D´ORBIGNY´S ROUND-EARED BAT

Lophostoma silvicolum d´Orbigny, 1836

FIGURE 1 - (FPMAM112PH) Head detail, Tres Gigantes, Departamento Alto Paraguay (Silvia Centrón September 2009).

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 2008). There are six species in the genus *Lophostoma,* d´Orbigny 1836, two of which are present in Paraguay. The origin of the generic name *Lophostoma* is Greek meaning "crest mouth" possibly in reference to the row of bony tubercles present on the lower lip (Palmer 1904). The species name *silvicolum* means "inhabiting woods" referring to the habitat preference of the species (Braun & Mares 1995).

There are four recognised subspecies, that in Paraguay currently being assigned to *L.s.silvicolum* d´Orbigny, 1836. However López-González (2005) notes that no studies of variation of the species in the southern part of the range have been performed and that the subspecific designation should be treated with caution. The type specimen is undetermined. The type locality was given as "... des grandes foréts qui bordent le pied oriental de la Cordillére bolivienne, au pais des sauvages Yuracarés" (the great forests that border the eastern foothills of the Bolivian cordillera in the land of the savage Yuracarés). This was later restricted to the "Yungas of Bolivia between the Río Securé and Río Isibara" by Hall (1981).

The species was originally described as *Lophostoma silvicolum,* but was frequently spelt *sylvicola* in the following literature. Davis & Carter (1978) first pointed out the error in using *sylvicola* but their arguments were disputed by Patterson (1992) who claimed that *silvicolum* was an "uneditted printer´s error" in the original description and that the correct spelling should be *sylvicola* as used by d´Orbigny himself in 1837. Gardner (2007) clarified the situation according to Article 32.2 (ICZN 1999: p39) which confirms that the original spelling is correct and refers to Artcle 32.5 which states that "incorrect transliteration or latinization....are not to be considered inadvertent errors".

This species was formerly considered to belong to the genus *Tonatia* (Gray 1827) but numerous authors had noted that some of the species included were highly divergent from others. Lee et al (2002) performed a revision and molecular review of the phylogenetics of the genus and concluded that it should be split into two distinct genera, with the majority of species, including this one relocated in *Lophostoma.* The genus *Lophostoma* is neuter and necessitates the species name ending *silvicolum.* If returned to *Tonatia* (feminine) the species name should be altered to *silvicola.* Synonyms adapted from López-González (2005) and Gardner (2007):

Lophostoma silvicola d´Orbigny 1836:6. Type locality "le pied oriental de la Cordillére bolivienne, au pais des sauvages Yuracarés".
Lophostoma sylvicolum d´Orbigny & Gervais 1847:11. Correction of gender and incorrect spelling of species name.
Lophostoma sylvicola Gray 1838:489. Incorrect gender and incorrect spelling of species name.
Phyllostoma ambylotis JA Wagner 1843:365. Type locality Matto Grosso, Brazil.
Ph [*yllostoma*]. *silvicola* Schniz 1844:238. Name combination.
Lophostoma ambylotis W. Peters 1865:509. Name combination.
Vampyrus (*Lophostoma*) *ambylotis* Pelzeln 1883:32. Name combination.
Phyllostoma midas Pelzeln 1883:32. In synonomy, nomen nudum.
Tonatia ambylotis O. Thomas 1902:54. Name combination.
Tonatia laephotis O. Thomas 1910:184. Type locality "River Supinaam, a tributary of the Lower Essequibo", Guyana.
Tonatia sylvicola Cabrera 1917:11. Name combination and incorrect spelling of species name.
Chrotopterus columbianus Anthony 1920:84. Type locality Río Quatequia, near Bogota, Colombia.
Tonatia loephotis Goodwin 1942:209. Incorrect spelling of species name.
Tonatia silvicola Husson 1962:88. Name combination.
Lophostoma silvicolum Lee, Hoofer & Van den Bussche 2002:55. First modern use of current name.
Lophostoma silvicoulm Baker, Fonseca, Parish, Phillips & Hoffman 2004:12. Incorrect spelling of species name.

ENGLISH COMMON NAMES: D´Orbigny´s Round-eared Bat (Gardner 2007), White-throated Round-eared Bat (Wilson & Cole 2000, Dechmann et al 2005).

SPANISH COMMON NAMES: Falso vampiro de oreja redonda (Redford & Eisenberg 1992), Murciélago orejón de vientre gris (Aguirre 2007), Murciélago gris de orejas redondas (Ascorra et al 1991).

GUARANÍ COMMON NAMES: No known names.

DESCRIPTION: The largest of the Paraguayan *Lophostoma/Tonatia* group with long, rounded ears and a short tail. Pelage long and dense, varying in colour from pale grey to reddish-brown or blackish, though typically some shade of brown (Mars brown to Mummy brown - Goodwin 1942) often with a whitish or whitish-grey patch on the throat, extending exceptionally to the chest or even the genital region. Dorsal pelage is bicoloured, with the tips darker than the bases. Muzzle sparsely-furred, appearing pinkish and almost naked with rows of small rounded tubercles on the chin forming a U-shape. Eyes small. Nose leaf relatively short but well-developed, the base being fused to the upper lip. Ears large with clear transverse lines and rounded tips, connected by an indistinct band of skin across the forehead - mostly greyish in colour with pinkish bases. Characteristically this species has a long tragus with three tooth-like projections near the base of the outer border. The forearm is almost naked and pinkish for at least half its length, but furred on both sides for the proximal half. Uropatagium longer than the legs, and short tail (approximately half the uropatagial length) is completely enclosed within it, except for the tip which protrudes slightly from the dorsal side. Wing and tail membranes blackish. Wings are remarkably short, round-tipped and broad giving it the lowest wing aspect ratio of any Phyllostomid. Feet robust. Measurements facilitate specific identification. (Goodwin 1942, Medellín & Arita 1989, Emmons 1999).

CRANIAL CHARACTERISTICS: Skull robust with short, broad rostrum that rises abruptly towards the brain case. Brain case rounded, narrow and elongated with distinct projection of lamboid region backwards. Sagittal crest begins low on the forehead. Extremely narrow postorbital constriction is characteristic of the species. Posterior border of palate forms a line across the front of the third molars. (Goodwin 1942, Medellín & Arita 1989).

