Juan (Refugio Bartola). *Species with new localities. **Site was an abandoned mine, number of individuals shown here is only for captured individuals. Total number of individuals present was greater.

Species	Rodeo Grande	San Juan de Limay	Miraflor	El Sauce	Nagarote	Tolapa	Refugio Bartola
Emballonuridae							
*Centronycteris centralis**							1
Noctilionidae							
Noctilio albiventris	4			5			
Noctilio leporinus				4			
Mormoopidae							
Pteronotus gymnonotus		4		2			
Pteronotus mesoamericanus		5					
*Pteronotus psilotis**	1	1		1			
Phyllostomidae							
Desmodus rotundus	2	6					
Diphylla ecaudata		2					
Lophostoma nicaraguae						1	
Macrophyllum macrophyllum	1						
Glossophaga commissarisi						1	7
Glossophaga leachii							
Glossophaga mutica						5	
Carollia castanea							2
Carollia perspicillata	11	14			4	33	2
Carollia sowelli							3
Carollia subrufa						7	
Artibeus jamaicensis	24				6	18	
Artibeus lituratus	2					2	4
*Artibeus inopinatus**	1				1		
Artibeus intermedius	2						1
Dermanura azteca			1				
Dermanura toltecus			2				
Dermanura watsoni	5			1		25	2
Sturnira parvidens	1					1	
Uroderma convexum	4			1		34	
*Uroderma davisi**						1	
Molossidae							
Molossus alvarezi						1	
Molossus molossus	9						
Molossus nigricans				2			
Natalidae							
Natalus mexicanus		11					
Vespertilionidae							
Rhogeessa bickhami	1					2	
Myotis nigricans							1

All captured individuals were clearly identified based on having smaller forearm lengths (< 43 mm) compared to other hairy-backed *Pteronotus* species from Nicaragua. Forearm length for this species ranges from 40.8 to 45 mm, 55 to 63 mm for *P. mesoamericanus*, and 43 to 48 mm for *P. personatus* (Reid 2009; Pavan 2019).

Artibeus inopinatus Davis and Carter 1964. On February 2, 2018, we captured an adult male (Figure 3a; USACF000024; FA 53mm; HF 15 mm; Wt 37 g) covered by yellow pollen which we presume came from Poro-poro trees (*Cochlospermum vitifolium*) which were blooming and abundant in the area. The site was in Nagarote, León department (12°16'4.44"N, 86°30'4.68"W; 85 m). On March 9, 2024, a second adult male individual (USACF000023; FA 50mm; Wt 31 g) was captured in Rodeo Grande, Department of Chinandega (13° 8'38.76"N, 86°48'18.36"W; 123 m).

Figure 2. New bat records of Emballonuridae and Mormoopidae from Nicaragua. **a.** *Centronycteris centralis* Thomas 1912, USACF000020, from Refugio Bartola, Rio San Juan. **b.** *Pteronotus psilotis* (Dobson 1878), USACF000021, from El Sauce, León. Photos: Martínez-Fonseca JG.

Capture was on a mist net set over El Gallo riverbed (mostly dry at this time) and surrounded by lowland arid forest and cropland. *Artibeus inopinatus* is often confused with smaller *A. jamacensis* (Turcios-Casco *et al.* 2020). However, the captured individuals match the typical forearm length of *A. inopinatus* that ranges from 48 to 53 mm (Reid 2009; Medina-Fitoria 2014; Solari *et al.* 2019) and had faint facial stripes and evident hair fringes on the uropatagium. The only other species of *Artibeus* that have similar forearm sizes and occur in the area are *A. jamaicensis* (FA 55–67 mm), which lacks a hair fringe on the uropatagium, and *A. watsoni* and *A. phaeotis* (both with FA 35–41 mm); the latter two also have conspicuous facial stripes.

Dermanura azteca K. Andersen 1909. On July 16, 2016, we captured an adult male (Figure 3b; USACF000022) in Finca Beylla Vista in Miraflor, Estelí (13°15'5.04"N, 86°13'47.28"W; 1479 m). Our individual had a charcoal-brown body color, which is similar only to the similar sized *D. tolteca* and *Enchisthenes hartii* (Reid 2009). However, unlike *A. tolteca*, our individual had longer forearm (43 mm), greater mass (29 g), longer dorsum fur, and a distinctively short but hairy tail membrane with long hairs (~5mm) along the edge (Solari et al. 2019). Unlike *E. hartii*, the captured individual had larger forearms, had unfused upper lip with nose leaf, and lacked the "dirty whitish" facial stripes (Reid 2009).

