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List of Dental Anomalies in Bats from Panama and First Report for Phyllostomus hastatus (Pallas, 1767)

Lista de anomalías dentales en murciélagos de Panamá y primer informe sobre *Phyllostomus hastatus* (Pallas, 1767)

Nelson Guevara

Fundación Biomundi. Panamá

nelson2295@hotmail.com https://orcid.org/0000-0002-3200-6648

Yosari Caceres

Universidad de Panamá, Facultad de Ciencias Naturales, Exactas y Tecnología. Panamá

giorenix36@gmail.com https://orcid.org/0009-0001-7884-4217

Mallory Salgado

Fundación Biomundi. Panamá

mallorysalgado04@gmail.com https://orcid.org/0009-0002-6268-026X

Adrián Cisneros

Fundación Biomundi. Panamá

adralexis23@gmail.com https://orcid.org/0009-0009-5429-9881

Manuela Pérez

Universidad de Panamá, Facultad de Ciencias Naturales, Exactas y Tecnología. Panamá

maperezge@gmail.com https://orcid.org/0009-0001-7612-5040

Bryan Vargas

Fundación Biomundi. Panamá

bryan26a26@gmail.com https://orcid.org/0009-0007-6450-7854

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Abstract

Dental anomalies in bats are of special interest due to the wide range of morphological variation among them. The first list of bat species with dental anomalies in Panama is presented. In addition, the known record for the species *Phyllostomos hastatus* is presented.

Keywords: animal taxonomy, mammals, morphology

Resumen

Las anomalías dentales en murciélagos son de especial interés debido al amplio rango de variación morfológica entre ellos. Se presenta la primera lista de especies de murciélagos con anomalías dentales en Panamá. Además, se presenta el registro conocido para la especie *Phyllostomos hastatus*.

Palabras clave: mamífero, morfología, taxonomía animal

INTRODUCTION

The origin of mammals is closely linked to the appearance and evolution of dentition (Bonaparte, 2009), although mammals share similar basic dental components, these vary in shape, size, and number depending on the species' diet (Kemp, 2005), leading to specific dental formulas that contribute to studies in ecology, paleontology, functional morphology, systematics, and the taxonomic diagnosis of genera and species (Bergqvist, 2003). However, a high frequency of dental anomalies is often found in wild individuals (Libardi & Percequillo, 2014), with bats being the group with the highest number of recorded anomalies among mammals (Ghazali & Dzeverin, 2010; Liposki-Biassi et al., 2020).

In bats, systematics and taxonomy are primarily based on the morphological characteristics of their teeth (Simmons & Jones, 2024), as their dental formulas can characterize all members of a family and even distinguish cryptic species (Díaz et al., 2021). Therefore, the existence of various types of dental anomalies, ranging mainly from additional teeth (polyodontia) to the lack or absence of teeth (oligodontia) (López-Aguirre, 2014), can

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result in misidentifications or misclassifications of groups, species, and the description of invalid taxa (Lanza et al., 2008; Esquivel-Melo et al., 2017).

According to López-Aguirre (2014), in the Neotropical region, the Phyllostomidae family has the highest number of reported dental anomalies, which may increase the likelihood of misidentified individuals, this is because leaf-nosed bats exhibit the greatest dental diversification, reflecting their wide variety of diets and feeding strategies (Esquivel-Melo et al., 2017; Wilson & Mittermeier, 2019).

Moreover, in genera such as *Artibeus*, it has been observed that *A. lituratus* presents the highest number of anomalies in the region (López-Aguirre, 2014). Additionally, exceptional cases have been reported in *A. jamaicensis*, where the number of teeth can vary depending on geographic distribution, even among relatively close populations in northern and southeastern Mexico (Davis, 1970). This highlights the importance of documenting and emphasizing cases of unusual or abnormal dentition (Ramírez-Pulido & Müdespache, 1987).

