



# PALE SPEAR-NOSED BAT

*Phyllostomus discolor* (JA Wagner, 1843)



**FIGURE 1** - Adult (© Marco Mello, [www.casadosmorcegos.org](http://www.casadosmorcegos.org)).

**TAXONOMY:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Chiroptera; Suborder Microchiroptera; Superfamily Noctilionoidea; Family Phyllostomidae, Subfamily Phyllostominae, Tribe Phyllostomini (López-Gonzalez 2005, Myers et al 2006, Hoffman et al 2008). There are four species in this genus, two of which occur in Paraguay. The generic name *Phyllostomus* is Greek meaning “leaf mouth” in relation to the prominent nose leaf (Palmer 1904). The species name *discolor* is Latin meaning “variegated” or “of different colours” in relation to the variably tricoloured hairs of the dorsal pelage which give a variegated appearance (Braun & Mares 1995). Czaplewski & Cartelle (1998) describe Quaternary fossils of this species from Bahía, Brazil.

The type specimen is an adult male (ZSM 133) from Cuyabá (=Cuiabá), Brazil, deposited in the Zoologisches Staats-Sammlung, Munich, Germany (Carter & Dolan 1978). Despite the extensive geographic range the species was considered variable but monotypic by Power & Tamsitt (1973) following a morphological review of the specimens. They noted patterns of pronounced heterogeneity in populations west of the Andes and into Central America, with populations east of the Andes more homogeneous. Valdez (1970) had earlier recognised *P.d.verrucosum* Elliot, 1905 for the variable Central American and west of the Andes populations, but Power & Tamsitt (1973) noted that populations close to the Andes and on other side exhibit intermediate characters. Willig (1983) found significant differences in

cranial and external measurements for populations from northeastern Brazil. A comprehensive modern analysis is required to fully understand the complex geographical variation in this variable species and for now we prefer to follow Gardner (2007) in considering the species monotypic. Synonyms adapted from Gardner (2007) and López-González (2005):

*Phyllostoma discolor* JA Wagner 1843:366. Type locality "Cuyaba" Mato Grosso, Brazil.

*Phyllostoma*. *innominatum* Tschudi 1844:62. Type locality "Maynas" Loreto, Peru.

*Phyllostoma angusticeps* P.Gervais 1856:47 Type locality "Provincia de Bahía" Brazil.

*Phyllostomus discolor* JA Allen 1904:344. First use of current name combination.

*Phyllostoma verrucosum* Elliot 1905:236 Type locality "Niltepec, Oaxaca, Mexico".

*Phyllostomus* *verrucosus* Miller 1907:131. Name combination and emendation.

**ENGLISH COMMON NAMES:** Pale Spear-nosed Bat (Redford & Eisenberg 1992, Wilson & Cole 2000, Gardner 2007), Lesser Spear-nosed Bat (Goodwin & Greenhall 1961), Long-tongued Spear-nosed Bat (Goodwin & Greenhall 1961).

**SPANISH COMMON NAMES:** Falso vampiro gris (Redford & Eisenberg 1992), Murciélago nariz de lanza pálido (Aguirre 2007), Murciélago que hoja nasal lanceolada (Emmons 1999).

**GUARANÍ COMMON NAMES:** No known names.

**DESCRIPTION:** A robust, medium-sized bat with a well-developed nose leaf. Pelage smooth and dense, not extending to the membranes. Overall colour brownish with dorsal surface having somewhat grizzled appearance due to tricoloured hairs – basally white, broad central band dark brown and tip ashy. Head and shoulders slightly paler and underparts notably paler, varying from cinnamon-buff to creamy-white. Ears narrow and somewhat pointed, well-separated on head. Lower lip with V-shaped groove bordered by elongate papillae. Uropatagium extensive.

**CRANIAL CHARACTERISTICS:** Skull robust but long and slender when compared to other *Phyllostomids*. Rostrum broad and low, braincase rounded and sagittal crest poorly developed. Goodwin & Greenhall (1981).

Power & Tamsitt (1973) found a significant difference in measurements of mastoid width and zygomatic width between sexes with males being larger. They noted the following mean measurements from across the species wide range (n=138 males, 85 females): *Greatest Skull Length* male 30.39mm, female 29.61mm; *Interorbital Constriction* male 6.55mm, female 6.43mm; *Condylolincisive Length* male 27.33mm, female 26.67mm; *Zygomatic Width* male 15.65mm, female 15.21mm; *Mastoid Width* male 14.81mm, female 14.25mm; *Width of Braincase* male 12.19mm, female 11.97mm; *Width Across Molars* male 10.11mm, female 9.97mm.