Uroderma davisi R. J. Baker and McDaniel 1972. On March 8, 2024, an adult male (Figure 3c; USACF000025; FA 40 mm, E 16 mm, HF 11 mm, Wt 14 g) was captured in Tolapa, León department (12°35'58.56"N, 86°33'6.84"W; 87 m). The captured individual of *U. davisi* is distinguished from *U. magnirostrum* by the presence of well-marked facial stripes, which are faint or indistinguishable in the latter (Reid 2009; Solari *et al.* 2019). Unlike *U. davisi* and *U. convexum*, *U. magnirostrum* can also be distinguished by its deep rostrum, which forms a continuation of the forehead, creating a "gradual, nearly straight-line slope between the crown and tip of snout" (Solari *et al.* 2019). Karyotype analysis of the individual of *U. davisi* is consistent with the original descriptions of the holotypes (48 fundamental arms in autosomal complement and 44 diploid) by Baker

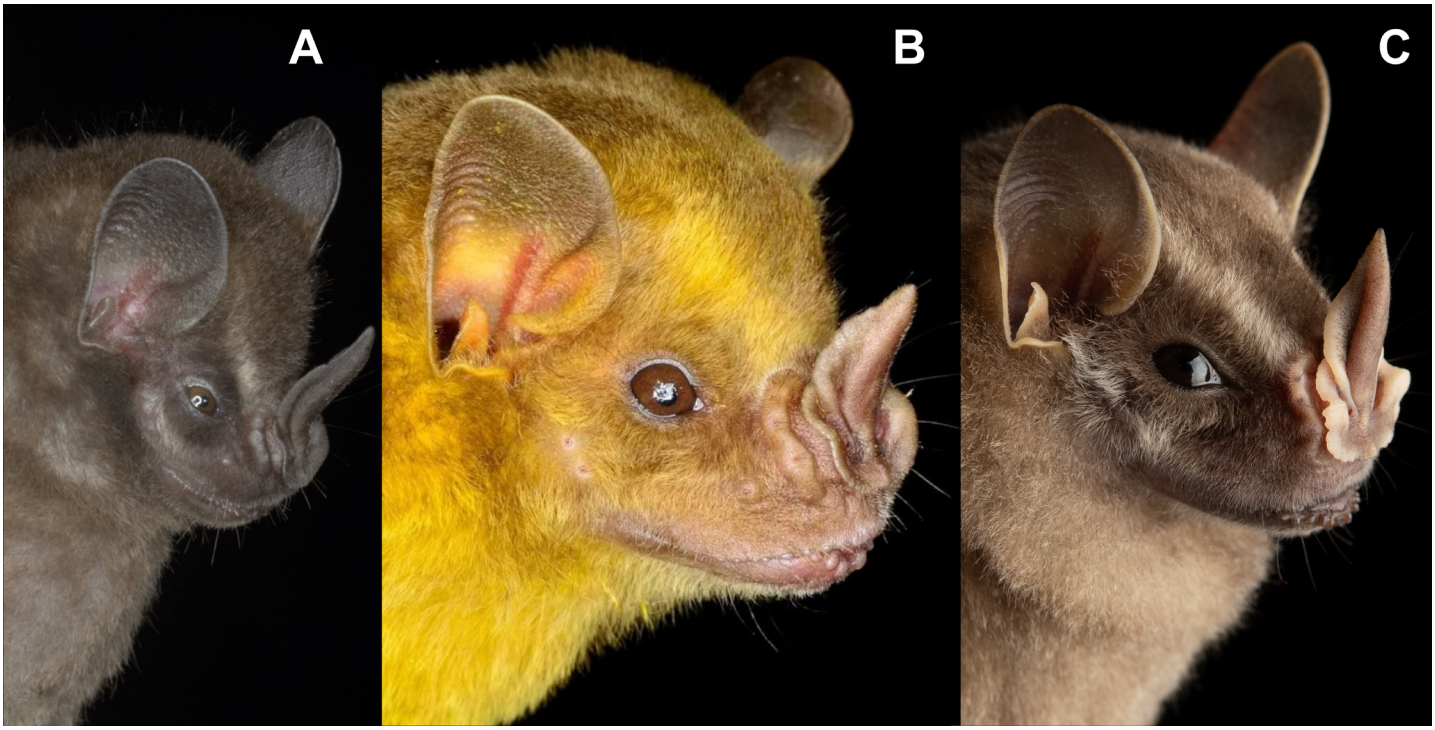

Figure 3. New records of Stenodermatinae from Nicaragua. **a.** *Artibeus inopinatus* Davis and Carter 1964, USACF000024 from Nagarote, León (covered in yellow pollen). **b.** *Dermanura azteca* K. Andersen, 1909, USACF000022 from Miraflor, Estelí. **c.** *Uroderma davisi* R. J. Baker and McDaniel 1972, USACF000025 from Tolapa, León. Photos: Aguirre-Obando YS (A-B); Martínez-Fonseca JG (C).