Phyllostomus hastatus (Pallas, 1767) is an omnivorous bat considered to be one of the largest species in the Americas (Cortés-Delgado, 2014). It has a broad distribution, ranging from southern Belize to Paraguay and northern Argentina (Guevara et al., 2024). It primarily inhabits caves, hollow trees, buildings, and termite nests (LaVal & Rodríguez-Herrera, 2002). Like other members of the genus *Phyllostomus*, its dental formula is I 2/2, C 1/1, P 2/2, M 3/3 (X2), with large upper incisors that leave no space between them and the canines (Aguirre, 2019).

Through this study, we present the first list of bats with dental anomalies in Panama, along with the first recorded case of a dental anomaly observed in an individual of the greater spear-nosed bat (*P. hastatus*).

MATERIALS AND METHODS

The captured specimens inhabit in the interior of Las Cuevas de Chilibre, located along the edge of the Boyd-Roosevelt Highway, also known as Transistmica Highway, in the town of Las Cuevas de Chilibre, Chilibre District, Panama Province (Coordinates: 9°10'34.63"N,

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79°36'59.62"W). The caves, at an elevation of 350 meters above sea level, are part of the Chilibre River and Chilibrillo River sub-basin in the eastern region of the Panama Canal Watershed.

The capture of the individuals took place on December 27, 2024, using a manual technique with a telescopic net, and they were identified based on the descriptions provided in the guides by Reid (2009), Wilson & Mittermeier (2019), and the taxonomic key by Díaz et al. (2021). Morphometric measurements and weight were recorded using a manual caliper and a scale with a range of 100g x 1g, respectively. Additional data collected included age, sex, and reproductive status.

The collection of the individuals was conducted under the research permit ARG-016-2023 issued by the Ministry of Environment of Panama and they remain in the custody of the researchers. The specimens are preserved through biological preparation of the skin and cleaning of the skull using 3% hydrogen peroxide and 3% sodium hypochlorite. The comparison and observation of cranial-dental structures were conducted based on the descriptions provided by Santos et al. (2003).

Finally, a bibliographic search of articles was conducted through the ISI Web of Knowledge and Scopus databases; and from the Google Scholar and ResearchGate platforms, only publications in national and international indexed journals were considered, listing bat species with reported records of dental anomalies in Panama. The following keywords were used: dental anomaly, Chiroptera, dental formula, bat, and Panama. Only a single article containing the relevant information was compiled.

RESULTS AND DISCUSION

An adult male individual of *Phyllostomus hastatus* in a non-reproductive state was identified, showing dental anomalies in the inner upper incisors and in the upper and lower molars on both sides of the maxilla and mandible, respectively. Morphometric measurements and weight: Body: 61 mm, Forearm: 40 mm, Tail: 33 mm, Ear: 15 mm, Leg: 9 mm, Tibia: 16 mm, Calcar: 15 mm, 13 g.

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The upper incisors were smaller than usual, showing large spaces between them and notable wear. Meanwhile, the upper molars, specifically M2 and M3 on the right side, and M1, M2, and M3 on the left side, were absent, with no visible alveoli and seemingly covered by secondary bone tissue (Figure 1).

At first glance, the lower molars appear to be absent on each side of the mandible. However, closer observation reveals that they are extremely reduced in each of their components, appearing as small fragments of fractured teeth. Additionally, there is notable wear on the crowns (Figure 2).

The bibliographic review revealed, two other cases of bats with dental anomalies in Panama have been reported, making this report of *P. hastatus* the third case recorded on the isthmus, all within the Phyllostomidae family (Table 1).

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Figure 1.

Dental anomalies recorded in the maxilla. A1, A2 and A3, individual with abnormal dentition; B1, B2 and B3, individual with normal dentition.