Sanborn (1936) gives the following measurements for specimens in the Chicago Field Museum: *Condylolbasal Length* ssp. "*discolor*" 25.3-26.2mm; *Condylolbasal Length* ssp. "*verrucosus*" 25-27.8mm.

Valdivieso & Tamsitt (1962) give the following ranges of measurements for two skulls from Colombia: *Greatest Skull Length* 29.8mm 31mm; *Interorbital Constriction* 6.5mm 6.5mm; *Length of Mandible* 20.2mm 20.5mm; *Zygomatic Width* 14.5mm 15.4mm; *Mastoid Width* 14.1mm 14.7mm; *Width Across Molars* 9.9mm 10.2mm. Anderson (1997) gives the following ranges for 4 males from Bolivia: *Condylolbasal Length* 26.7-27.2mm; *Zygomatic Width* 15.1-16mm; *Lamboidal Width* 14.4-15.4mm; *Width of Braincase* 11.6-12.2mm; *Skull Depth* 10.9-11.7mm; *Width Across Canines* 6.8-7.5mm.

Taddei (1975) gives the following measurements for a sexed sample (n=15 males, n=15 females) from northeast Brazil: *Greatest Skull Length* male 29.50mm (+/- 0.15mm) female 29.27mm (+/- 0.12mm); *Condylolbasal Length* male 26.61mm (+/- 0.13mm) female 26.30mm (+/- 0.12mm); *Condylolcaninal Length* male 25.35mm (+/- 0.15mm) female 25.17mm (+/- 0.11mm); *Basal Skull Length* male 22.63mm (+/- 0.12mm) female 22.57mm (+/- 0.11mm); *Length of Palate* male 12.66mm (+/- 0.06mm) female 12.57mm (+/- 0.08mm); *Length of Mandible* male 19.61mm (+/- 0.13mm) female 19.50mm (+/- 0.09mm); *Width Across Upper Canines* male 7.34mm (+/- 0.04mm) female 6.91mm (+/- 0.05mm); *Width Across Upper Molars* male 10.10mm (+/- 0.04mm) female 9.83mm (+/- 0.08mm); *Postorbital Width* male 6.55mm (+/- 0.07mm) female 6.43mm (+/- 0.05mm); *Transverse Zygomatic Width* male 15.55mm (+/- 0.06mm) female 15.55mm (+/- 0.12mm); *Width of Braincase* male 12.25mm (+/- 0.06mm) female 12.24mm (+/- 0.06mm); *Mastoid Width* male 14.90mm (+/- 0.06mm) female 14.62mm (+/- 0.06mm); *Height of Braincase* male 10.95mm (+/- 0.03mm) female 10.76mm (+/- 0.06mm).

**DENTAL CHARACTERISTICS:** I2/2 C 1/1 P2/2 M3/3 = 32. Outer incisors short and broad with lower incisors forming a continuous row between the canines and outer tooth only slightly smaller than inner. Cutting edges faintly trifold. Goodwin & Greenhall (1981).

Valdivieso & Tamsitt (1962) give the following measurement for two skulls from Colombia: *Upper Tooth Row* 9mm. Anderson (1997) gives the following ranges for 4 males from Bolivia: *Molar Width* 2.1-2.2mm; *Dental Span* 9.5-10mm. Power & Tamsitt (1973) gave the following mean measurements from across the species wide range (n=138 males, 85 females): *Upper Tooth Row* male 9.75mm, female 9.57mm. Taddei (1975) gives the following measurements for a sexed sample (n=30 males, n=30 females) from northeast Brazil: *Upper Tooth Row* male 9.40mm (+/- 0.04mm) female 9.31mm (+/- 0.06mm); *Lower Tooth Row* male 10.90mm (+/- 0.05mm) female 10.79mm (+/- 0.07mm).

**GENETIC CHARACTERISTICS** 2n=32. FN=60. All autosomes are biarmed. X chromosome is a medium-sized submetacentric, Y chromosome is a small acrocentric. Entire series of autosomal chromosomes grades smoothly in size from large to small. 2 rDNA sites and 2 telemetric chromosomes (Baker 1967). G and C-banding patterns identical to *P.bastatus* (Varella-Garcia et al 1989).

