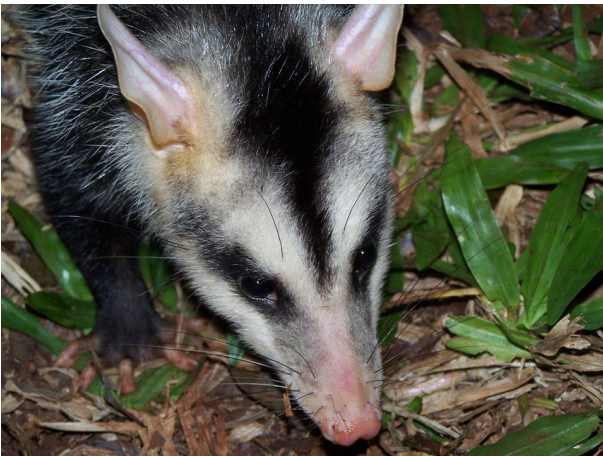


**FAUNA**  
**Paraguay**

# FAUNA PARAGUAY HANDBOOK OF THE MAMMALS OF PARAGUAY



**VOL 1: MARSUPIALIA**  
**2009 EDITION**

FAUNA PARAGUAY  
HANDBOOK  
OF THE  
MAMMALS OF  
PARAGUAY

VOL 1: MARSUPIALIA  
2009 EDITION

by  
Paul Smith

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# 1a

## Introduction to Paraguayan Marsupialia

The word marsupial, to the uninitiated, conjours up images of “primitive” mammals with a belly pouch in which they rear their young – their limited distribution across the globe indicative of the inferiority of their reproductive system when compared to the “higher” mammals. But that would do them a great disservice. Firstly not all marsupials even possess pouches, in fact more than half the species living Paraguay do not! Secondly pouch-breeding did not evolve by accident and is in no way inferior to “womb-breeding” when it comes to an effective strategy for self-perpetuation. In fact it has several distinct advantages. By raising the young outside of the womb from an early stage, breeding can be easily aborted if conditions later become too harsh to permit its success and at much lower cost to the parent (in fact the newly-born young can be converted quickly back into much-needed nutrients by the mother!). Secondly it allows for a faster breeding cycle with larger litter sizes than is possible in most other mammals. Thirdly the mother can remain mobile throughout her pregnancy, the young simply hanging on to her as she goes about her business. Marsupials are not inferior; they have just managed to find a different answer to the same question of how to propagate themselves effectively.

South America was once home to a great diversity of marsupials on a par with those of modern-day Australia – with the “sabre-toothed tiger-like” *Thylacosmilus* occupying first place in the food web hierarchy, right down to the tiny shrew-like *Palaeothentes* somewhere down near the bottom, marsupials evolved to fill every available niche. Today only three surviving Neotropical orders remain – the Didelphimorphia, the Paucituberculata and the Microbiotheria - with all Paraguayan species belonging to the former and the sole family Didelphidae, commonly known as “opossums” (which should not be confused with the unrelated Australian “possums”).

A total of 15 species of opossum occur in Paraguay, from the large and adaptable White-eared Opossum *Didelphis albiventris* which has no problem living alongside man, right down to the tiny Dwarf Short-tailed Opossum *Monodelphis kunyi* the smallest member of the family and so tiny that its presence in Paraguay has been overlooked until very recently! Though principally forest dwellers, opossums have evolved to fill every niche imaginable, both humid and dry, and are present in all the major ecosystems in modern day Paraguay. The Brown Four-eyed Opossum *Metachirus nudicaudatus* is largely terrestrial; the ponderous Brown-eared Woolly Opossum *Caluromys lanatus* scarcely ever descends to the ground; whilst a host of other species fill every space in between, with tiny mouse-like arboreal species making use of vines and bamboo tangles (*Gracilinanus*, *Micoureus* etc); the nimble Southeastern Four-eyed Opossum *Philander frenatus* as at home on the ground as he is in the trees.

The aim of this volume is to summarise the current knowledge of the biology and ecology of the Paraguayan species of Marsupialia and present it in an accessible and readable form that I hope will be of interest to amateurs and of utility to professionals who work with this fascinating and ancient group of mammals.

# 1b

## Taxonomy of the Didelphimorphia, Gill 1872

The higher level taxonomy of the Didelphimorphia has undergone considerable changes over recent years with wider use of new molecular and genetic techniques for determining relationships radically re-shaping our traditional understanding of the group and the species limits. That said much work still needs to be done, especially to clarify the species limits in the genera *Gracilinanus*, *Cryptonanus*, *Marmosa*, *Marmosops*, *Monodelphis* and *Thylamys* amongst others. The taxonomy used in this volume follows Gardner (2007).