Willig (1983) reported slight sexual dimorphism in measurements for the subspecies *laephotis* for specimens northeast Brazil, with males showing statistically significantly larger measurements than females for greatest skull length, condylobasal length, zygomatici width, mastoid width, height of braincase and mandibular length measured from the canine to the last molar.

Measurements taken from Paraguayan specimens (n=4 males and n=4 females) from Concepción and Tobatí published in López-González (2005): *Greatest Skull Length* male 26.1mm (+/-0.17mm), female 26.1mm (+/-0.47mm); *Condylobasal Length* male 22.6mm (+/-0.14mm), female 22.7mm (+/-0.41mm); *Transverse Zygomatic Width* male 13.3mm (+/-0.23mm), female 13.2mm (+/-0.17mm); *Mastoid Width* male 12.8mm (+/-0.2mm), female 13.1mm (+/-0.5mm); *Interorbital Constriction* male 4.1mm (+/-0.05mm), female 4.3mm (+/-0.12mm); *Width Across Upper Molars* male 8.5mm (+/-0.15mm), female 8.6mm (+/-0.1mm); *Width Across Upper Canines* male 5.2mm (+/-0.12mm), female 5.3mm (+/-0.12mm).

Willig (1983) gave the following external measurements for both sexes in the caatinga of northeastern Brazil (male n=13 female n=36): *Greatest Skull Length* male 27.80mm (+/- 0.54mm) female 27.32mm (+/- 0.52mm); *Condylobasal Length* male 24.31mm (+/- 0.50mm) female 23.84mm (+/- 0.32mm); *Transverse Zygomatic Width* male 13.68mm (+/- 0.24mm) female 13.47mm (+/- 0.25mm); *Postorbital Constriction* male 6mm (+/- 0.15mm) female 6mm (+/- 0.22mm); *Mastoid Width* male 13.49mm (+/-0.2mm) female 13.27mm (+/- 0.26mm); *Width of Brain Case* male 11.03mm (+/- 0.19mm) female 11.10mm (+/- 0.22mm); *Width of Rostrum* male 5.99mm (+/- 0.19mm) female 5.92mm (+/- 0.16mm); *Height of Brain Case* male 13.96mm (+/- 0.32mm) female 13.73mm (+/- 0.27mm); *Length of Mandible* male 18.10mm (+/-0.34mm) female 17.98mm (+/- 0.31mm); *Length of Coronoid Process* male 7.35mm (+/- 0.21mm) female 7.25mm (+/- 0.21mm); *Width Across Upper Molars* male 8.90mm (+/- 0.22mm) female 8.84mm (+/-0.17mm); *Width Across Upper Canines* male 6.12mm (+/- 0.15mm) female 6.05mm (+/- 0.17mm).

DENTAL CHARACTERISTICS: I2/1 C 1/1 P2/3 M3/3 = 32. One pair of lower incisors only. Cheek teeth and canines large. Internal upper incisors at least three times the size of outer pair and leaving no space between canines. W-shaped lophs obvious on large molars.

Measurements taken from Paraguayan specimens (n=4 males and n=4 females) from Concepción and Tobatí published in López-González (2005): *Upper Tooth Row* male 8.7mm (+/-0.1mm), female 9mm (+/-0.1mm); *Lower Tooth Row* male 9.8mm (+/-0.13mm), female 10mm (+/-0.1mm).

Willig (1983) gave the following external measurements for both sexes in the caatinga of northeastern Brazil (male n=13 female n=36): *Upper Tooth Row* male 10.12mm (+/-0.21mm), female 10.03mm (+/-0.14mm); *Length of Upper Molar Row* male 7.96mm (+/-0.16mm), female 7.93mm (+/-0.15mm); *Width of Widest Molar* male 2.42mm (+/-0.10mm), female 2.45mm (+/-0.09mm); *Lower Tooth Row* male 11.29mm (+/-0.22mm), female 11.09mm (+/-0.25mm).

GENETIC CHARACTERISTICS: 2n=34. FN=60. (Redford & Eisenberg 1992). The X-chromosome is submetacentric and the Y-chromosome is acrocentric (Genoways & Williams 1984). Arnold et al (1983) considered this species to possess the proposed primitive karyotype of the genus.

EXTERNAL MEASUREMENTS: Genoways & Williams (1984) and Willig (1983) reported slight sexual dimorphism in measurements for the subspecies *laephotis* for specimens from Surinam and northeast Brazil respectively, with statistically significant differences being found in ear length and weight, males larger than females. Dechmann et al (2005) found males to be heavier and larger in three parameters that they measured in individuals of the subspecies *centralis* on Barro Colorado Island, Panama.

Measurements taken from Paraguayan specimens (n=4 males and n=4 females) from Concepción and Tobatí published in López-González (2005): **TL** male 102.3mm (+/-2.63mm), female 100.5mm (+/-6.45mm); **TA** male 21mm (+/-2.16mm), female 24.3mm (+/-10.59mm); **FT** male 14.8mm (+/-1.89mm), female 14.8mm (+/-0.5mm); **FA** male 55.3mm (+/-0.76mm), female 54.4mm (+/-1.16mm); **EA** male 34.8mm (+/-3.30mm), female 36.5mm (+/-1.73mm); *Length of Third Digit* male 45.8mm (+/-0.46mm), female 45.4mm (+/-1.75mm); **WT** male 29.2g (+/-1.44g), female 30.7g (+/-1.15g).

Willig (1983) gave the following external measurements for both sexes in the caatinga of northeastern Brazil (male n=13 female n=36): **TL** male 97.85mm (+/- 3.34mm), female 97.58mm (+/- 3.12mm); **TA** male 17.69mm (+/- 2.50mm), female 17.69mm (+/- 2.04mm); **FT** male 14.62mm (+/- 0.51mm), female 14.69mm (+/- 0.82mm); **FA** male 58.23mm (+/- 1.42mm), female 57.58mm (+/- 0.97mm); **EA** male 29.62mm (+/- 1.12mm), female 28.81mm (+/- 0.82mm); *Length of Tragus* male 11.69mm (+/- 1.38mm), female 11.86mm (+/- 0.80mm); *Length of First Digit* male 15.08mm (+/- 0.76mm), female 14.94mm (+/- 0.89mm); *Length of Third Digit* male 106.54mm (+/- 2.63mm), female 106mm (+/- 1.82mm); *Length of Fourth Digit* male 80.46mm (+/- 2.37mm), female 79.81mm (+/- 1.56mm); *Length of Fifth Digit* male 81.39mm (+/- 2.40mm), female 80.47mm (+/- 1.32mm); *Tibia* male 27.08mm (+/- 1.66mm), female 27.25mm (+/- 0.77mm); *Calcar* male 18.54mm (+/- 1.33mm), female 17.78mm (+/- 1.27mm); *Length of Noseleaf* male 6.54mm (+/- 0.52mm), female 6.33mm (+/- 0.48mm).

