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# First records of *Phyllostomus hastatus* (Pallas, 1767) (Chiroptera, Phyllostomidae), Greater Spear-nosed Bat, in Mexico

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**Abstract.** We report *Phyllostomus hastatus* (Pallas, 1767), Greater Spear-nosed Bat, for the first time in Mexico. We captured two adult males in the Lacandona rainforest, in Chiapas, Mexico. These records extend the known northern distribution limit of the species by 120 km from the nearest occurrence in Lanquín, Alta Verapaz, Guatemala. Given the limited distribution of *P. hastatus* in the country and its potential vulnerability due to habitat loss, we highlight the need for more studies and conservation actions, aiming to its inclusion in the national list of threatened species.

**Key words.** Bat ecology, Lacandona rainforest, range extension, roosting behavior, species conservation

**Aranda-Coello JM, Hernández-Mijangos LA, Weber M** (2025) First records of *Phyllostomus hastatus* (Pallas, 1767) (Chiroptera, Phyllostomidae), Greater Spear-nosed Bat, in Mexico. Check List 21 (4): 652–657. https://doi.org/10.15560/21.4.652

## INTRODUCTION

The genus *Phyllostomus* Lacépède, 1799 was the first recognized group of Neotropical leaf-nosed Bats (family Phyllostomidae) (Rodriguez-Posada and Sanchez-Palomino 2009). Currently, four species are classified within this genus: *Phyllostomus discolor* (Wagner, 1843), *P. elongatus* (É. Geoffroy Saint-Hilaire, 1810), *P. hastatus* (Pallas, 1767), and *P. latifolius* (Thomas, 1901) (Kwiecinski 2006).

*Phyllostomus hastatus*, whose common name is Greater Spear-nosed Bat, is similar in size to *Chrotopterus auritus* (Peters, 1856) and *Phylloderma stenops* (Peters, 1865), making it the second-largest Neotropical bat species in the Americas, surpassed only by *Vampyrum spectrum* (Linnaeus, 1758) (Santos et al. 2003). It is the largest species within the genus *Phyllostomus* (forearm length: $\bar{x} = 83.17$ mm $\pm$ 2.02 SD, $n = 80$; weight: $\bar{x} = 100.96$ g $\pm$ 9.25 SD, $n = 38$), with a wingspan reaching up to 60 cm (Santos et al. 2003).

*Phyllostomus hastatus* is an omnivorous bat species (Gardner 1977; Santos et al. 2003). According to Santos et al. (2003), this species presents triangular, pointed ears; a simple, well-developed nasal leaf; an unfused horseshoe structure from the upper lip; and a lower lip with a V-shaped groove bordered by warty protuberances; its wings are relatively large and well developed, adapted for long-distance flight. The tail is short, and the calcars are similar in length to the hind limbs. The wing membranes, ears, and face are black, while the dorsal and ventral fur is dark brown to reddish brown, but some individuals exhibit a golden hue.

*Phyllostomus hastatus* uses various types of diurnal roosts such as caves, hollow trees, termite nests, palm leaves, and man-made structures (Graham 1988; Costa et al. 2010; Cortés-Delgado and Jiménez 2014). Individuals can roost alone, in pairs, in harems, or in male-only groups (Costa et al. 2010). It has been reported to cohabit roosts with species from the genera *Carollia* Gray, 1838, *Chrotopterus* Peters, 1865, *Desmodus* Wied-Neuwied, 1826, *Diaemus* Miller, 1906, *Glossophaga É. Geoffroy Saint-Hilaire, 1818*, *Lonchophylla* Thomas, 1903, *Lophostoma* d'Orbigny, 1836, *Micronycteris* Gray, 1866, *Molossus É. Geoffroy*, 1805, *Myotis* Kaup, 1829, *Platyrrhinus* Saussure, 1860, *Pteronotus* Gray, 1838, *Peropteryx* Peters, 1867, and *Saccopteryx* Illiger, 1811 (Graham 1988; Santos et al. 2003; Costa et al. 2010; Cortés-Delgado and Jiménez 2014).