**EXTERNAL MEASUREMENTS:** A large bat but a small *Phyllostomus*.

Podtiaguin (1944) gives the following measurements for males (n=4) and females (n=2) in Paraguay: **HB:** male 70mm female 69-70mm; **FA:** male 56-57mm, female 56-58mm; **TA:** male 8mm, female 8mm; **Thumb** male 10mm female 10mm; **First phalange** male 14-16mm female 14-16mm; **Second phalange** male 28-29mm female 28mm; **Third phalange** male 15mm female 15mm.

Power & Tamsitt (1973) gave the following mean forearm measurements from across the species wide range (n=138 males, 85 females): **FA:** male 61.79mm, female 61.40mm.

Giannini & Brenes (2001) gave the following masses for unsexed adults (n=21) from Costa Rica: **WT:** 38.2g (+/- 3.1g). Valdivieso & Tamsitt (1962) give the following ranges of measurements for eight specimens from Colombia: **HB:** 69-92mm; **TA:** 12-18mm; **FT:** 12.1-15.1mm; **FA:** 57.5-64.1mm; **EA:** 19.4-23.5mm. Sanborn (1936) gives the following measurement for specimens in the Chicago Field Museum: ssp. "*discolor*" **FA:** 55.4-61.1mm; ssp. "*verrucosus*" **FA:** 57.7-65.6mm.

Anderson (1997) gives the following measurements for 6 males and 4 females from Bolivia: **HB:** male 85-95mm, female 88-89mm; **TA:** male 9-16mm, female 10-18mm; **FT:** male 10-20mm, female 15-20mm; **FA:** male 57-64mm, female 59-62mm; **EA:** male 15-21mm, female 19-22mm; **WT:** male 18-31g, female 31-32g.

Taddei (1975) gives the following measurements for a sexed sample (n=30 males, n=30 females) from northeast Brazil: **HB:** male 79.99mm (+/- 0.42mm) female 80.62mm (+/- 0.45mm); **FT** male 12.72mm (+/- 0.09mm) female 10.88mm (+/- 0.11mm); **FA** male 62.50mm (+/- 0.32mm) female 62.68mm (+/- 0.27mm); **EA** male 21.65mm (+/- 0.12mm) female 22.52mm (+/- 0.15mm); **Height of tragus** male 6.45mm (+/- 0.07mm) female 6.50mm (+/- 0.06mm); **Third Metacarpal** male 54.30mm (+/- 0.30mm) female 54.37mm (+/- 0.32mm); **First Phalange of Third Digit** male 14.50mm (+/- 0.13mm) female 14.75mm (+/- 0.13mm); **Second Phalange of Third Digit** male 26.67mm (+/- 0.22mm) female 27.06mm (+/- 0.22mm); **Third Phalange of Third Digit** male 13.82mm (+/- 0.21mm) female 14.22mm (+/- 0.17mm); **Fourth Metacarpal** male 53.16mm (+/- 0.27mm) female 53.25mm (+/- 0.31mm); **First Phalange of Fourth Digit** male 11.32mm (+/- 0.11mm) female 11.35mm (+/- 0.10mm); **Second Phalange of Fourth Digit** male 18.00mm (+/- 0.14mm) female 18.35mm (+/- 0.15mm); **Fifth Metacarpal** male 52.75mm (+/- 0.32mm) female 53.13mm (+/- 0.26mm); **First Phalange of Fifth Digit** male 9.97mm (+/- 0.06mm) female 10.13mm (+/- 0.11mm); **Second Phalange of Fifth Digit** male 12.47mm (+/- 0.12mm) female 13.03mm (+/- 0.14mm); **Tibia** male 23.75mm (+/- 0.19mm) female 23.92mm (+/- 0.18mm); **Calcar** male 10.83mm (+/- 0.11mm) female 10.88mm (+/- 0.11mm); **WT:** male 37.18g (+/- 0.55g, n=16), subadult males 34.88g (+/- 2.05g, n=4); non-gravid females 34.70g (+/- 0.92g, n=13); gravid females 36.07g (+/- 0.43g, n=22).

**SIMILAR SPECIES:** This is a small *Phyllostomus* considerably smaller than *P.bastatus* the other Paraguayan species in all measurements. This species has a forearm in the range 56-58mm and a head and body length of 69-70mm, compared to forearm of 78-87mm and head and body of 95-115mm in *bastatus*. Note that the pelage does not extend onto the membranes, whereas in *P.bastatus* it extends onto the first third of the forearm and onto the uropatagium. Furthermore the tricoloured hairs of *P.discolor* give its pelage a grizzled effect, compared to the more uniform colouration of *P.bastatus*.