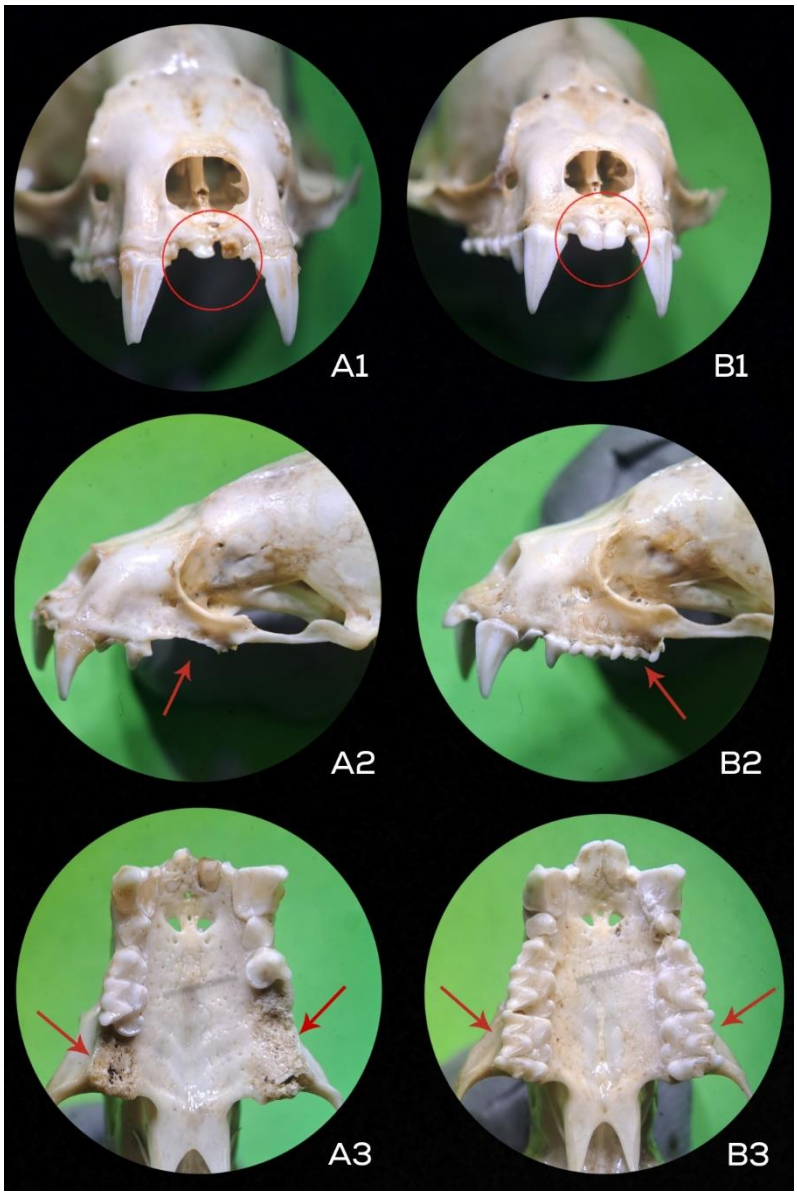

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Figure 2.

Dental anomalies recorded in the mandible. A4, A5, A6 and A7, individual with abnormal dentition; B4 and B5, individual with normal dentition.