This species is widely distributed across the Neotropical region, from Peru, Bolivia, and Brazil north to Guatemala and Belize (Bárquez and Díaz 2015). Its northwestern range was recently extended to Guatemala (Kraker-Castañeda et al. 2023). Two allopatric subspecies are currently recognized (Santos et al. 2003). The distribution of *P. h. hastatus* extends from eastern Venezuela to northern Bolivia and southeastern Brazil,

OPEN ACCESS

**Academic editor:** Roberto Leonan Novaes
**Received:** 12 May 2025
**Accepted:** 1 July 2025
**Published:** 14 July 2025

while *P. h. panamensis* is present from Guatemala to Peru and western Venezuela (Santos et al. 2003; Kraker-Castañeda et al. 2023). Typically, this species occurs in lowland areas, but it has also been recorded at elevations up to 1,900 m a.s.l. (Graham 1983). It inhabits diverse environments, including deciduous forests, evergreen tropical forests, and anthropogenically disturbed clearings (Santos et al. 2003).

In Mexico, the only species of the genus *Phyllostomus* previously recorded is *P. discolor* (Ceballos et al. 2005; Ramírez-Pulido et al. 2005), which is a smaller species (forearm length: $\bar{x} = 61.96$ mm ± 1.62 SD, $n = 143$; weight: $\bar{x} = 37$ g ± 4.03 SD, $n = 75$, own data) compared to *P. hastatus*. Here, we confirm the presence of *P. hastatus* in Mexico, with a consequent northern range extension.

## METHODS

As part of the project "Flavivirus in Wild Mammals with Zoonotic and Anthropozoonotic Potential in the Southern Region of the Lacandona rainforest, Chiapas, Mexico" we conducted bat sampling along the banks of the Lacantún River (municipality of Marqués de Comillas, Chiapas, Mexico) (Figure 1). The municipality of Marqués de Comillas is characterized by a warm and wet weather with yearly average temperatures between 24 and 26 °C, and precipitation of 2,000–3,000 mm per year, with a dry season that occurs from January to April and wet season from May to December (Carabias et al. 2021). The predominant vegetation in Marqués de Comillas is the high tropical rainforest, with trees reaching 30–50 m in height; among the notable tree species are *Terminalia Amazonia* (J.F.Gmel.) Exell, *Dialium guianense* (Aubl.) Sandwith, *Moquilea platypus* Hemsl., *Schizolobium parahyba* (Vell.) S.F.Blake, *Ficus* spp., *Swietenia macrophylla* King, and *Ceiba pentandra* (L.) Gaertn. (Miranda and Hernández-X 2014; Carabias et al. 2021).

During April and July 2024, we placed a homemade double-frame harp trap in front of a hollow tree roost located on the trunk of a *Ceiba pentandra* (L.) Gaertn. tree (16.33°N, 90.8393°W). Additionally, a 3 × 3 m mist net was set up behind the harp trap. Both the harp trap and mist net remained active between 17:00 and 21:00 h. Captured bats were handled following the American Society of Mammalogists' guidelines for the use of wild mammals in research and education (Sikes 2016), and the biosafety protocol outlined in the Investigating the Role of Bats in Emerging Zoonoses manual (FAO 2011).

Captured bats were temporarily contained inside a cotton holding bag. Somatic measurements were recorded using a digital caliper (SureBilt®, China; maximum range: 150 mm, precision: 0.01 mm). Measures included total body length, tail length, right hind foot length, right ear length, and forearm length. Weight was measured using a Medio Line spring scale (Pesola®, Switzerland; capacity: 300 g, precision: 2 g). Taxonomic identification was conducted using the field guide by Medellín et al. (2009). Photographs were also taken of the captured bat prior to its release. All bats were released at the capture site. The study was carried out under scientific collection permit No. F00-DRFSIPS/OTA/036/2022, provided by the Secretaría de Medio Ambiente y Recursos Naturales.