Structurally note that the calcar is shorter than the length of the hindfoot, whereas in all other members of the genus it is as long as or longer. Cranially the sagittal crest is reduced or absent. Dentally the first upper and lower incisors are wider than they are high, those of all other members of the genus are higher than they are wide.

**DISTRIBUTION:** Widely distributed from Veracruz, Mexico (Villar 1966) south through Central America to the Guianas, Colombia, Venezuela, Ecuador, eastern Peru and Bolivia, northeastern Paraguay and southeast Brazil.

In Bolivia the species has been recorded in Departamentos Beni, Cochabamba and Santa Cruz (Aguirre 2007). In Brazil the species has been recorded in the following states: Acre, Amazonas, Amapá, Bahia, Ceará, Distrito Federal, Espírito Santo, Minas Gerais, Mato Grosso do Sul, Mato Grosso, Pará, Paraíba, Pernambuco, Piauí, Paraná, Rio de Janeiro, Roraima and São Paulo (dos Reis et al 2007). The species is not known to occur in Argentina.

In Paraguay the species is known only from two localities in Departamento Alto Paraguay, Laguna Chamacoco near Fuerte Olimpo and Puerto Sastre (López-Gonzalez 2005). No specimens apparently exist today. Podtiaguin (1944) states that a specimen was collected by a G. Foster in 1901 at Puerto Sastre and sent to Dr Adolfo Pira in Stockholm, Sweden who initially identified it erroneously as a subadult male *Phyllostomus hastatus*. At the time of Podtiaguin's publication a male and a female were supposedly deposited in the Museo de Historia Natural del Paraguay having been collected on 23 January 1914 at Laguna Chamococo "33 leagues west of Fuerte Olimpo" and given to the museum by Sr. Domingo Gallea. Podtiaguin himself claims to have seen three individuals captured at Puerto Sastre by RPJ Méndez Baya in 1939 and stored in Baya's "magnificent collection". Podtiaguin provides a detailed description of the specimens that he saw as well as measurements and a summary of the characteristics that distinguish them from *Phyllostomus hastatus*, the only confusion species.

**HABITAT:** A habitat generalist able to utilise a range of both humid and dry habitats when sufficient food resources and roost sites are available. Willig et al (2007) found the species exclusively in human-altered agricultural areas in the Iquitos region of Peru. Mares et al (1981) found it locally common in banana and mango orchards in the caatinga of northeastern Brazil.

In Brazil the species occurs in primary and secondary forest but is also found in heavily-altered environments such as villages and banana plantations (dos Reis et al 2007). Faria et al (2006) note the species as roosting in hollow trees in shade cacao plantations. Willig (1985) found the species to be rare to common in the caatinga of northeast Brazil but abundant in cerrado. In Bolivia the species has also been recorded in flooded grasslands and exceptionally humid foothill forest (Aguirre 2007).

In Paraguay the two cited locations are in chaco habitat, one in typical dry thorn forest and the other in humid riverine semideciduous forest (López-Gonzalez 2005).

**ALIMENTATION:** Willig (1985) and Bernard (2002) consider this species an omnivore though it was considered a nectarivore by Kalko (1996).

**Foraging Behaviour and Diet** Aguiar & Marinho-Filho (2007) identified Coleoptera and Hymenoptera in fecal pellets of a single individual from this species in Atlantic Forest in Minas Gerais, Brazil. Bernard (2002) lists unknown insect remains for central Amazonian Brazil. Mares et al (1981) state that in the caatinga of northeastern Brazil the species is primarily frugivorous, though at certain times of year nectarivorous and/or pollenivorous. Fleming et al (1972) noted that in Costa Rica 57% of 128 captured individuals had food in their stomachs with combined results consisting of 99% insect material and just 1% plant material.

**Diet in Captivity** The first Colombian specimens were captured in nets near vegetation with fruiting papaya, banana, guayaba and almonds (Valdivieso & Tamsitt 1962). Goodwin & Greenhall (1981) note that the species was maintained in captivity in Trinidad on a diet of soft fruit such as ripe bananas,



mangos and pawpaws but that it rejected meat. The long, extensile tongue is deeply-grooved on the upper surface and this is used to scoop out fruit pulp.