As currently recognised the Didelphimorphia forms an Order within the Cohort Marsupialia, a more wide-ranging group containing two other extant Neotropical orders and a host of more distantly related orders in Australasia. The latest review of the group splits the family Didelphidae into two subfamilies, the Caluromyinae (for the Woolly Opossums) and the Didelphinae (for the True Opossums). The Didelphinae are further separated into three tribes, the Didelphini (the Pouched Opossums), the Metachirini (the Brown Four-eyed Opossum) and the Monodelphini (the Pouchless Opossums). The Didelphimorphia in their current form are entirely New World in distribution, with the great majority of species in the Neotropical region. (Gardner 2007).

The previous review of the group by Hershkovitz (1992) was controversial in splitting the Didelphidae into four separate families based largely on morphological grounds. The arrangement failed to gain widespread following and with the advent of DNA analysis was rapidly abandoned. See below for a comparison of the most recent classifications:

### Hershkovitz (1992)

#### INFRAClass MARSUPIALIA

#### ORDER DIDELPHIDIA

##### Family Caluromyidae

Subfamily Caluromyinae – *Caluromys*

Subfamily Caluromysopsinae – *Caluromysiops*

##### Family Marmosidae

Subfamily Marmosinae – *Micoureus*, *Marmosa*,  
*Marmosops*, *Gracilinanus*

Subfamily Thylaminae – *Thylamys*

Subfamily Lestodelphinae - *Lestodelphys*

Subfamily Monodelphinae - *Monodelphis*

Subfamily Metachirinae – *Metachirus*

##### Family Glironidae – *Glironia*

Family Didelphidae – *Didelphis*, *Chironectes*,  
*Philander*, *Lutreolina*

### Gardner (2007)

#### COHORT MARSUPIALIA

#### ORDER DIDELPHIMORPHIA

##### Family Didelphidae

Subfamily Caluromyinae - *Caluromys*, *Caluromysiops*,  
*Glironia*

Subfamily Didelphinae

Tribe Didelphini - *Chironectes*, *Didelphis*, *Lutreolina*,  
*Philander*

Tribe Metachirini - *Metachirus*

Tribe Monodelphini - *Chacodelphys*, *Cryptonanus*,  
*Gracilinanus*, *Hyladelphys*, *Lestadelphys*, *Marmosa*,  
*Marmosops*, *Micoureus*, *Monodelphis*, *Thylamys*

# 2

## Family

# Didelphidae: Opossums

**General characteristics:** Fifteen species, the only Paraguayan representatives of the order Marsupialia. Most species are nocturnal (*Monodelphis* is a notable exception) and can be detected by the bright red or orange eye-shine they give under torchlight, the eyes typically appearing small and well-separated. Terrestrial opossums are characterized by a comparatively short tail and well-developed hind legs, arboreal species by a long tail (often with a prehensile tip) and large forelimbs. There is much variation in size amongst the genera, from very small (*Cryptonanus* 12cm; 15g) to large (*Didelphis* 105cm; 2kg). The snout is long and in most species the ears are well-developed though delicate, often being smoothed down against the head whilst walking to avoid damage. Each foot possesses five digits, the forefeet small, the hind feet slightly longer with a large opposable thumb lacking a nail. The dentition is heterodont with as many as 50 teeth typical, all teeth behind the canines being pointed. A fenestrated bony palate is diagnostic of the family. Fossil Didelphids are known from the Late Cretaceous in South America. The reproductive behaviour of this family is unique amongst Paraguayan mammals, the young being born undeveloped but with well-developed forelimbs after a brief gestation of a couple of weeks. The newborn then makes its way to the teat where it continues its development for a further 4 to 6 weeks. Once they reach a size too large to be transported by the mother they are deposited in a nest lined with dry leaves where they continue to be fed. A pouch is present in some genera (*Didelphis*, *Philander*, *Chironectes* etc) but absent in others (*Monodelphis*, *Metachirus*, mouse-opossums), while *Caluromys* develops a pouch only during the period of lactation.

**Cranial characteristics:** Robust zygomatic arch. Elongated cranial case. Angular process of mandible bent inwards. Small auditory bullae are tripartite consisting of unfused elements of the alisphenoid, petrotic and ectotympanic. See Fig 2 for annotated Didelphid skull.

**Dental characteristics:** Dental formula I5/4 C1/1 P3/3 M4/4 = 50. Incisors polyprotodont, I1 being longest and separated from I2 by a space. Upper canines well-developed. Third premolar small multicuspid, molariform and deciduous. Molars trituberculate with prominent stylar shelf.