## RESULTS

***Phyllostomus hastatus* (Pallas, 1767)**
Figures 1, 2

**New records.** MEXICO — Chiapas • Marqués de Comillas; 16.33°N, 090.8393°W; 130 m a.s.l.; 27.IV.2024; J.M. Aranda-Coello obs.; 1 ♂ adult, scroted testicles; somatic measurements: 92.3-19-20-20.3≡132, FA = 90.1 mm; captured in hollow tree roost of a *Ceiba pentandra* tree; from the same roost, we also captured eight individuals of *Saccopteryx bilineata* (Temminck, 1838), four of *Carollia sowelli* Baker, Solari & Hoffmann, 2002, two of *C. perspicillata* (Linnaeus, 1758), and one of *Noctilio leporinus* (Linnaeus, 1758) • same locality; 30.VII.2024; J. M. Aranda-Coello obs.; 1 ♂ adult; somatic measurements: 110-?-20-20.2≡144, FA = 94 mm; we also captured six individuals of *C. perspicillata*, four of *Trachops coffini* Goldman, 1925, two of *Saccopteryx bilineata*, one of *C. sowelli*, and one of *Desmodus rotundus* (É. Geoffroy, 1810), all of them shared the roost with the *P. hastatus* individual.

**Identification.** Among the most distinctive features of the unidentified bats were the presence of a well-developed nose leaf, the presence of a tail, a forearm length of 90.1 and 94.0 mm, respectively, and a generally dark brown skin and fur coloration. Based on these characteristics, we subsequently identified the individuals as *Phyllostomus hastatus* (Santos et al. 2003; Reid 2009). We confirmed that the coloration, morphological characteristics, body length, and weight of the captured *P. hastatus* individuals aligned with the values reported by Timm et al. (1999), Santos et al. (2003), Reid (2009), and Kraker-Castañeda et al. (2023).

Among the large-bodied phyllostomid bat species known in Mexico and distributed within the Lacandona rainforest, only *Chrotopterus auritus* has a forearm length that could match the measurements of the captured individuals of *Phyllostomus hastatus*. However, *C. auritus* has significantly larger ears (40–48 mm)

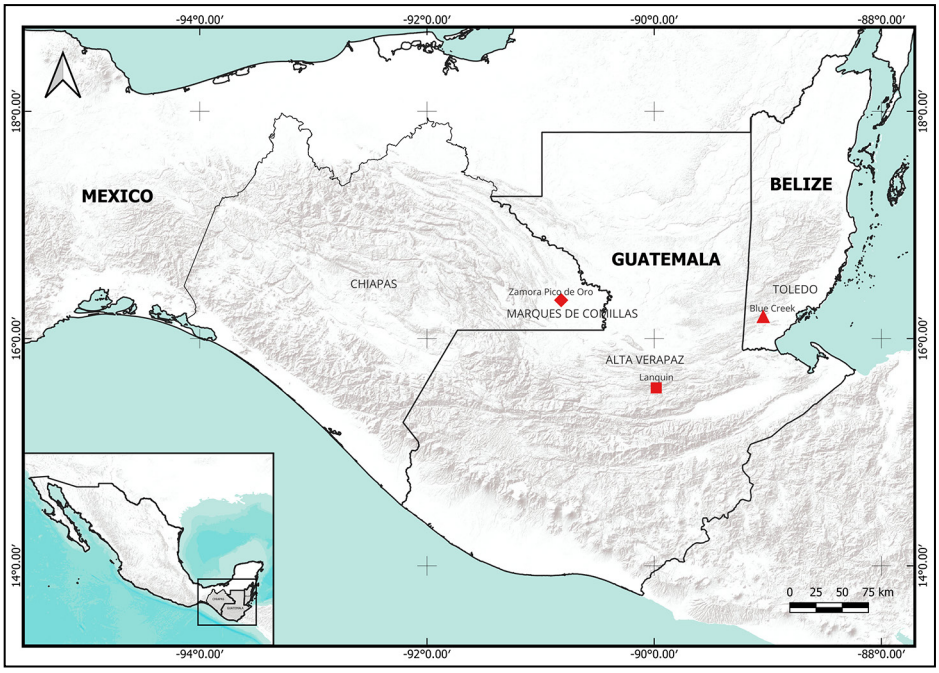


**Figure 1.** New records of *Phyllostomus hastatus* in Marqués de Comillas, Chiapas, Mexico (red diamond) and closest previous records: Alta Verapaz, Guatemala (red square); Blue Creek Village, Belize (red triangle). The map was produced in QGIS v. 3.32.3 (QGIS.org 2023).