Dechmann et al (2005) gave the following external measurements for sexed individuals on Barro Colorado Island, Panama **FA** male 52.7mm (+/- 0.11mm), female 52.1mm (+/- 0.12mm); *Tibia* male 28.5mm (+/- 0.15mm), female 27.9mm (+/- 0.10mm); **WT** male 31.9g (+/-0.37g), female 29.8g (+/-0.27g).

SIMILAR SPECIES: This is a medium-small Phyllostominae (long ears, nose leaf well-developed with horseshoe shape enclosing the nostrils) with a short tail and round-tipped ears. Bats in the genus *Lophostoma* are extremely similar to *Tonatia bidens* and can be most easily separated on account of the naked or sparsely-furred muzzle, the band of skin connecting the ears and the fact that they roll their ears when handled. Both *Tonatia* and *Lophostoma* are unique amongst small Phyllostomids in having only one pair of lower incisors, the character being shared only by the much larger *Chrotopterus auritus*.

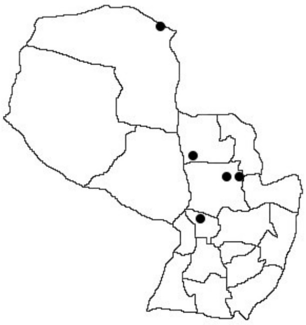
This species can be distinguished from the other Paraguayan member of the genus *L.brasiliense* principally by its larger size, having a forearm >50mm as opposed to <45mm and being almost twice the weight (*silvicolum* generally not less than 25g, *brasiliense* usually not more than 15g). Note also that ear length is invariably >30mm in *silvicolum* and typically <27mm in *brasiliense*.

This species typically has a white throat patch of variable size that distinguishes it from both *L.brasiliense* and *T.bidens*. Note also that *T.bidens* has the ears are well-separated - they are united by a small piece of skin in *Lophostoma silvicolum*. Characteristically this species has a long tragus with three tooth-like projections near the base of the outer border (Genoways & Williams 1980). Typically *L.silvicolum* has ear length >30mm whereas it is <30mm in *T.bidens*. Cranially the sagittal crest of *L.silvicolum* is more developed and the postorbital constriction of *T.bidens* is broader (>5mm in *Tonatia*, <5mm in *L.silvicolum*). Note also the presence of antero-medial foramina behind the upper incisors *Tonatia*, being absent in *Lophostoma*.

The only other member of the subfamily that even approaches this species in size is the Long-legged Bat *Macrophyllum macrophyllum,* but that species can be easily separated on account of its over-sized feet, long tail and longitudinal rows of dermal denticles on the ventral side of the uropatagium.

DISTRIBUTION: Widespread occurring from Honduras to Paraguay and Pernambuco, Brazil. It is absent from much of northern Venezuela and the Andes, but occurs on the western slope as far south as northwestern Peru and the eastern slope south to Bolivia. The species has been recorded from sea-level to 1500m (Medellín & Arita 1989). There are four recognised subspecies. *L.s.centralis* (Davis & Carter, 1978) is found in Central America. *L.s.occidentalis* (Davis & Carter, 1978) occurs only in the Río Chira drainage basin of northwestern Peru and southwestern Ecuador. *L.s.laephotis* (O.Thomas, 1910) is found from the Guianas to the lower Amazon Basin of Brazil. *L.s.silvicolum* is the most widespread subspecies being found from southern Panama, Colombia, Venezuela, Brazil, Ecuador east of the Andes, through Bolivia to Paraguay.

In Bolivia the species has been recorded in Departamentos Beni, Cochabamba, Pando, Santa Cruz and La Paz (Aguirre 2007). In Brazil the species has been recorded in the following Brazilian states: Acre, Alagoas, Amazonas, Amapá, Bahía, Mato Grosso do Sul, Pará, Paraiba, Pernambuco, Rio de Janaiero, Rondônia and Roraima (dos Reis et al 2007). Records of this species from Argentina in Provincias Jujuy (Fornes et al 1967) and Misiones (Villa-R & Villa-Cornejo 1973) are actually *Tonatia bidens* according to Barquez et al (1993).



In Paraguay the species is currently known only from the northeastern Oriental region in the Departamentos of Cordillera (12km north of Tobatí), Concepción (8km north of the city of Concepción) and San Pedro (from the now disappeared Yaguareté Forests). A single specimen was captured and photographed by Silvia Centrón near Bahía Negra, Departamento Alto Paraguay in 2009 (see images) but not collected.

HABITAT: The Paraguayan specimens were captured in Atlantic Forest. (López-González et al 1998). Paraguayan specimens captured by Myers & Wetzel (1979) were caught in nets set across forest tracks or streams. Elsewhere the species is associated with forested areas (typically moist, though rarely in drier forest) and streamside habitats, occasionally also foraging over agricultural clearings (Handley 1976).

Kalko et al (1999) noted during their radio-tracking study in Panama that this species never left the forest despite a substantial quantity of potential prey being attracted to lights in a nearby clearing. Of 42 specimens captured in Venezuela 58% were captured over or near streams, 36% in moist areas and just 6% in dry situations (Handley 1976). Willig (1985) found the species to be common in the caatinga of northeast Brazil but absent from cerrado. Faria et al (2006) found the species roosting in termite nests in Atlantic Forest shade cacao plantations.

ALIMENTATION: Members of this genus are principally perch hunters that detect prey by emitting sounds whilst hanging from a branch and flying out to capture it once it is located (Emmons 1999). This species was classed as a foliage-gleaning insectivore by Willig (1983) and it is said to glean from foliage and from the floor, as well as to snatch prey in flight (Kalko et al 1999).