**Skeletal characteristics:** Pentadactyl feet with a phalangeal formula 2-3-3-3-3. Hallux lacks a nail but retains a reduced eponychium.

**Taxonomy:** According to Reig, Kirsch & Marshall (1985) the Didelphidae can be separated into two subfamilies - Caluromyinae and Didelphinae. The former is represented in Paraguay only by a single species in the genus *Caluromys*, the latter can be split into three tribes Metachirini (containing only *Metachirus*), Monodelphini (containing the genera *Monodelphis*, *Cryptonanus*, *Gracilinanus*, *Micoureus* and *Thylamys*) and Didelphini (containing the genera *Chironectes*, *Didelphis*, *Lutreolina* and *Philander*).

# 3

## Key to the Adult Opossums of Paraguay

- 1a** Pelage long and woolly, long prehensile tail furred along basal third, conspicuous medial facial stripe, large forward-facing eyes and arboreal behaviour.....*Caluromys lanatus*
- 1b** Not as above.....**2**
- 2a** Size small to medium, terrestrial and typically diurnal in behaviour. Aspect shrew-like or mouse-like with short tail <70% of head and body length..... *Monodelphis* **3**
- 2b** Not as above.....**5**
- 3a** Colouration uniform on dorsum without contrasting colouration on flanks, head or rump..... **4**
- 3b** Flanks reddish, contrasting with browner dorsum and paler underparts. Rump dark reddish. Fur short and smooth, lying flat against body.....*Monodelphis sorex*
- 4a** Size small (hindfoot with claw <16mm). Dorsal colouration uniformly reddish or reddish-brown.....*Monodelphis kunsi*
- 4b** Size larger (hindfoot with claw >18mm). Dorsal colouration uniformly grey or grey-brown.....*Monodelphis domestica*
- 5a** Conspicuous pale spots above eye and at base of ears..... **6**
- 5b** No conspicuous pale spots above eye and at base of ears.....**7**
- 6a** Dorsal pelage predominately brown. Secondary pale spots large and located behind ears. Tail naked at base and uniformly-coloured or paling gradually towards tip - not sharply bicoloured. Female lacks pouch..... *Metachirus nudicaudatus*
- 6b** Dorsal pelage predominately greyish or blackish. Secondary pale spots small and located in front of ears. Tail furred for basal 6-8cm and sharply bicoloured. Pouch present in female.....*Philander frenatus*
- 7a** Dorsal pelage dense and velvety, predominately black with grey markings. Tail furred for basal 10%, naked and black for rest of length with whitish tip. Webbed feet. Swims well.....*Chironectes minimus*
- 7b** Not as above.....**8**
- 8a** Ears extremely short, rounded and dark, barely projecting above fur. General appearance weasel-like. Pelage uniformly brownish or reddish. Tail extremely thick at base, and furred along basal third. Mainly terrestrial but climbs and swims readily.....*Lutreolina crassicaudata*
- 8b** Not as above.....**9**

- 9a** Size large (total length >500mm). Pelage with long, prominent guard hairs and soft, dense underfur. Females with well-developed marsupium.....*Didelphis* **10**
- 9b** Size small or medium (total length generally much less than 450mm) . General appearance mouse-like. Pouch absent.....**11**
- 10a** Dorsal pelage mostly greyish. Prominent white facial markings. Ears pale. Widespread in a variety of habitats.....*Didelphis albiventris*
- 10b** Dorsal pelage mostly blackish. Golden-buff facial markings. Ears dark. Forested areas only.....*Didelphis aurita*
- 11a** Size medium (>350mm). Pelage long and woolly. Pelage extends onto white-tipped tail for >30mm or more.....*Micoureus paraguayanus*
- 11b** Size small (<200mm). Pelage short. Pelage extends onto tail for c15mm or less.....**12**
- 12a** Ratio of tail length to head and body length between 1 and 1.25. Fat may be stored at base of tail at certain times of year. Soles of feet densely covered with small tubercles. Length of digit IV <0.45 times the hindfoot length. Teats arranged in bilaterally symmetrical rows.....*Thylamys* **13**
- 12b** Ratio of tail length to head and body length between 1 and 1.96. Fat never stored at base of tail. Tail scales rounded or square with annular arrangement. Soles of feet smooth or sparsely granulated. Length of digit IV >0.45 times the hindfoot length. Teats with typical circular arrangement.....**14**
- 13a** Size large, tail >135mm. Weight >40g. Tail with whitish tip.....*Thylamys macrurus*
- 13b** Size small, tail <135mm. Weight <35g. Tail lacks whitish tip.....*Thylamys pusillus*
- 14a** Dorsal pelage short, pale brown to greyish-brown. Ventral pelage creamy with greyish base. Ratio of tail length to head and body length >1.2 but usually <1.5. Tail length 110-165mm. P2 and P3 of equal height.....*Gracilinanus agilis*
- 14b** Dorsal pelage brownish-grey. Ventral pelage not grey-based. Ratio of tail length to head and body length <1.2. Tail length 95-117mm. P2 smaller than P3.....*Cryptonanus chacoensis*