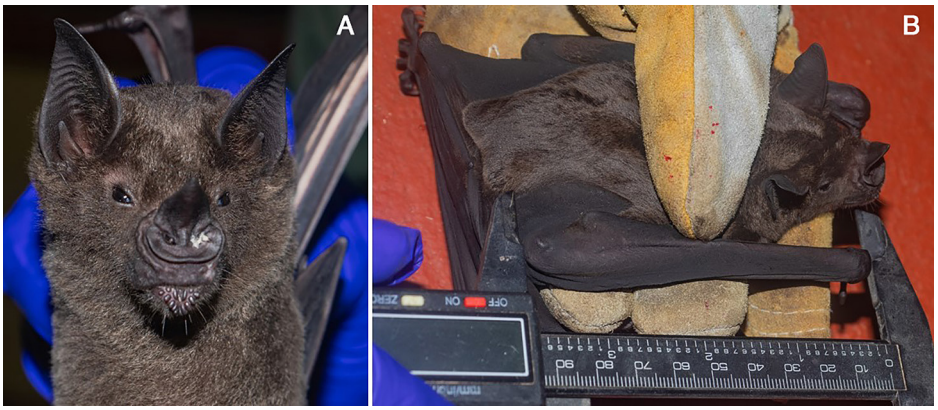


**Figure 2.** Adult male *Phyllostomus hastatus* captured on 30 July 2024, in the Lacandona rainforest, Chiapas, Mexico. **A.** Facial view. **B.** Forearm length measurement.

and longer, woollier fur. *Vampyrum spectrum*, the largest bat in the Americas, has a longer forearm (>98 mm), larger ears (39–49 mm), lacks a tail, and possesses an elongated snout. Meanwhile, *Phylloderma stenops* has a shorter forearm (<83 mm) and distinctive white wingtips (Reid 2009).

## DISCUSSION

With the present record of *Phyllostomus hastatus* in Chiapas, Mexico, we extend the known northern distribution range of this species by 120 km from the nearest documented occurrence in Lanquín, Alta Verapaz, Guatemala (Bárquez and Díaz 2015; Kraker-Castañeda et al. 2023), and 190 km from the Blue Creek Village record, in Belize (Jennings 2024). This finding increases the number of bat species recorded in Mexico to 146 (ASM 2025) and in Chiapas to 108 (Hernández-Mijangos 2017; López-Cuamatzi et al. 2022).

Our study adds *Ceiba pentandra* to the list of tree species used by *P. hastatus* as a diurnal roost. Previous studies have documented the use of tree cavities as roosts in *Anacardium excelsum* (Bertero ex Kunth) Skeels in Colombia (Cortés-Delgado and Jiménez 2014), *Agonandra brasiliensis* Miers ex Benth. & Hook.f. in Brazil (Esbérard et al. 2003), and *Copernicia alba* Morong palms in Bolivia (Aguirre 2007). The hollow tree where the two *P. hastatus* individuals were captured is located in a pastureland area along the banks of the Lacantún River. On the opposite side of the river lies the boundary of the Montes Azules Biosphere Reserve, which harbors an extensive, well-preserved tract of tropical rainforest. Moreover, this region of the Lacandona rainforest is designated as an Area of Importance for Bat Conservation (AICOM A-MX-018 Selva Lacandona), highlighting its significance for bat conservation in Mexico (Hernández-Mijangos 2022).