and McDaniel (1972) and differs from that of *U. convexum* (44 fundamental and 38 diploid). Two individuals of *U. convexum* from the same locality were also confirmed to have the expected chromosomal structure. *Uroderma davisi* can be further distinguished from the superficially similar *U. convexum* by the relatively concave, short rostrum and less prominent forehead (Mora 2017). Additionally, only the base of the tragus and ears are tinted yellow, whereas those of *U. convexum* are "prominently edged with yellow or white" and much more evident (Reid 2009). *Uroderma davisi* also averages smaller forearm lengths (40–43 mm) than *U. convexum* (40-46 mm; Baker and McDaniel 1972; Solari *et al.* 2019). The individual of *U. davisi* was browner in color than the other *U. convexum* of the same locality.

Our fieldwork yielded novel records for five bat species in Nicaragua that help fill important gaps in the known distribution of the species in Central America. For *C. centralis*, this represents the fourth confirmed locality for the country (Martínez-Fonseca *et al.* 2020). The current records of *P. psilotis* represent the first confirmed localities for the species in Nicaragua close to the Honduras-Nicaragua border (8-50 km) and confirms a contact zone between *P. personatus* and *P. psilotis* (Martínez-Fonseca *et al.* 2020; Arias-Aguilar and Ramos-Pereira 2022). Although *D. azteca* has been listed as expected to occur in the highlands of the country (Medina-Fitoria and Saldaña-Tapia 2012; Medina-Fitoria 2014; Martínez-Fonseca *et al.* 2020), our record represents the first official record between Honduras and Costa Rica.

The record for *U. davisi* in Nicaragua expands the distribution of the species southwards ca. 128 km from the closest record in Honduras (GBIF.org 2024b). *Uroderma davisi* has been listed as expected to occur in the lowlands of the Pacific of Nicaragua by several authors (see Medina-Fitoria 2014; Martínez-Fonseca *et al.* 2020) with a zone of sympatry with *U. convexum* suggested across El Salvador, Honduras, and Nicaragua (Baker and McDaniel 1972). Hybridization between the two species may also occur in this region (Barton 1982; Mantilla-Meluk 2014). Finally, both of our records of *A. inopinatus* represent new localities between previous Nicaraguan records and the recent locality from northern Costa Rica (Artavia Durán *et al.* 2023).

With the recent additions of *P. fulvus* (see Medina-Fitoria *et al.* 2020; Méndez-Rodríguez *et al.* 2021; Martínez-Fonseca *et al.* 2022) and the validity of *A. intermedius* as a species separate from *A. lituratus* (Perea-Martínez *et al.* 2013; Hedrick 2021; López-Cuamatzi *et al.* 2024) our records elevate the number of bat species in Nicaragua to 116. Our work contributes to the knowledge of *D. azteca* which is catalogued by International Union for Conservation of Nature (IUCN) as Least Concern (Solari 2016), and the Data Deficient *A. inopinatus* (Reid and Medina 2016). Currently, IUCN assessment for *C. centralis* (Arroyo-Cabrales *et al.* 2015), *P. psilotis* (Davalos *et al.* 2016), and *U. davisi* (Solari 2019) do not reflect the recent taxonomic splits.

Our findings highlight the outstanding biodiversity of Nicaragua and the need for additional sampling efforts in areas that historically have not been the focus of research. Currently, at least an additional 9 bat species are likely to be recorded in the country based solely on proximity to the Nicaraguan borders of Honduras, Costa Rica, or both

countries (Mora 2012; Martínez-Fonseca *et al.* 2020). The advances and ever-changing taxonomy and nomenclature based on genetic, morphological, and behavioral evidence of neotropical bats might continue to increase the number of bat species in Nicaragua and the rest of Central America.

Acknowledgements

We want to thank The Rufford Foundation (grants 40860-1; 463010-2) for providing the funding necessary for conducting fieldwork and data collection. We thank Karla Samantha Orellana Arévalo at USAC for providing voucher numbers and to Yuri S. Aguirre-Obando for providing photographs and additional information on some records. We thank Charles Hood, Nancy Brennan-Dubbs, Mary DeJong, Ian Harrison, and Rusty Brennan for their support during fieldwork. We also thank the Ministerio de Ambiente y Recursos Naturales (MARENA) for providing research permits for this study.

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Associate editor: Romeo A. Saldaña Vázquez
Submitted: August 28, 2025; Reviewed: October 22 2025.
Accepted: November 20, 2025;
Published on line: March 21, 2026.