Foraging Behaviour and Diet Kalko et al (1999) radio-tracked individuals in Panama and described two foraging strategies in this species, one involving continuous flights (mean 2.9 minutes +/- 3.4 minutes, maximum 27 minutes) over a small area (3-12ha) and the other the typical "hang and wait" strategy involving short sally flights (<1minute) from a perch. More short flights were performed than long flights. Between flights bats observed stationary periods with a mean of 2.8 minutes (+/-2.8 minutes, maximum 27 minutes). Bats were found directly to fly directly to their foraging areas on leaving the roost and to be faithful to them.

Diet consists of fruit and insects (López-González 2005), particularly katydids (Tettigoniidae). Medellín & Arita (1989) speculated that insect prey was caught largely based on the sound that it makes and noted that the bats are attracted by insect calls but not by frog calls, a factor that helps with resource partitioning where the species overlaps with the frog-hunting bat *Trachops cirrhosus* (Spix 1823). Katydids are subdued by the bat pouncing onto the prey item and smothering it with the wings and uropatagium. Pellets found below roosts consisted entirely of insect fragments but prey is never consumed at the roost.

Howell & Burch (1974) found two stomachs from Costa Rica to contain only plant remains (pollen from legumes and Apocynaceae). Eleven bats from Panama had consumed only insects (Fleming et al 1972) and fecal samples inspected by Bonaccorso (1979) contained only insects and remains of whipscorpions (Arachnida). Orthopterans dominated the insect remains in Panama with 83% of fecal samples containing their remains, whilst Coleoptera, Lepidoptera and seeds each accounted for <2% (Belwood 1989). One bat from La Selva, Costa Rica contained 95% by volume Coleoptera, likely Carabidae (Whitaker & Findley 1980), whilst an individual from Manaus, Brazil had "meat and bones" in the stomach (Reis & Peracchi 1987). Bernard (2002) found Coleoptera and unknown insect remains in the diet in central Amazonian Brazil, but also plants of the genera *Vismia* (less than 1% of total fecal material) and *Piper*.

Dechmann et al (2009) found that bats used bilateral postcanine (56% of observations) and unilateral postcanine bites when feeding, contrasting this with different bite techniques used for excavation of roost chambers. The following mean bite forces were generated for different bite types in this species: precanine unilateral 19.7 (+/-11.30); precanine bilateral 21.50 (+/-10.30); postcanine unilateral 27.83 (+/-7.82); postcanine bilateral 23.20 (+/-7.03).

Bravo et al (2008) did not record this species as *collpas* (clay licks) in Amazonian Peru though they were present in the study area. The *collpas* were used almost exclusively by Phyllostomid bats, but apparently only by frugivorous species and not insectivores such as *Lophostoma*.

Diet in Captivity Belwood & Morris (1987) noted that bats of this species were only caught in mist nets baited with singing male katydids (nine individuals caught) and that no bats were captured in nets baited with silent female katydids.

REPRODUCTIVE BIOLOGY: Breeding system is bimodally polyoestrous (Krutzsch 2000).

Seasonality Myers & Wetzel (1979) noted that a pregnant female was captured in July in Departamento Concepción and three lactating females were taken in March.

Brazil Willig (1985) notes pregnant females from the caatinga of northeast Brazil in February (2, 1 lactating), July (9, all lactating), September (1), October (2), November (2) and December (1) with reproductively inactive females in April (1), July (5), August (5), September (3), November (1) and December (1) and lactating non-pregnant females in September (2). Bernard (2002) found non-pregnant females in Amazonia from March to June, with a lactating female in June and a juvenile captured in May.

Panama Bonaccorso (1979) documenting birth peaks in January and July for the species in Panama and a similar pattern is likely followed wherever forest resources permit it (Medellín & Arita 1989). Fleming et al (1972) found that 2 of 2 females captured in March were pregnant (foetal length 22mm), but that individuals captured in October, November and December showed no signs of reproduction. Dechmann et al (2005) recorded two yearly pregnancy peaks on Barro Colorado Island, one in March/April and a second in August/September, with each peak being followed by an increase in the number of lactating females (more distinct after the first pregnancy peak). Presence of males with enlarged testes slowly decreased and peaked in November.

Peru Pregnant females were collected in July (Tuttle 1970). Ascorra et al (1991) note a lactating female in April and a pregnant female in September from PN Manu.

Courtship Only 30% of the 47 individuals of this species documented in Willig (1983) were males, suggesting a significant inequality in the sex ratio. Kalko et al (1999) noted that males were particularly faithful to roosts sites and returned to the roost throughout the night, leading the authors to speculate in the possibility of harem formation in this species - a breeding system that would be apparently supported by the unbalanced sex ratio. Dechmann et al (2007) however demonstrated that the sex ratio is not in fact skewed when captures are made away from roosts, and the apparent scarcity of males when the species is capture at roost sites is an artefact of the breeding system.

Dechmann et al (2005) noted that males captured with a harem of females were in notably better condition than those without females (larger and heavier). During a five year study harem males were never seen to lose their status, but three single males and a male from a bachelor group were later seen to have acquired a harem for themselves. Reproduction of females is highly synchronised and seasonal. Females may change roost site often, meaning that males occasionally raise young of other within their roosts. However the synchronicity of breeding in females mean that there is little to be gained by the male in killing young that are not his own, and the costs incurred are outweighed by the benefits of access to numerous other females guaranteeing him a high breeding success. 17 of 21 mothers caught were still roosting with the father of their young, indicating that females typically remain in the same roost providing they are undisturbed, and acting as an incentive to the male for effective roost maintenance.

Pregnancy Females give birth to a single young. (Medellín & Arita 1989). Dechmann et al (2005) found that the harem male of the nest cavity where the female gave birth was the most likely father of the pup. Harem males were significantly more related to pups found in their own nests than to pups in other nests. Females as young as 6 months were reproductively active (Dechmann et al 2007).

Development Individuals of both sexes depart from the natal roost on approaching sexual maturity. Young females likely disperse to avoid mating with their own father, young males disperse to gain access to females. (Dechmann et al 2007). Females become receptive shortly after parturition.

GENERAL BEHAVIOUR: *Activity Levels* Through radio-tracking, Kalko et al (1999) found that the species emerged late from the day roost (mean 62 minutes after dark, +/-15 minutes) and that there was no notable peak of activity. The lack of an activity peak may be related to the constant low level activity of katydids, the main prey item, throughout the night. Dechmann & Kerth (2008) note that males spend less time foraging than females and devote the extra time to roost maintenance, the costs involved indicating that the benefits of a well-maintained roost in terms of reproductive success are high.