Although little is known about its use of tree cavities as diurnal shelters, *P. hastatus* is considered a generalist species in its roosting habits (Graham 1988; Santos et al. 2003), Other bat species previously found roosting in *Ceiba pentandra* cavities in Chiapas include *Carollia subrufa* (Hahn, 1905), *Desmodus rotundus*, *Noctilio leporinus*, and its congener *P. discolor* (Hernández-Mijangos et al. 2011). The roost used by *P. hastatus* in the Lacandona rainforest was shared with *Carollia perspicillata*, *C. sowelli*, *Desmodus rotundus*, *Trachops coffini*, *Saccopteryx bilineata*, and *Noctilio leporinus*. Previous studies have reported *P. hastatus* sharing roosts with *C. perspicillata*, *D. rotundus*, and *S. bilineata* (Graham 1988; Cortés-Delgado and Jiménez 2014). Therefore, our findings provide novel evidence of *P. hastatus* roosting alongside *C. sowelli*, *T. coffini*, and *N. leporinus*.

The presence of *P. hastatus* in the Lacandona rainforest is unlikely to be incidental, as individuals of this species have been captured on different dates, suggesting that the species may already be well established in the area. Notably, the individual captured in April had scrotal testes, indicating that the species is reproductively active in the region. Given that this may represent the only population of *P. hastatus* in Mexico, efforts should be made to include the species in Mexico's list of protected and threatened species, as has been done for other large-bodied phyllostomid bats (DOF 2019). We suggest further ecological and genetic studies to provide more information of the population of this species.

Furthermore, considering that the Lacandona rainforest has undergone extensive deforestation and landscape modifications over the past 40 years due to human population growth, habitat loss, and illegal resource extraction (Medellín 1994; Mendoza and Dirzo 1999; De Jong et al. 2000), conservation actions for this newly recorded population are urgently needed. It is noteworthy to mention that both *P. hastatus* captured tested negative to seroneutralization tests for orthoflaviviruses and alphaviruses, while other bat species cohabiting in the roost tested positive (but see Aranda-Coello et al. 2025).

## ACKNOWLEDGEMENTS

The study was supported by the Secretaría de Ciencia, Humanidades, Tecnología, e Innovación of Mexico, the Instituto de Ciencia, Tecnología, e Innovación del Estado de Chiapas, and Natura y Ecosistemas Mexicanos, A. C. The authors would like to thank the staff of Biological Station Tzendales for providing logistical support. We are also thankful to Joaquín Arroyo-Cabrales, Cristian Kráker-Castañeda, Juliana Rodrigues, and Roberto Leonan M. Novaes for their revisions and for their useful suggestions that improved the manuscript.

## ADDITIONAL INFORMATION

### Conflict of interest

The authors declare that no competing interests exist.

### Ethical statement

Captured bats were handled following the American Society of Mammalogists' guidelines for the use of wild mammals in research and education (Sikes 2016) and the biosafety protocol outlined in the Investigating the Role of Bats in Emerging Zoonoses manual (FAO 2011).

### Funding

This study was financially supported by Secretaría de Ciencia, Humanidades, Tecnología, e Innovación of Mexico, the Instituto de Ciencia, Tecnología, e Innovación del Estado de Chiapas, and Natura y Ecosistemas Mexicanos, A.C.

### Author contributions

Conceptualization: JMAC, LAHM. Funding acquisition: JMAC. Investigation: JMAC. Methodology: JMAC, LAHM. Resources: JMAC. Validation: LAHM. Writing – original draft: JMAC, LAHM. Writing – review and editing: LAHM, MW.

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### Data availability

All data that support the findings of this study are available in the main text.

## REFERENCES

**Aguirre LF** (2007) Historia natural, distribución y conservación de los murciélagos de Bolivia. Centro de Ecología y Difusión Fundación Simón Patiño, Sirena, Bolivia, 416 pp.

**ASM** (American Society of Mammalogist) (2025) Mammal diversity database (version 2.1). https://www.mammaldiversity.org. Accessed on: 2025-04-02.

**Aranda-Coello JM, Machain-Williams C, Weber M, Dzul Rosado AR, Simpkins TR, Blitvich BJ** (2025) Serologic surveillance for orthoflaviviruses and chikungunya virus in bats and opossums in Chiapas, Mexico. Viruses 17: 590. https://doi.org/10.3390/v17050590

**Bárquez R, Díaz M** (2015) *Phyllostomus hastatus*. The IUCN Red List of Threatened Species 2015: e.T17218A221359. https://www.iucnredlist.org/search?query=Phyllostomus%20hastatus&searchType=species. Accessed on: 2025-04-02.