# 4

## Subfamily Caluromyinae, Kirsch 1977

**Cranial characteristics:** Palatal fenestrae and vacuities absent.

**Dental characteristics:** M2 longer than or of equal length to M3. Upper molars separated with subequal paracones and metacones and paracrista not united to styler cusps.

**Taxonomy:** Five species in three genera in South America. A single species in the genus *Caluromys* occurs in Paraguay.

### CONTENTS

*Caluromys* JA Allen, 1900: Woolly Opossums

#### **Synonyms:**

*Didelphis* Linnaeus 1758:54. In part.

*Philander* Beckmann 1772:244. Type species *Didelphis philander* Linnaeus 1758 by absolute tautonymy. Preoccupied by *Philander* Brisson 1762.

*Didelphys* Schreber 1777:532. In part. Unjustified emendation.

*Sarigua* Muirhead 1819:429. In part.

*Micoureus* Lesson 1842:186. In part.

*Philander* Burmeister 1856:74. Type species *Didelphys (Philander) cayopollin*, Burmeister 1856 (= *Didelphys cayopollin* Schreber 1778). Described as a subgenus of *Didelphis*. Name preoccupied.

*Gamba* Liais 1872:330. In part.

*Cuica* Liais 1872:330. In part.

*Micoureus* Ihering 1894:11. In part.

*Caluromys* JA Allen 1900:189. Type species *Didelphis philander* Linnaeus 1758.

*Micoureus* Matschie 1916:269. In part. Described as a subgenus of *Didelphis*.

*Mallodelphys* O.Thomas 1920:195. Type species *Didelphis laniger* Desmarest 1820. Described as subgenus of *Philander*.

*Calaromys* A.Miranda-Ribeiro 1936:324. Incorrect spelling.

*Mallodelphis* Gilmore 1941:317. Incorrect spelling.

*Calurosmys* Ávila-Pires 1964:11. Incorrect spelling.

**General characteristics:** A single, strictly arboreal species in Paraguay with extremely thick, woolly pelage and dark facial stripes. Tail very long and prehensile, furred along the basal one-third of its length. Ears large and naked. Captive specimens live longer than other Didelphids and studies reveal that extended maternal care and small litter sizes are the norm. They have a larger brain volume than other members of the family. Females develop a pouch only for the period of lactation. Fossil material is known from the Pleistocene of South America. Diploid chromosome number 14.

**Cranial characteristics:** Skull is short and broad with well-developed supraorbital processes, large orbits, a broad brain case and a broad palate lacking fenestrae.