Bernard & Fenton (2003) radiotracked two males and two females in Amazonian Brazil and found the area utilised to be 60-135ha with a maximum linear movement of 0.8-1.6km. It was noted that activity was restricted to the area close to the roost. Bernard (2002) noted a peak of activity in the first part of the night near Manaus, Brazil with most individuals caught between 6 and 11pm, and a second peak of activity from 2-4am.

In Panama bats of this species typically fly through the understorey and close to the ground, whilst the sympatric *Tonatia bidens* flies higher in the subcanopy and canopy, thereby avoiding competition for resources (Bonaccorso 1979).

Home Range Kalko et al (1999) note that foraging took place within 200-500m of the roost site in an area of 4-12ha. 96% of 104 recaptures were within 750m of the original capture site and 46% within 250m.

Roosts In Venezuela the species has been found roosting in termite nests (Handley 1976) and Emmons (1999) suggested that the ability to fold the ears may be an adaptation to such specialised roost sites. Only active termite nests are occupied which have a higher temperature than inactive ones. Dechmann et al (2005) suggested that this may be related to breeding, with altricial young growing more effectively in a warm environment than a cold one (temperatures inside termite nests are 2.1-2.8ºC higher than those inside tree cavities), but refused to rule out other potential benefits such as protection afforded by the hardened nests and the presence of the termites themselves. Dechmann & Kerth (2008) speculated that the termites might provide a protection against parasites that might otherwise infest the nest chamber – the ectoparasite load of this species being lower than that of sympatric and ecologically similar bats.

Kalko et al (1999) documented roosting behaviour in Panama as part of a radiotracking study. Roosts were in active arboreal termite nests measuring 70-80cm high and 40-50cm in diameter located 5-7m from the forest floor. The nests had an opening 15-20cm wide at the bottom leading into a chamber 40-50cm high in which the bats roosted, and they could be clearly seen from below with the use of a head lamp. The roosts were monospecific and contained 4 to 5 individuals which were found to be faithful to their day roosts. Day roosts were also used for periods at night by males but not by the tagged females.

Dechmann et al (2005) demonstrated that the chambers were excavated by single male bats. Males enlarged cavities by biting with the teeth, reinforcing the biting power by pushing themselves off the cavity walls with their forearms. Nest modification bouts recorded lasted between 2 to 35 minutes. Dechmann et al (2009) demonstrated that excavating bats used precanine bilateral bites on 89.7% of excavations, with precanine unilateral (7.6%) and unilateral postcanine bites (2.7%) being much more rarely used. Bite force using this technique was found to be greater in this species than in two other bats (*Trachops cirrhosus* and *Tonatia saurophila*) that occupy a similar feeding niche but do not excavate. Bilateral postcanine bites were not observed at all during excavation. Kalko et al (2006) observed a male bat fall from a roost while excavating, returning immediately and continuing the work. The same authors also observed one bat chew through a 2cm wide branch that traversed the roost chamber. Though only males excavate, no difference in tooth wear was found between males and females and in fact tooth wear was found to be extremely low in adults, which possessed teeth in almost as pristine condition as those of subadults of juveniles. (Dechmann et al 2009)

Only the adult male was seen to modify cavities and did so only when no other bats were present in the roost. Roosts are typically excavated into the arboreal termite nests of *Nasutitermes corniger* (at least on Barro Colorado Island, Panama where nests of other arboreal termite species were ignored). Such nests are constructed from a hardened mixture of chewed wood and excrement, and the excavation and maintenance of cavities is presumed to be a costly exercise for the bat. However the construction of a roost provides potential access to females which brings with it reproductive benefits. Cavities disocuppied by the bats were refilled a few days or weeks later by the termites. (Dechmann et al 2005). Kalko et al (2006) found evidence of a refilled cavity being re-excavated by bats. They also found fragments of nest wall material of 5-10mm diameter below roosts following periods of excavation, these being smooth on one side and rough on the other, suggestive of the fact that they had been actively broken off from the wall cavity.

Kalko et al (2006) noted that a male bat with a recently excavated roost abandoned it when the termite nest cracked and the insects deserted. They noted that a thick branch passing through the middle of the nest had limited enlargement of the cavity, though tooth marks on the branch suggested that the bat had attempted to chew through it.

Certain characteristics of termite nests made them suitable for excavation by bats according to the study of Kalko et al (2006). Chosen nests were at least 30x30cm in diameter, with a mean of 45.9 cm (+/-10.5) wide x 65.2cm (+/-22.2) high. Typically there was little vegetation below the roost but dense vegetation above it. A mean of 1.6 (+/-2.2) small branches dissected occupied roosts. Bats were observed to use less than 15% of the suitable available nests on Barro Colorado Island as roosts. Roosts act as an extended male phenotype, indicating the excellent physical condition of the owner (unfit males are unable to spare the extra energy required for construction) and hence attracting females.

Individuals in Amazonian Brazil used the same roost for a minimum of five and maximum of ten consecutive nights (Bernard & Fenton 2003). They also found the species exclusively in live arboreal termite nests in *Xylopia* trees in secondary forest in monospecific groups of 5 to 7 individuals.

Tuttle (1970) found some roosts in Peru to be shared with *Phyllostomus hastatus* and up to 18 individuals of *L.silvicolum* present, and also reported that a local man had apparently collected specimens that were roosting in a hollow tree. Graham (1988) examined nine roosts of this species in Peru and found 44.4% to be shared with *Phyllostomus hastatus* and none shared with any other species. Note that *P.hastatus* shares a similar social system to this species, yet is much larger and hence *Lophostoma* is unlikely to be able to repel individuals that choose to roost with them. *P.hastatus* is however much less specific in its roosting sites and such "guests" occur only temporarily.

Dechmann et al (2005) found that typically roosts consisted of a single adult male, one to several adult or subadult females and up to five juveniles. Only one group was found to contain a subadult male in addition to the adult male. Non-harem males either roosted alone (n=8) or in larger groups with a maximum of four adult males (n=3). Four groups of females without an adult male were also located. They noted that females often deserted a roost once a capture attempt had been made there but may remain faithful to a single roost for several seasons if undisturbed. (Dechmann & Kerth 2008). Females deserting a roost were often found the following day in a different roost where they had been openly accepted. This indicated that females are aware of the location of roosts in the surroundings, presumably facilitating dispersal and minimising the chances of inbreeding. Dechmann et al (2007) documented cases of females following males to a new roost when forced to abandon the original roost. Such females had already given birth to pups which the male had fathered.