Giannini & Brenes (2001) studied the flower-feeding behaviour of this species under captive conditions in Costa Rica. Presented with banana inflorescences, the bats approached in direct flight, rotated in the air and landed head downwards. They probed a single flower for about a second before flying away and returning shortly afterwards, repeating this behaviour on numerous occasions (mean = 16 +/-10). Constant revisiting of the flower was suggested as a behavioural adaptation to allow this heavy bat to visit delicate flowers aimed more at small, hovering nectarivorous bats and unable to withstand the weight of a larger bat perching on it – representing an intermediate tactic between hovering and larger landing bats. Total mean foraging time was 181 seconds (+/-83s) with the reaction time from being presented with the flowers 320 seconds (+/-123s). Flowers were usually approached from the side or below, and only once was a flower approached from above, the bat then crawling head downwards to the flower. A mean of 74% (range 39-96%) of the nectar supply was consumed and foraging efficiency (mean microlitres of consumed nectar per gram of mean body mass) was 30.

**REPRODUCTIVE BIOLOGY:** Harem breeders, a single male maintaining a group females. The species is bimodally polyoestrous.

**Seasonality** No breeding data specifically for Paraguay is available.

**Brazil** In southern Brazil breeding coincides with the wettest months of the year (dos Reis 2007). Willig (1985) notes a pregnant, lactating female from the caatinga of northeast Brazil in March and lactating, non-pregnant females in March, October and November. In the cerrado pregnant females were recorded in January (2, both lactating), February (2, none lactating), March (1 lactating), April (7 all lactating), September (4, 1 lactating), October (1 lactating) and December (16, 9 lactating). Lactating, non-pregnant females were recorded in March (1), April (2), September (2), October (5) and December (1), whilst females showing no signs of reproductive activity were reported for January (1), February (2), March (2), September (1), October (1) and December (1). Barnett et al (2006) document a lactating female in Jaú National Park, Amazonian Brazil on 3 November 2000 (late dry season). Bernard (2002) recorded a pregnant female in July in Amazonian central Brazil.

**Colombia** Pregnant females were captured in Colombia during the rainy season in October, but bats caught in the same area during the dry season in June were not pregnant (Valdivieso & Tamsitt 1962).

**Costa Rica** Fleming et al (1972) found 1 of 12 females to be pregnant in March and 4 of 25 to be pregnant in December. Non-pregnant females were captured in January (1), April (3), May (6) and July (3).

**Peru** Hice et al (2004) found one lactating and one non-reproductive female in northeast Peru during June.

**Trinidad** Goodwin & Greenhall (1981) give the following data for Trinidad: gravid females in February, March, June and August; lactating females in August, September and October and males in breeding condition in January, August and October. Carter et al (1981) note that none of the ten females they collected in Trinidad from 2 to 8 August were pregnant.

**Venezuela** In Venezuela 1 of 4 specimens captured in April was lactating (August & Baker 1982).

**Courtship** Typically males maintain an annual harem of 12 to 20 females, though harem composition is unstable, with females often moving between groups (dos Reis et al 2007).

**GENERAL BEHAVIOUR:** Unknown in Paraguay, though this is a widespread and often common bat in other areas.

**Activity Levels** Aguirre (2007) notes that the species is most active in savannas in Departamento Beni, Bolivia between 8 and 10pm. Fleming et al (1972) found the mean recapture distance of 13 marked individuals to be 400m.

**Roosts** Goodwin & Greenhall (1981) noted a preference for roosting in hollow *Ceiba pentandra* trees in Trinidad and that colonies of up to 25 individuals of both sexes form. Typically they roosted high up and well away from the single entrance. In Trinidad the species has been recorded as roosting in association with *Saccopteryx bilineata*, *Noctilio leporinus* and *Carollia perspicillata* of the species of confirmed or potential occurrence in Paraguay. Podtiaguin (1944) notes that three Paraguayan specimens collected by Méndez Baya were found hanging under a palm leaf but that they more typically prefer hollow trees.

Valdivieso & Tamsitt (1964) speculated that the strong-smelling, milky secretions of the chest gland may act to facilitate individual recognition and to advertise day roosts to conspecifics.

**Flight Pattern** Giannini & Brenes (2001) gave the following measurements associated with flight for unsexed adults (n=21) from Costa Rica: *Wing loading* 13.6Nm<sup>2</sup> (+/- 1.22Nm<sup>2</sup>); *Aspect ratio* (wingspan/area of wings and chest) 7 (+/- 0.25); *Tip area index* (area of dactylopatagium or wing tip area between the fingers/area of wing) 0.8 (+/- 0.95); *Tip length index* (length of Digit III/length of arm and forearm) 1.36 (+/- 0.04); *Tip shape index* (tip area index/tiplength index – tip area index) 1.5 (+/- 0.27).