**Dental characteristics:** Styler shelf of the upper molars reduced and styler cusps reduced.

#### **Paraguayan Species:**

*Caluromys lanatus* - Brown-eared Woolly Opossum

5

Brown-eared  
Woolly Opossum  
*Caluromys lanatus*

- Didelphys lanata* Illiger, 1815:107. Nomen nudum.  
*D[idelphys] lanata* Olfers, 1818:206. Caazapá, Paraguay, based on Azara (1801).  
*Didelphis lanigera* Desmarest, 1820:258. Caazapa', Paraguay; based on Azara's (1801).  
*Didelphys lanigera* Waterhouse, 1841:98. Name combination.  
*Micoureus lanigera* Lesson, 1842:186. Name combination.  
*Didelphys ochropus* Wagner, 1842:359. Barra do Rio Negro, Amazonas, Brazil.  
*D[idelphys] ornata* Tschudi, 1845:146. "der mittleren und tiefen Waldregion," Peru.  
*Didelphys [Philander] lanigera* Thomas, 1888:339. Part; name combination.  
*Philander cicur* Bangs, 1898:161 "Pueblo Viejo, Colombia."  
*P[hilander]. ornatus*: Bangs, 1898:162. Name combination.  
*[Didelphys (Philander)] cicur* Trouessart, 1898:1238. Name combination.  
*[Didelphys (Philander) laniger] ochropus* Trouessart, 1898:1238. Name combination; synonymy of *Didelphys (Philander) laniger derbiana*.  
*[Didelphys (Philander) laniger] ornata* Trouessart, 1898:1238. Name combination.  
*Caluromys cicur* Allen, 1900:189. Name combination.  
*Caluromys laniger* Allen, 1900:189. Name combination for *Didelphis lanigera* Desmarest, 1820.  
*Caluromys derbianus ornatus* Allen, 1900:189. Name combination.  
*[Caluromys] ochropus* Thomas, 1901:196. Name combination.  
*C[aluromys] [laniger] cicur* Thomas, 1901:196. Name combination.  
*[Caluromys] ornatus* Thomas, 1901:196. Name combination.  
*[Didelphys (Philander) laniger] ornatus* Trouessart, 1905:855. Name combination and incorrect gender.  
*P[hilander] [laniger] cicur* Thomas, 1913:358. Name combination.  
*P[hilander] [laniger] ornatus* Thomas, 1913:358. Name combination.  
*Philander laniger jivaro* Thomas, 1913:360. "Sarayacu on the Pastasa River," Pastaza, Ecuador.  
*Philander laniger* Cabrera, 1916:514. Name combination.  
*Micoureus ochropus* Matschie, 1916:269. Name combination.  
*Micoureus ornatus* Matschie, 1916:269. Name combination.  
*Micoureus juminensis* Matschie, 1917:283. "Chanchamayo in der Nähe von La Merced, Provinz Junin, Peru"  
*Micoureus meridensis* Matschie, 1917:285. "von Briceno in der Montana de la Sierra bei Merida in Venezuela"  
*Micoureus cahyensis* Matschie, 1917:288. "Am Rio Cahy in Rio Grande do Sul," Brazil.  
*Micoureus bartletti* Matschie, 1917:288. "Chamicaros-Fluß, südlicher Nebenfluß des Marañon zwischen Huallaga and Ucayali," Loreto, Peru.  
*Micoureus nattereri* Matschie, 1917:291. "von Caissara, Matto Grosso," Brazil.  
*[Philander laniger] ochropus*: Cabrera, 1919:33. Name combination.  
*Mallodelphis lanigera ochropus*: Miranda-Ribeiro, 1936:355. Name combination.  
*Mallodelphis lanigera hemiura* Miranda-Ribeiro, 1936:355. Type locality unknown.  
*Mallodelphis lanigera vitalina* Miranda-Ribeiro, 1936:355. "Barra do Paraope'ba, Minas Geraes," Brazil.  
*Mallodelphis lanigera nattereri* Miranda-Ribeiro, 1936:356. Name combination.  
*Mallodelphis lanigera modesta* Miranda-Ribeiro, 1936:356. "Mato Grosso, provavelmente Pantanal," Brazil.  
*Caluromys laniger ochropus* Tate, 1939:163. Name combination.

[*Caluromys laniger*] *meridensis* Tate, 1939:163. Name combination.

[*Caluromys laniger*] *jivaro* Tate, 1939:163. Name combination.

*Caluromys laniger ornatus* Sanborn, 1949:277. Name combination.

P[*hilander*] *lanata* Hershkovitz, 1951:552. Name combination.

*Philander calmensis* Vieira, 1955:347 Incorrect subsequent spelling of *Micoureus cabyensis* Matschie, 1917.

*Caluromys lanatus cicur* Cabrera, 1958:2. Name combination.

*Caluromys lanatus lanatus* Cabrera, 1958:2. Name combination.

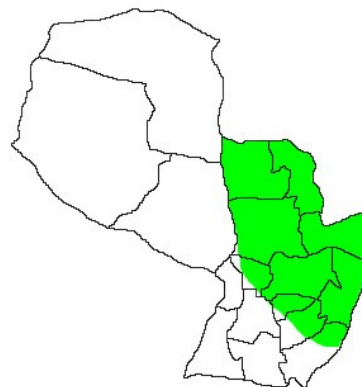
*Caluromys lanatus ochropus* Cabrera, 1958:3. Name combination.

*Caluromys lanatus ornatus* Cabrera, 1958:3. Name combination.

## ***Caluromys lanatus* (Olfers 1818)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Caluromyinae (Myers et al 2006). The genus *Caluromys* contains four species one of which occurs in Paraguay. *Caluromys* is derived from the Greek meaning "beautiful mouse", *lanatus* means "woolly", in reference to the woolly pelage of the species. There are six subspecies, that present in Paraguay is *C.l.lanatus* Olfers 1818 (Type Locality Caazapá, Paraguay). The species description was attributed to Illiger (1815) by Redford & Eisenberg (1992) and Massoia et al (2000) but this is a Nomen nudum and the error was corrected by Cáceres & Carmignotto (2006). Synonyms adapted from Cáceres & Carmignotto (2006).