Nest longevity varies from a few months to several years, nests being vulnerable to attack by *Tamandua* sp, tree falls, and factors affecting the termite colony itself. Dechmann et al (2007) observed that 40% of the 45 nests that they followed to observe longevity of roosts were abandoned because the termite colony died. All other roosts persisted until the end of the three year study period, though none were older than 30 months.

Parasites Herrin & Tipton (1975) reported the spinturnicid mite *Periglischrus tonatii* from Venezuela. Medellín & Arita (1989) list one nycteribiid (*Basilia constricta*), six strebliids (*Pseudostrebla ribeiroi, Strebla kohlsi,Trichobius dybasi* all known only from this species, plus *T.joblingi, T.parasiticus* and *Mastoptera minuta*) and one tick (*Ornithodoros hasei*). Guerrero (1997) listed ten streblids as being found on the species (including *Stizostrebla longirostris*).

Dechmann & Kerth (2008) found a mean of 3.62 (+/-5.84) wing mites (Acarina) and 0.79 (+/-1.67) streblids (Streblidae) on this species on Barro Colorado Island, Panama. Sympatric and ecologically very similar *Tonatia saurophila,* a species which roosts in tree holes, where found to have almost triple the parasite load, supporting the hypothesis that the chemical defences of termites and the chosen roost sites of this species help minimise parasite load.

VOCALISATIONS: Sonograms of calls are similar to other foliage-gleaning Phyllostomids. Calls are low amplitude and high frequency and have a duration <2msec. They are typical of the "high-resolution, clutter-rejection strategy" of Simmons et al (1979) which refers to bats that forage in dense habitats.

HUMAN IMPACT: The species is not known to be utilised by indigenous groups in Paraguay, but the Nambiquara tribe of western Brazil collected individuals of this species that were hanging from a branch near a termite nest and consumed them.

CONSERVATION STATUS: Globally considered to be of Low Risk Least Concern by the IUCN, on account of its wide geographic range and unspecialised habitat requirements. See http://www.iucnredlist.org/details/21988 for the latest assessment of the species. Considered stable in Paraguay by López-Gonzalez (2005). Deforestation may represent a threat to the species, and the species is captured less often in disturbed than pristine forest (Brosset et al 1996). Kalko et al (1999) note that the small foraging area of this species and the sedentary foraging technique may render them vulnerable to habitat fragmentation and that availability of roost sites is likely important for the presence of the species. The same authors considered it a good indicator species for habitat quality and level of forest disturbance. Willig et al (2007) found the species to be more abundant in the wet season than the dry season in Iquitos, Peru regardless of the habitat sampled. As far is as currently known the Paraguay records represent the southern limits of the species geographical range.

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REFERENCES:

Aguirre LF 2007 - Historia Natural, Distribución y Conservación de los Murciélagos de Bolivia - Fundación Simón I. Patiño, Santa Cruz.

Anthony HE 1920 - New Rodents and New Bats from Neotropical Regions - *Journal of Mammalogy* 1: p81-86.

Arnold ML, Baker RJ, Honeycutt RL 1983 - Genic Differentiation and Phylogenetic Relationships Within Two New World Bat Genera - *Biochemical Systematics and Ecology* 11: p295-303.

Ascorra CF, Wilson DE, Romo M 1991 - Lista Anotada de los Quirópteros del Parque Nacional Manu, Peru - *Publicaciones del Museo de Historia Natural Universidad Nacional Mayor de San Marcos* 42: p1-14.

Baker RJ, Fonseca RM, Parish DA, Phillips CJ, Hoffmann FG 2004 - New Bat of the Genus *Lophostoma* (Phyllostomidae: Phyllostominae) from Northwestern Ecuador - *Occasional Papers of Museum of Texas Tech University* 232.

Belwood JJ 1989 - Foraging Behaviour, Prey Selection and Echolocation in Phyllostomine Bats p601-605 in *Nachtigall PE* ed. Animal Sonar: Processes and Performance - Plenum Press, New York.

Belwood JJ, Morris GK 1987 - Bat Predation and Sexual Advertisement in Neotropical Katydids - *Science* 238: p64-67.

Bernard E 2002 - Diet, Activity and Reproduction of Bat Species (Mammalia: Chiroptera) in Central Amazonia, Brazil - *Revista Brasileira de Zoologia* 19: p173-188.

Bernard E, Fenton EB 2003 - Bat Mobility and Roosts in a Fragmented Landscape in Central Amazonia, Brazil - *Biotropica* 35: p262-277.

Bonaccorso FJ 1979 - Foraging and Reproductive Ecology in a Panamanian Bat Community - *Bulletin of Florida State Museum of Biological Science* 24: p359-408.

Braun JK, Mares MA 1995 - The Mammals of Argentina: An Etymology – *Mastozoologia Neotropical* 2: p173-206.

Bravo A, Harms KE, Stevens RD, Emmons LH 2008 – *Collpas*: Activity Hotspots for Frugivorous Bats (Phyllostomidae) in the Peruvian Amazon – *Biotropica* 40: p203-210.

Brosset A, Charles-Dominique P, Cockle A, Cosson JF, Masson D 1996 - Bat Communities and Deforestation in French Guiana - *Canadian Journal of Zoology* 74: p1974-1982.

Cabrera A 1917 - Mamíferos del Viaje al Pacífico Verificado de 1862-1865 por una Comisión de Naturalistas Enviada por el Gobierno Español - *Trab. Mus. Nac. Cien. Nat. Serie Zool.* 31.

Davis WB, Carter DC 1978 - A Review of the Round-eared Bats of the *Tonatia silvicola* Complex with Descriptions of Three New Taxa - *Occasional Papers of Museum of Texas Tech University* 53.

Dechmann DKN, Kalko EVK, Kerth G 2007 - All-offspring Dispersal in a Tropical Mammal with Resource Defence Polygyny - *Behavioural Ecology and Sociobiology* 61: p1219-1228.