**Grooming Behaviour** Seven of nine females collected on Trinidad in August were moulting (Carter et al 1981).

**Parasites** No data available for Paraguay.

**Caribbean** Tamsitt & Fox (1970) list the Streblids *Trichobius costalimai* and *Trichobioides perspicillatus* noting that *P. discolor* is the principal host of these species having been reported from El Salvador south to Colombia and Trinidad. Additionally *Strebla hertigi* (Colombia) and *S. consocius* (Colombia). Goodwin & Greenhall (1981) list the following parasites of this species *Trombicula carmenae* (Trombiculidae), *Euctenodes mirabilis*, *Trichobius costalimai*, *T. mixtus*, *Trichobioides perspicillatus* (Streblidae) and unidentified trematodes.

**VOCALISATIONS:** Juveniles immediately give isolation calls when separated from their mother and can modify these to match the maternal directive call they hear from their mother (Esser 1994).

**HUMAN IMPACT:** None in Paraguay where it is a little known species with an apparently restricted range. Elsewhere this species is common, large and conspicuous, and frequently found in areas of human habitation.

**CONSERVATION STATUS:** Globally considered to be of Low Risk Least Concern by the IUCN, see <http://www.iucnredlist.org/details/17216/0> for the latest assessment of the species. This species is under no immediate threat over most of its range and may actually benefit from habitat fragmentation in some areas. Willig et al (2007) for example found the species exclusively in human-altered agricultural areas in the Iquitos region of Peru and absent from pristine habitats nearby. Paraguay represents the southern limits of the species range. The lack of recent records from Paraguay are likely a product of the isolated nature of the species range and it should be considered Data Deficient at national level.

#### REFERENCES:

- Aguiar LMS, Marinho-Filho J** 2007 - Bat Frugivory in a Remnant of Southeastern Brazilian Atlantic Forest - *Acta Chiropterologica* 9: p251-260.
- Aguirre LF** 2007 - Historia Natural, Distribución y Conservación de los Murciélagos de Bolivia - Fundación Simón I. Patiño, Santa Cruz.
- Allen JA** 1904 - List of Mammals from Venezuela Collected by Mr Samuel M Klages - *Bulletin AMNH* 20: P337-345.
- Anderson S** 1997 - Mammals of Bolivia Taxonomy and Distribution - *Bulletin AMNH* 231.
- August PV, Baker RJ** 1982 - Observations on the Reproductive Ecology of Some Neotropical Bats - *Mammalia* 46: p177-181.
- Baker RJ** 1969 - Karyotypes of Bats of the Family Phyllostomidae and Their Taxonomic Implications - *Southwestern Naturalist* 12: p407-428.
- Barnett AA, Sampaio EM, Kalko EKV, Shapely RL, Fischer E, Camargo G, Rodríguez-Herrera B** 2006 - Bats of Jaú National Park, Central Amazônia, Brazil - *Acta Chiropterologica* 8: p103-128.
- Bernard E** 2002 - Diet, Activity and Reproduction of Bat Species (Mammalia: Chiroptera) in Central Amazonia, Brazil - *Revista Brasileira de Zoologia* 19: p173-188.
- Braun JK, Mares MA** 1995 - The Mammals of Argentina: An Etymology - *Mastozoologia Neotropical* 2: p173-206.
- Carter DC, Dolan PG** 1978 - Catalogue of Type Specimens of Neotropical Bats in Selected European Museums - *Special Publications of the Museum of Texas Tech University* 15.
- Carter CH, Genoways HH, Loregnard RS, Baker RJ** 1981 - Observations on Bats from Trinidad with a Checklist of Species Occurring on the Island - *Occasional Papers of the Museum of Texas Tech University* 72.
- Czaplewski NJ, Cartelle C** 1998 - Pleistocene Bats from Cave Deposits in Bahia, Brazil - *Journal of Mammalogy* 79: p784-803.
- Elliot DG** 1905 - Descriptions of Apparently New Species and Subspecies of Mammals from Mexico and San Domingo - *Proceedings of Biological Society of Washington* 18: p233-236.