**Carabias J, Meli P, Castro E, de la Maza J, Cadena R** (2021) Naturaleza y servicios ecosistémicos sanos: condición para el bienestar en la Selva Lacandona, México, In: Rincón-Ruiz A, Arias-Arévalo P, Clavijo-Romero M (Eds.) Hacia una valoración incluyente y plural de la biodiversidad y los servicios ecosistémicos: visions, avances y retos en América Latina. Centro Editorial-Facultad de Ciencias Económicas, Bogotá, Colombia, 229–250.

**Ceballos G, Arroyo-Cabrales J, Medellín RA, Domínguez-Castellanos Y** (2005) Lista actualizada de los mamíferos de México. Revista Mexicana de Mastozoología 9: 21–71. https://doi.org/10.22201/ie.20074484e.2005.9.1.153

**Cortés-Delgado N, Jiménez L** (2014) Descripción de un refugio usado por *Phyllostomus hastatus* (Chiroptera: Phyllostomidae) en la Serranía del Perijá, La Guajira, Colombia. Revista Interdisciplinar de Estudios en Ciencias Básicas e Ingeniería 1 (2): 10–14.

**Costa LM, Lourenço EC, Esbérard CE, Silva RM** (2010) Colony size, sex ratio and cohabitation in roosts of *Phyllostomus hastatus* (Pallas) (Chiroptera: Phyllostomidae). Brazilian Journal of Biology 70 (4): 1047–1053. https://doi.org/10.1590/S1519-69842010000500019

**De Jong BHJ, Ochoa-Gaona S, Castillo-Santiago MA, Ramírez-Marcial N, Cairns MA** (2000) Carbon flux and patterns of land-use/land-cover change in the Selva Lacandona, Mexico. Ambio 29 (8): 504–511. https://doi.org/10.1579/0044-7447-29.8.504

**DOF** (Diario Oficial de la Federación) (2019) Modificación del Anexo Normativo III, Lista de especies en riesgo de la Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-Especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo, publicada el 30 de diciembre de 2010. Diario Oficial de la Federación, 14 de noviembre de 2019. https://www.dof.gob.mx/nota_detalle_popup.php?codigo=5578808. Accessed on: 2024-12-14.

**Esbérard C, Motta A, Oliveira D, Areas A, Rodrigues R, Bergallo H** (2003) Observação de fidelidade ao abrigo em *Molossus rufus* no Estado do Rio de Janeiro, Sudeste do Brasil. Chiroptera Neotropical 9: 175–178.

**FAO** (Food and Agriculture Organization of the United Nations) (2011) Investigating the role of bats in emerging zoonoses: balancing ecology, conservation and public health interests. Edited by S.H. Newman, H. Field, J. Epstein, and C. de Jong. FAO Animal Production and Health Manual No. 12. Food and Agriculture Organization of the United Nations. Rome, Italy, 169 pp.

**Gardner AL** (1977) Feeding habits. In: Baker RJ, Jones, JK Jr., Carter DC (Eds.) Biology of bats of the New World family Phyllostomidae, Part II. Special Publications, The Museum, Texas Tech University Press, Texas, USA, 293–350. https://doi.org/10.5962/bhl.title.142603

**Graham, GL** (1983) Changes in bat species diversity along an elevational gradient up the Peruvian Andes. Journal of Mammalogy 64: 559–571. https://doi.org/10.2307/1380511

**Graham GL** (1988) Interspecific associations among Peruvian bats at diurnal roost sites. Journal of Mammalogy 69 (4): 711–720. https://doi.org/10.2307/1381626

**Hernández-Mijangos LA** (2017) El murciélago en mis manos: Guía ilustrada para la identificación de murciélagos Neotropicales. Editorial Académica Española, Saarbrücken, Germany, 100 pp.