Dechmann DKN, Kalko EVK, Konig B, Kerth G 2005 – Mating System of a Neotropical Roost-making Bat: The White-throated Round-eared Bat *Lophostoma silvicolum* (Chiroptera: Phyllostomidae) – *Behavioural Ecology and Sociobiology* 58: p316-325.

Dechmann DKN, Kerth G 2008 - My Home is Your Castle: Roost Making is Sexually Selected in the Bat *Lophostoma silvicolum* - *Journal of Mammalogy* 89: p1379-1390.

Dechmann DKN, Santana SE, Dumont ER 2009 – Roost Making in Bats: Adaptations for Excavating Active Termite Nests - *Journal of Mammalogy* 90: p1461-1468.

Eisenberg JF, Redford KH 1999 - Mammals of the Neotropics: Volume 3 The Central Neotropics - University of Chicago Press, Chicago.

Eisenberg JF 1989 - Mammals of the Neotropics: Volume 1 The Northern Neotropics - University of Chicago Press, Chicago.

Emmons LH 1999 - Mamíferos de los Bosques Húmedos de América Tropical - Editorial FAN, Santa Cruz.

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 Cycle and Movement Patterns - *Ecology* 53: p555-569.

Fornes A, Massoia E, Forrest GE 1967 - *Tonatia silvicola* (d´Orbigny) Nuevo Género y Especie para la República Argentina (Chiroptera: Phyllostomidae) - *Physis* 27: p149-152.

Gardner AL 2007 - Mammals of South America Vol 1: Marsupials, Xenarthrans, Bats and Shrews - University of Chicago Press, Chicago.

Genoways HH, Williams SL 1980 - Results of the Alcoa Foundation-Suriname Expeditions I: A New Species of Bat of the Genus *Tonatia* (Mammalia: Phyllostomidae) - *Annals of the Carnegie Museum* 49: p203-211.

Genoways HH, Williams SL 1984 - Results of the Alcoa Foundation-Suriname Expeditions IX: Bats of the Genus *Tonatia* (Mammalia: Chiroptera) in Suriname - *Annals of the Carnegie Museum* 53: p327-346.

Goodwin GG 1942 - A Summary of Recognisable Species of *Tonatia* with Descriptions of Two New Species - *Journal of Mammalogy* 23: p204-209.

Graham GL 1988 - Interspecific Associations Among Peruvian Bats at Diurnal Roosts and Roost Sites - *Journal of Mammalogy* 69: p711-720.

Gray JE 1827 - The Animal Kingdom Arranged in Conformity with its Organisation by the Baron Cuvier with Additional Descriptions of all the Species Hitherto Named and of Many Not Before Noticed by Edward Griffith....and Others - E.Griffith, London.

Gray JE 1838 - A Revision of the Genera of Bats (Vespertilionidae) and the Description of Some New Genera - *Magazine Zoology and Botany* 2: p483-505.

Guerrero R 1997 - Catalogo de los Streblidae (Diptera: Pupipara) Parásitos de Murciélagos (Mammalia: Chiroptera) del Nuevo Mundo VII. Lista de Especies, Hospedadores y Paises - *Acta Biologica Venezolana* 17: p9-24.

Hall ER 1981 - The Mammals of North America - John Wiley & Sons, New York.

Handley CO 1976 - Mammals of the Smithsonian Venezuelan Project - *Brigham Young Univ. Sci. Bull. Biological Series* 20: p1-89.

Herrin CS, Tipton VJ 1975 – Spincturnicid Mites of Venezuela (Acarina: Spincturnicidae) - *Brigham Young Univ. Sci. Bull. Biological Series* 20: p1-72.

Hoffman FG, Hoofer 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.

Howell DJ, Burch D 1974 - Food Habits of Some Costa Rican Bats - *Revista de Biologia Tropical* 21: p281-294.

Husson AM 1962 - The Bats of Suriname - *Zool. Verhand. Rijksmus. Nat. Hist. Leiden* 58: p1-282.

Kalko EKV, Friemel D, Handley CO, Schnitzler HU 1999 - Roosting and Foraging Behaviour of Two Neotropical Gleaning Bats, *Tonatia silvicola* and *Trachops cirrhosus* (Phyllostomidae) - *Biotropica* 31: p344-353.

Kalko EKV, Ueberschaer, Dechmann D 2006 - Roost Structure, Modification and Availability in the White-throated Round-eared Bat *Lophostoma silvicolum* (Phyllostomidae) Living in Active Termite Nests - *Biotropica* 38: p398-404.

Krutzsch PH 2000 - Anatomy, Physiology and Cyclicity of the Male Reproductive Tract p91-155 in *Crichton E, Krutzsch PH* eds Reproductive Biology of Bats - Academic Press, London.

Lee TE, Hoofer SR, Van den Bussche RA 2002 - Molecular Phylogenetics and Taxonomic Revision of the Genus *Tonatia* (Chiroptera: Phyllostomidae) - *Journal of Mammalogy* 83: p49-57.

López-Gonzalez C 2005 - Murciélagos del Paraguay - Biosfera Numero 9.

Médellin RA, Arita HT 1989 - *Tonatia evotis* and *Tonatis silvicola* - *Mammalian Species* 334.

Myers P, Espinosa R, Parr CS, Jones T, Hammond GS, Dewey A 2006 - The Animal Diversity Web (online). Accessed December 2007.

Myers P, Wetzel R 1979 - New Records of Mammals from Paraguay - *Journal of Mammalogy* 60: p638-641.

d´Orbigny A 1836 - Voyage dans l´Amérique Méridionale (le Brésil, la République Orientale de l´Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou) Exécuté Pendants les Années 1826-1833 - P. Bertrand, Paris.

d´Orbigny A 1837 - Voyage dans l´Amérique Méridionale (le Brésil, la République Orientale de l´Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou) Exécuté Pendants les Années 1826-1833 - P. Bertrand, Paris.

d´Orbigny A, Gervais P 1847 - Voyage dans l´Amérique Méridionale (le Brésil, la République Orientale de l´Uruguay, la République Argentine, la Patagonie, la République du Chili, la République de Bolivia, la République du Pérou) Exécuté Pendants les Années 1826-1833 - P. Bertrand, Paris.

Palmer TS 1904 - Index Generum Mammalium - US Department of Agriculture Biological Survey, North American Fauna 23, 984pp.

Patterson BD 1992 - Mammals in the Royal Natural History Museum, Stockholm Collected by AM Olalla during 1934-1938 - *Fieldiana Zoology* 1432.