- Emmons LH** 1999 - Mamíferos de los Bosques Húmedos de América Tropical - Editorial FAN, Santa Cruz.
- Esser KH** 1994 - Audio-vocal Learning in a Non-human Mammal: The Lesser Spear-nosed Bat *Phyllostomus discolor* - *Neuro Report* 5: p1718-1720.
- Faria D, Laps RR, Baumgarten J, Cetra M** 2006 – Bat and Bird Assemblages from Forests and Shade Cacao Plantations in Two Contrasting Landscapes in the Atlantic Forest of Southern Bahía, Brazil – *Biodiversity and Conservation* 15: p587-612.
- Fleming TH, Hooper ET, Wilson DE** 1972 - Three Central American Bat Communities: Structure, Reproductive Cycles and Movement Patterns - *Ecology* 53: p555-569.
- Gardner AL** 2007 - Mammals of South America Vol 1: Marsupials, Xenarthrans, Bats and Shrews - University of Chicago Press, Chicago.
- Gervais P** 1856 - Deuxième Mémoire. Documents Zoologiques pour Servir a la Monographie des Chéiroptères Sid-Américains p25-88 in de Castelnau F, Animaux Nouveaux our Rares Recueillis Pendant l'Expédition dans les Parties Centrales de l'Amérique du Sud, de Rio de Janeiro a Lima et de Lima au Para, Exécutée par Ordre du Gouvernement Français Pendant les Années 1843 a 1847 su la Direction de Comte Francis de Castelnau - Bertrand, Paris.
- Giannini NP, Brenes FV** 2001 - Flight Cage Observations of Foraging Mode in *Phyllostomus discolor*, *P.bastatus* and *Glossophaga commissarisi* - *Biotropica* 33: p536-550.
- Goodwin GG, Greenhall AM** 1961 - A Review of the Bats of Trinidad and Tobago: Descriptions, Rabies Infection and Ecology - *Bulletin AMNH* 122: p187-302.
- Hice CL, Velazco PN, Willig MR** 2004 - Bats of the Reserva Nacional Allpayuaho-Mishana, Northeast Peru, with Notes on Community Structure - *Acta Chiropterologica* 6: p319-334.
- Hoffman FG, Hooper SR, Baker RJ** 2008 - Molecular Dating of the Diversification of Phyllostominae Bats Based on Nuclear and Mitochondrial DNA Sequences - *Molecular Phylogenetics and Evolution* 49: p653-658.
- Kalko EKV, Handley CO, Handley D** 1996 - Organization, Diversity and Long-term Dynamics of a Neotropical Bat Community p503-553 in *Cody ML, Smallwood JA* eds. Long Term Studies in Vertebrate Communities - San Diego Academic Press.
- López-Gonzalez C** 2005 - Murciélagos del Paraguay - Biosfera Numero 9.
- Mares MA, Willig MR, Streilein KE, Lacher TE** 1981 - Mammals of Northeastern Brazil: A Preliminary Assessment - *Annals of the Carnegie Museum* 50: p81-137.
- Miller GS** 1907 - The Families and Genera of Bats - *Bulletin USNM* 57.
- Palmer TS** 1904 - Index Generum Mammalium - US Department of Agriculture Biological Survey, North American Fauna 23, 984pp.
- Podtiaguin B** 1944 - Contribuciones al Conocimiento de los Murciélagos del Paraguay - *Revista de la Sociedad Científica del Paraguay* 6: p25-62.
- Power DM, Tamsitt JM** 1973 - Variation in *Phyllostomus discolor* (Chiroptera: Phyllostomatidae) - *Canadian Journal of Zoology* 51: p461-468.
- Redford KH, Eisenberg JF** 1992 - Mammals of the Neotropics: Volume 2 The Southern Cone - University of Chicago Press, Chicago.
- Reis dos NR, Peracchi AL, Pedro WA, Lima de IP** 2007 - Morcegos do Brasil - Londrina, Brazil.
- Sanborn CC** 1936 – Records and Measurements of Neotropical Bats – *Fieldiana Zoology* 20: p93-106.
- Santos M, Aguirre LF, Vázquez LB, Ortega J** 2003 - *Phyllostomus bastatus* - *Mammalian Species* 722: p1-6.
- Taddei VA** 1975 - Phyllostomidae (Chiroptera) do Norte-Occidental do Estado de São Paulo I: Phyllostominae - *Ciencia e Cultura* 27: p621-632.
- Tamsitt JR, Fox I** 1970 - Records of Bat Ectoparasites from the Caribbean Region (Siphonaptera, Acarina, Diptera) - *Canadian Journal of Zoology* 48: p1093-1097.
- Tschudi JJ von** 1844 - Untersuchungen Über die Fauna Peruana - Scheitlin und Zollikoffer, St. Gallen.
- Valdez R** 1970 - Taxonomy and Geographic Variation of the Bats of the Genus *Phyllostomus* - Texas A&M University, PhD Dissertation.
- Valdivieso D, Tamsitt JR** 1962 - First Records of the Pale Spear-nosed Bat in Colombia - *Journal of Mammalogy* 43: p422-423.