**ENG:** Brown-eared Woolly Opossum (Gardner 2007), Western Woolly Opossum (Cáceres & Carmignotto 2006), Woolly Opossum (Redford & Eisenberg 1992).



**ESP:** Comadreja lanuda (Chebez 2001), Comadreja lanosa (Chebez 2001, Massoia et al 2000), Cuica lanosa (Chebez 2001, Redford & Eisenberg 1992), Cuica lanuda (Massoia et al 2000), Chucha (Massoia et al 2000), Zarigüeya lanuda occidental (Emmons 1999).

**GUA:** Mbicuré lanoso (Chebez 2001), Mykuré viyú (Chebez 2001, Massoia et al 2000).

**DES:** A medium-sized opossum with dense woolly fur. Dorsally they are predominately pale brown in coloration, frequently with shades of greyish or reddish, and more strongly orange on the shoulders, limbs and crown. Some individuals possess a greyish patch between the shoulders. Head somewhat greyer with a dark stripe along the centre of the face passing from the forehead, between the eyes and along the rostrum and contrasting with whiter cheeks. Snout short, giving the face a vaguely flattened appearance. The large, rounded eyes have brownish or orange orbital rings which accentuate their "teddy bear-like" appearance. Eyes give a bright orange-yellow reflection at night. Ears are large, rounded and naked with pinkish-tan coloration, appearing dark against the pelage. Ventrally they are yellowish-white, darkening to greyish medially. The reddish-brown feet are strong with well-developed pads for gripping and long claws on all digits except the thumb of the hindfeet. Tail is densely-furred along half the dorsal side and 20% of its ventral side, and is approximately 140% body length. Females develop a pouch only when they have young, and abdominal and inguinal mammae are confined to the pouch region. The terminal portion of the tail is naked, usually pale yellowish in colour and is fully prehensile. Juveniles are similar but greyer in coloration. **CR** - Braincase large, rostrum short but robust. Paraoccipital process does not surpass occipital condyle. Postorbital processes well-developed, lambdoidal and sagittal crests reduced. Dorsal projection of superior portion of zygomatic reduces orbit size. Small palatine foramina and foramen rotundum, and no foramen ethmoidale. Palatal process absent but rostral process of premaxillae present so that upper canine inserts in maxillary bone. Nasal bone broadens posteriorly with tips extending anteriorly above or beyond I1 so that nasal orifice is not visible dorsally. Mandible with two mental foramina. Angular process obtuse and weakly inflected. Maxillopalatine, palatine and maxillary fenestrae all absent. Transverse canal foramen lacking.

*Condylolincisive Length* 59.5mm (56.5-62.8mm); *Zygomatic Width* 34.8mm (32.7-37.1mm); *Width of Braincase* 20.6mm (19.4-22.3mm); *Interorbital Constriction Width Posterior to Postorbital Processes* 8.4mm (7.6-9.2mm); *Rostral Length* 22.8mm (21.7-24.0mm); *Rostral Width* 13.0mm (12.3-13.8mm); *k* 25.8mm (22.2-27.1mm); *Length of Palate* 31.9mm (30.5-33.4mm); *Width of Palate* 17.7mm (17.1-18.2mm); *Mastoid Width* 23.3mm (21.4-25.6mm); *Basioccipital Length* 8.7mm (8.2-9.2mm); *Cranial Depth* 18.9mm (16.6-21.1mm); *Length of Molar Row* 9.8mm (9.2-10.1mm); *Length C to M4* 20.6mm (18.2-22.2mm). (Patton et al 2000).



*Caluromys lanatus*. Photo courtesy of www.skullsunlimited.com

**DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. Crowns of I2-I5 asymmetrical with longer anterior than posterior cutting edges. Upper canine simple lacking accessory cusps. Upper premolar small and situated directly behind the canine. Clear gap between small P1 and much larger P2. P3 with well-developed cutting edges but shorter in height than P2. M1 wider than M4 and upper molars lack ectoflexus. Molar dentition weakly carnassialized and weakly dilambdodont with a continuous shelf along anterior margin of crowns of M1-M3. Mandibular teeth with distinct lingual cusps in i1-i4, a p2 taller than p3, a deciduous p3 with a complete tricuspid trigonid, a labially salient hypoconid in m3, and a large and well-developed entoconid in m1-m3. Occlusal area of molars

reduced. (Redford & Eisenberg 1992, Cáceres & Carmignotto 2006). **CN:** 2n=14. FN=24. (Redford & Eisenberg 1992). The autosomal complement consists of four pairs of large biarmed and two pairs of medium-sized subtelocentric autosomes; the X-chromosome is a small biarmed element and the Y-chromosome is very small but appears distinctly biarmed (it is uni-armed in other *Caluromys* species). (Patton et al 2000).