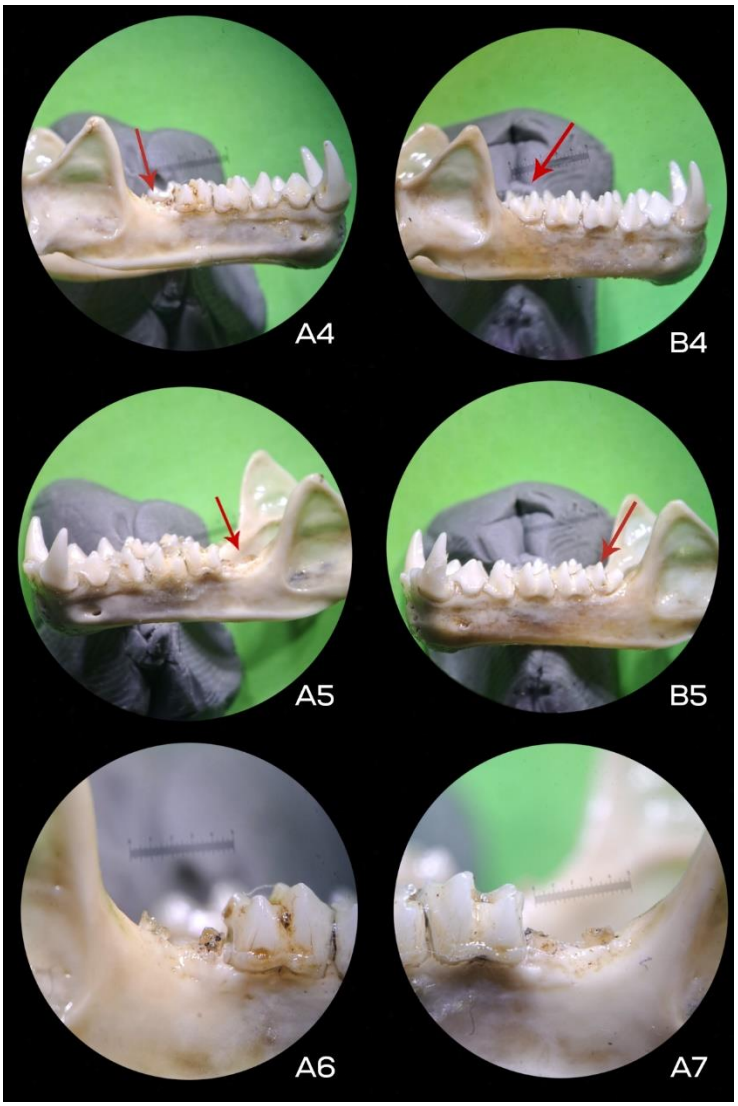

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Table 1.

Bats with dental anomalies in Panama.

Species	Taxonomic Update	Subfamily	Diet	Anomaly	Study
Lichonycteris obscura		Glossophaginae.	Nectarivore.	Polydontia.	Lanza et al. (2008).
Lonchophylla mordax	*Lonchophylla concava*	Lonchophyllinae.	Nectarivore.	Polydontia.	Lanza et al. (2008).
Phyllostomus hastatus		Phyllostominae.	Omnivore.	Microdontia, oligodontia, and dental agenesis.	Present.

According to the classifications of dental anomalies presented by Durante (1982), Martín-González et al. (2012), and Agurto et al. (2019), the *Phyllostomus hastatus* individual appeared to have microdontia in the inner upper incisors and oligodontia in the upper molars on each side of the maxilla. Furthermore, it showed relative dental agenesis in the lower molars on each side of the mandible.

Particularly in bats, reported dental anomalies are attributed to genetic, nutritional, pathogenic, and developmental factors (Hoff & Hoff, 1996). However, Martin (2007) mentions that in some cases, these anomalies may also result from physical injuries or mechanical stress. Nevertheless, no cranio-dental injuries were observed in the individual examined.

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It is also known that constant habitat pollution can cause severe diseases or morphological alterations in various organs and skeletal structures of mammals such as bats (Rodríguez et al., 2019). This could be one of the possible reasons for the anomaly found, as the caves are saturated with plastics, metals, and electronics, both on the ground and in the water, leading to relentless contamination of the area. However, it is difficult to determine with certainty which dental anomalies occur in each individual and their possible causes (Asahara et al., 2012). Regarding other anomalies documented in Panama by Laza et al. (2008), the in-situ condition at the time of specimen collection is unknown, so no possible cause is suggested.

On the other hand, most dental anomalies in Neotropical bats have been observed to correspond to oligodontia and polydontia in frugivorous, insectivorous, and nectarivorous species (Butler, 1995; López-Aguirre, 2014). Interestingly, although most cases pertain to the species *A. lituratus*, reports predominantly focus on various species of the genus *Myotis*. In contrast, within the family Phyllostomidae, most cases are attributed to nectarivorous species. This variability further complicates the establishment of a direct relationship between environment, diet, genetics, and evolutionary factors associated with the anomalies documented for a specific group (Rui and Drehmer, 2004; López-Aguirre, 2014).

The dental anomaly described here, like other cases previously reported in Panama involving a single individual, may be due to an isolated case or mutation within the population, as no other specimens with the mentioned types of anomalies were found in the study area. However, the analysis, preparation, and reporting of additional specimens with similar characteristics are essential to understanding the possible processes involved in the increase or absence of teeth in various individuals. This will also help prevent confusion and misidentification by anticipating these possible occurrences. Furthermore, we highlight this as the first reported case for an omnivorous bat and of the species *Phyllostomus hastatus*.

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