**Valdivieso D, Tamsitt JR** 1964 - Histology of the Chest Gland of the Pale Spear-nosed Bat - *Journal of Mammalogy* 45: p536-539.

**Varella-García M, Morielle-Versute E, Taddei VA** 1989 - A Survey of Cytogenetic Data on Brazilian Bats - *Revista Brasileira de Genética* 12: p761-793.

**Villar-R B** 1966 - Los Murciélagos de Mexico: Su Importancia emn la Economía y la Salubridad, Su Clasificación Sistemática - Universidad Autónoma de Mexico.

**Wagner JA** 1843 - Diagnosen Neuer Arten Brasilischer Handflügler - *Arch. Naturgesch.* 9: p365-368.

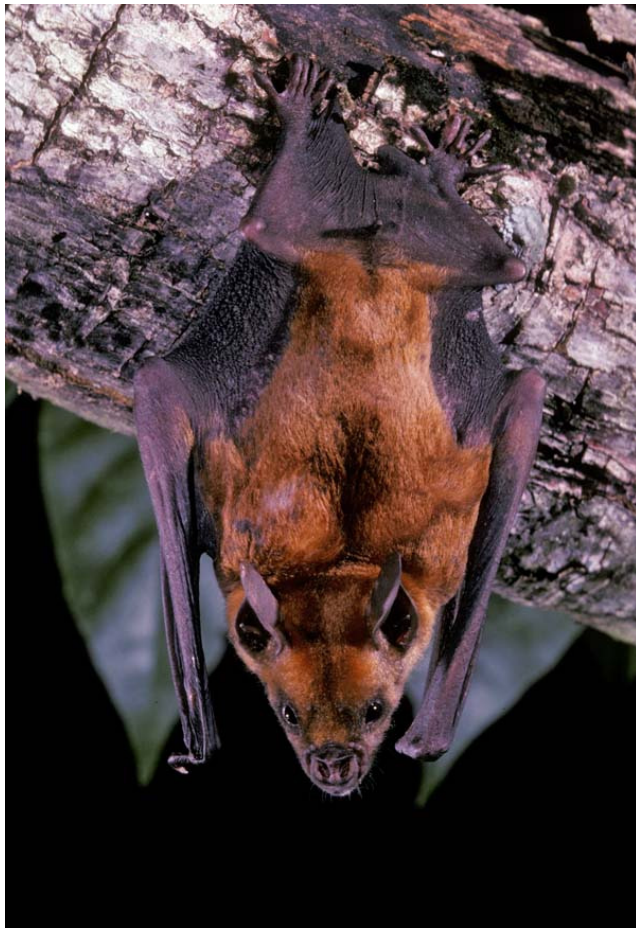
**Willig MR** 1983 - Composition, Microgeographic Variation and Sexual Dimorphism in Caatinga and Cerrado Bat Communities from Northeast Brazil - *Bulletin of the Carnegie Museum of Natural History* 23: p1-131.

**Willig MR** 1985 - Reproductive Activity of Female Bats from Northeast Brazil - *Bat Research News* 26: p17-20.

**Willig MR, Pressley SJ, Bloch CP, Hice CL, Yanoviak SP, Díaz MM, Chauca LA, Pacheco V, Weaver SC** 2007 - Phyllostomid Bats of Lowland Amazonia: Effects of Habitat Alteration on Abundance - *Biotropica* 39: p737-746.

**Wilson DE, Cole FR** 2000 - Common Names of Mammals of the World - Smithsonian Institution Press, Washington and London.

**CITATION:** Smith P 2009 - FAUNA Paraguay Handbook of the Mammals of Paraguay Number 36 *Phyllostomus discolor* - [www.faunaparaguay.com/phydishb.html](http://www.faunaparaguay.com/phydishb.html).



**FIGURE 2** - Adult perched on a tree (© Merlin D. Tuttle, Bat Conservation International, [www.batcon.org](http://www.batcon.org)).





**FIGURES 3-8** - Skull (©Philip Myers/Animal Diversity Web <http://animaldiversity.ummz.umich.edu>).