**TRA:** No information. This is a predominately arboreal species that rarely descends to the ground (Redford & Eisenberg 1992).

**MMT:** A medium-sized opossum with tail approximately 140% head and body length. **TL:** 66.1cm (60.2-70.2cm); **HB:** 27.3cm (20.1-31.9cm); **TA:** 38.77cm (33-44.6cm); **FT:** 4.22cm (3-5.1cm); **EA:** 3.49cm (3-4.1cm); **WT:** 3.2kg (3.1-5.2kg); **WN:** 3.6g. (Massoia et al 2001, Emmons 1999, Redford & Eisenberg 1992, Marshall 1978 (Cáceres & Carmignotto 2006).

**SSP:** Unlikely to be confused if seen well. This is the only medium-sized, arboreal, pale brownish opossum with dense woolly fur. Note also the characteristic vertical line down the centre of the face.

**DIS:** Widely distributed in the Neotropics, east of the Andes from central Colombia and southern and western Venezuela south through eastern Ecuador and western Brazil to Bolivia and eastern Paraguay, reaching extreme northern Argentina in Provincia Misiones. Brown (2004) lists the following specimen for Paraguay Departamento Canendiyú; Curuguaty 13.3 km N (Myers. 1979. MZUM). There are four described subspecies, the nominate subspecies *C.lanatus lanatus* (Olfers 1818) being found in Paraguay, northern Argentina, and from Mato Grosso to São Paulo states in Brazil. *C.laicur* (Bangs 1898) is the most northerly subspecies occurring in eastern Colombia and western Venezuela. *C.lornatus* (Tschudi 1845) is found in extreme eastern Ecuador, much of eastern Peru (except the north-eastern corner) and central-west Bolivia; *C.lochropus* (Goldman 1914) is the most wide-ranging subspecies occurring in southern Colombia and Venezuela, the Orinoco and Amazon Basins of Brazil and Amazonian Peru and Bolivia.

**HAB:** Found in humid and gallery forest, generally being trapped in the canopy and subcanopy at heights of 5-15m. They have also been reported to occur in xerophytic fores and dense savanna. They are apparently able to survive in quite fragmented forest as well as larger tracts.

**ALI:** The anatomy of the digestive tract shows specialisations for a diet of fruit and plant matter, having a large hind gut and caecum (associated with a plant based diet) and a small stomach chamber (associated with frugivory). In Brazil and Peru they are largely nectar feeders and likely play an important role in the pollinisation of certain plant species. A stomach of an individual from southern Brazil contained hundreds of *Ficus* seeds of which only 0.9% had been predated, whilst others in this region were observed to consume fruits of *Cecropia*, *Piper*, *Cyphomandra* and Solanaceae. Coleoptera larvae, Lepidopterans and Hymenopterans were the most prevalent arthropod items in stomach

samples from Paraná, Brazil with small birds and small mammals figuring in 40 and 60% of the stomachs analysed respectively (n=5). The species would seem to be mainly frugivorous but opportunistically omnivorous (Casella & Cáceres 2006). Nowak (1991) describes them as omnivores, noting that the diet consists of fruit, seeds, leaves, vegetables, insects and small vertebrates and even carrion. Captives have been fed on a diet of meat, fruit and eggs, showing a preference for bananas (Bucher & Fritz 1977) whilst another group had a preference for meat (Nowak 1991).

**BEH:** *General Behaviour* Nocturnal, solitary and arboreal, this species rarely descends to the ground. Nowak (1991) states that they are active mainly during the evening, night and early morning and pass the day in tree hollows or holes in branches. They are agile climbers when compared to *Didelphis albiventris*. It occasionally forages in pairs, but because of its canopy habits and nocturnal behaviour it is rarely seen and is trapped only in low numbers (Nowak 1991). Captive individuals became more excitable in small cages (Bucher & Fritz 1977). *Enemies* Animals at Flora y Fauna Itaipú Binacional have been electrocuted by power lines and Nelson Pérez-Villamayor is in possession of a mummified specimen that died in this way (Nelson Pérez-Villamayor pers. comm.). *Parasites* In Brazil individuals have been found infected with *Trypanosoma cruzi*. Nymphs of *Amblyomma* on a specimen in Peru. (Cáceres & Carmignotto 2006).