Pelzeln A von 1883 - Brasilische Säugethiere. Resultate von Johann Natterer´s Reisen in den Jahren 1817 bis 1835 - *Verhandl. Kaiserl.-Königl. Zool. Gesellsch Wien* 33 (supp): p1-140.

Peters W 1865 - Über die zu den *Vampyri* Gehörigen Flederthiere und über die natürliche Stellung der Gattung - *Antozous. Monatsber. König. Preuss. Akad. Wiss. Berlin* 1866: p503-525.

Reis dos NR, Peracchi A 1987 - Quirópteros da Região de Manaus, Amazonas, Brasil (Mammalia: Chiroptera) - *Bol. Mus. Paraense Emilio Goeldi Serie Zoologia* 3: p161-182.

Reis dos NR, Peracchi AL, Pedro WA, Lima de IP 2007 - Morcegos do Brasil - Londrina, Brazil.

Schinz HR 1844 - Systematisches Verzeichniss alles bis jetzt Bekannten Säugethiere oder Synopsis Mammalium nach der Cuvier´schen System - Jent und Gassman, Solothurn.

Simmons JA, Fenton MB, O´Farrell MJ 1979 - Echolocation and Pursuit of Prey in Bats - *Science* 203: p16-21.

Spix JB von 1823 - Simiarum et Vespertilionum Brasiliensum Species Novae: Ou Histoire Naturelle des Esepecies Nouvelles de Singes et Chauves-souris Observées et Recueilles Pendant le Voyage dans L´interieur de Bresil - Typis Francisi Serephici Hübschmanni, Monaco.

Thomas O 1902 - Notes on the Phyllostomatous Genera *Mimon* and *Tonatia* - *Annals and Magazine of Natural History Series 7* 10:p53-54.

Thomas O 1910 - Mammals from the River Supinaam, Demerara, Presented by Mr FV McConnell to the British Museum - *Annals and Magazine of Natural History Series 8* 6:p184-189.

Tuttle MD 1970 - Distribution and Zoogeography of Peruvian Bats with Comments on Natural History - *University of Kansas Science Bulletin* 49: p45-86.

Villa-R B, Villa-Cornejo M 1973 - Observaciones Acerca de Algunos Murciélagos del Norte de Argentina, Especialmente de la Biología del Vampiro *Desmodus rotundus* - *Annaes del Instituto Biol. Mexico Zoologia* 42: p107-148.
Wagner JA 1843 - Diagnosen neuer Arten Brasilischer Säugthiere - *Arch. Naturgesch* 9: p365-368.
Whitaker JO, Findley JS 1980 - Foods Eaten by Some Bats from Costa Rica and Panama - *Journal of Mammalogy* 61: p540-544.
Willig MR 1983 - Composition, Microgeographic Variation, and Sexual Dimorphism in Caatinga and Cerrado Bat Communities from Northeast Brazil - *Bulletin of Carnegie Museum* 23.
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.

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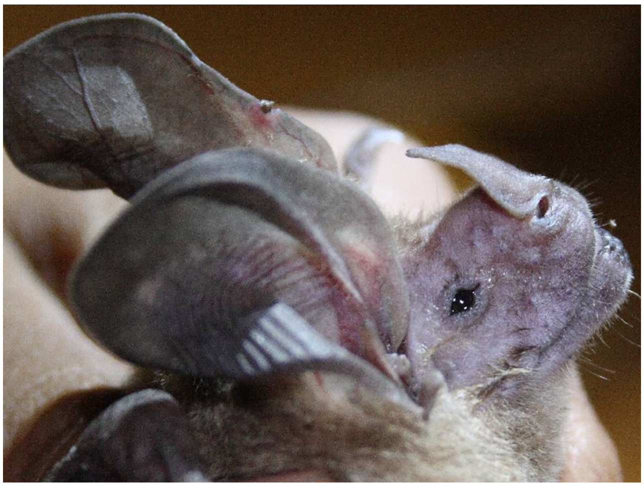
***FIGURE 2* - D´Orbigny´s Round-eared Bat** *Lophostoma silvicolum.*
Head detail (© Merlin D. Tuttle, Bat Conservation International, www.batcon.org).
***FIGURE 3* -** (FPMAM114PH) **D´Orbigny´s Round-eared Bat** *Lophostoma silvicolum.*
Adult head detail frontal. Bahía Negra, Departamento Alto Paraguay, September 2009. Photo Silvia Centrón.



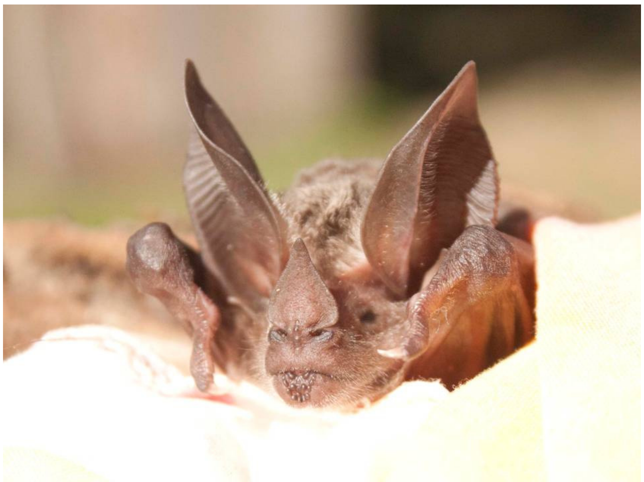


FIGURE 4 **-** (FPMAM113PH) **D´Orbigny´s Round-eared Bat** *Lophostoma silvicolum.*
Adult head detail. Bahía Negra, Departamento Alto Paraguay, September 2009. Photo Silvia Centrón.
FIGURE 5 **-** (FPMAM1073PH) **D´Orbigny´s Round-eared Bat** *Lophostoma silvicolum.*
Adult head detail. Laguna Blanca, Departamento San Pedro, January 2012. Photo Jonny Miller.
FIGURE 6 **-** (below) **D´Orbigny´s Round-eared Bat** *Lophostoma silvicolum.*
Adult head detail. (©Marco Mello www.casadosmorcegos.org).

FIGURES 7-12 - Skull (©Philip Myers/Animal Diversity Web http://animaldiversity.ummz.umich.edu).