**Hernández-Mijangos LA** (2022) AICOM A-MX-018 Selva Lacandona. In: Barquez RM, Aguirre LF, Nassar JM, Burneo SF, Mancina CA, Díaz MM (Eds.) Áreas y Sitios de Importancia para la Conservación de los Murciélagos en Latinoamérica y El Caribe. RELCOM, Tucumán, Argentina, 141.

**Hernández-Mijangos LA, Zárate-Gálvez K, Reyes-Hartmann C** (2011) Murciélagos refugiados en las comunidades de Ceniceros y Salto de Agua, Reserva de la Biosfera La Encrucijada, Chiapas, México: Manual de Identificación. Tierra Verde Naturaleza y Cultura, A. C., Chiapas, Mexico, 47 pp.

**Jennings R** (2024) WNMU mammal collection (Arctos). Version 32.91. Western New Mexico University. https://doi.org/10.15468/gcld3d. Accessed on 2025-03-26.

**Kraker-Castañeda C, Nuñez L, Guzmán G, Arévalo AL, Pernillo L, Pérez-Consuegra SG** (2023) Ampliación del límite noroeste de distribución de *Phyllostomus hastatus* y descripción de sus pulsos de ecolocalización. Therya Notes 4 (2): 60–67. https://doi.org/10.12933/therya_notes-23-107

**Kwiecinski GG** (2006) *Phyllostomus discolor*. Mammalian Species 801: 1–11.

**López-Cuamatzi IL, Hortelano-Monacada Y, Ortega J, Ospina-Garcés SM, Zúñiga G, MacSwiney MC** (2022) Extension of the distribution of Townsend's Big-eared Bat, *Corynorhinus townsendii* (Cooper, 1837) (Chiroptera, Vespertilionidae), to Chiapas, Mexico. Check List 18 (2): 335–339. https://doi.org/10.15560/18.2.335

**Medellín RA** (1994) Mammal diversity and conservation in the Selva Lacandona, Chiapas, Mexico. Conservation Biology 8: 780–799. https://doi.org/10.1644/801.1

**Medellín RA, Arita HT, Sánchez O** (2009) Identificación de los murciélagos de México: Clave de campo. Second edition. Instituto de Ecología, UNAM, Mexico, 78 pp.

**Mendoza E, Dirzo R** (1999) Deforestation in Lacandonia (southeast Mexico): evidence for the declaration of the northernmost tropical hot-spot. Conservation Biology 13: 967–977. https://doi.org/10.1023/a:1008916304504

**Miranda F, Hernández-X E** (2014) Los tipos de vegetación de México y su clasificación. Primera edición, conmemorativa del cincuentenario de la primera. Sociedad Botánica de México-Comisión Nacional para el Conocimiento y Uso de la Biodiversidad-Fondo de Cultura Económica. México, D.F., 220 pp.

**QGIS.org** (2023) QGIS Geographic Information System. QGIS Association. http://qgis.org.

**Ramírez-Pulido J, Arroyo-Cabrales J, Castro-Campillo A** (2005) Estado actual y relación nomenclatural de los mamíferos terrestres de México. Acta Zoológica Mexicana (n.s.) 21: 21–82. https://doi.org/10.21829/azm.2005.2112008

**Reid F** (2009) A field guide to the mammals of Central America & Southeast Mexico. Second edition. Oxford University Press, New York, USA, 346 pp.

**Rodríguez-Posada ME, Sánchez-Palomino P** (2009) Taxonomía del género *Phyllostomus* (Chiroptera: Phyllostomidae) en Colombia. Mastozoología Neotropical 16: 153–168.

**Santos M, Aguirre LF, Vázquez LB, Ortega J** (2003) *Phyllostomus hastatus*. Mammalian Species 722: 1–6. https://doi.org/10.1644/0.722.1

**Sikes, RS** (2016) Guidelines of the American Society of Mammalogists for the use of wild mammals in research and education. Journal of Mammalogy 97 (3): 663–688. https://doi.org/10.1093/jmammal/gyw078

**Timm RM, LaVal RK, Rodríguez-Herrera B** (1999) Clave de campo para los murciélagos de Costa Rica. Brenesia 52: 1–32.