**VOC:** Typically silent for much of the time (Emmons 1999). Open-mouthed threat displays are accompanied with hissing noises. Clicking sounds are used during courtship and other male female encounters and may progress into chirps at high intensity. (Redford & Eisenberg 1992)

**HUM:** Previously much in demand for its fur, though the demand has now abated (Emmons 1999). Impact on fruit crops has been suggested, but this is likely to be negligible in Paraguay given the apparent rarity of the species compared to other potential fruit eaters. They are of potential interest for laboratory studies (Bucher & Fritz 1977).

**CON:** Globally considered to be of Low Risk Near Threatened by the IUCN, (see [www.iucnredlist.org/search/details.php/3648/all](http://www.iucnredlist.org/search/details.php/3648/all)) for the latest assessment of the species. The major threat to species would seem to be habitat destruction and though undoubtedly under-recorded it would seem to be nowhere common in Paraguay. The species was previously hunted for its pelage though this would no longer seem to pose a threat. An urgent review of the conservation status of this species is required. Population density estimated at 13.3/km<sup>2</sup> in Amazonas State, Brazil, with a biomass of 4.6kg/km<sup>2</sup>.

**Online Account:** [www.faanaparaguay.com/callanhb.html](http://www.faanaparaguay.com/callanhb.html).

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# 6

## Subfamily

# Didelphinae Gray, 1821

### ***Tribe Didelphini* Gray, 1821**

**General characteristics:** Five large opossums in four genera with total length >500mm. Pouch moderately to well-developed. Diploid chromosome number 22.

#### **CONTENTS**

*Chironectes* Illiger 1811. Monotypic genus.

*Didelphis* Linnaeus 1758. Five species, two present in Paraguay.

*Lutreolina* O.Thomas 1910. Monotypic genus.

*Philander* Brisson 1762. Six species, one present in Paraguay.

### ***Tribe Metachirini* Reig, Kirsch & Marshall, 1985**

A single species in this tribe. Characteristics are discussed under the generic and species accounts.

#### **CONTENTS**

*Metachirus* Burmeister 1854. Monotypic genus.

### ***Tribe Monodelphini* Hershkovitz, 1992**

**General characteristics:** Eight species in five genera of small marsupials. These species are characterised by their lack of a marsupium and a large number of teats. *Gracilinanus*, *Cryptonanus*, *Thylamys* and *Micoureus* were formerly included in an all-inclusive genus *Marmosa* but recent work has revealed the taxonomy of the group to be much more complex.

**Dental characteristics:** The deciduous last premolar in non-molariform in morphology, a character unique amongst the Didelphidae.

#### **CONTENTS**

*Cryptonanus* Voss, Lunde & Jansa 2005. Five species, one present in Paraguay.

*Gracilinanus* Garnder & Creighton 1989. Six species, one present in Paraguay.

*Thylamys* Brisson 1762. Ten species, two present in Paraguay.

*Micoureus* Lesson 1842. Six species, one present in Paraguay.

*Monodelphis* Burnett 1830. Twenty-nine species, three present in Paraguay.

# 7

## Genus

# *Chironectes*, Illiger 1811

This is a monotypic genus. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Lutra* Zimmermann 1780:317. In part. Incorrect spelling of *Lutra*. Not *Lutra* Linnaeus 1758.

*Mustela* Kerr 1792:172. In part. Not *Mustela* Linnaeus 1758.

*Lutra* Link 1795:172. Not *Lutra* Linnaeus 1758.

*Didelphis* G.Cuvier 1798:125. In part. Not *Didelphis* Linnaeus 1758.

*Lutra* G.Shaw 1800:447. Not *Lutra* Linnaeus 1758.

*Mustela* Turton 1800:58. In part. Not *Mustela* Linnaeus 1758.

*Didelphis* Daudin in Lacépède 1802:152. Not *Didelphis* Linnaeus 1758.

*Chironectes* Illiger 1811:76. Type species *Lutra minima* Zimmermann 1780 by monotypy.

*Memina* G.Fischer 1813:15. Nomen nudum.

*Memina* G.Fischer 1814:11. Type species *Lutra memina* Boddaert 1784 by monotypy.

*Sarigua* Muirhead 1819:429. In part.

*Cheironectes* Gray 1821:308. Incorrect spelling.

*Cheronectis* Fleming 1822:212. Incorrect spelling.

*Gamba* Liais 1872:329. Type species *Gamba palmata* Liais 1872 by designation.

*Chironeytes* Goeldi & Hagman 1904:100. Incorrect spelling.

**General characteristics:** *Chironectes* is the only truly aquatic opossum. The tail is longer than the head and body, naked and rounded in cross-section. It is not prehensile. The ears are fairly large, rounded and naked. The snout is long with stiff facial bristles. Further adaptations for an aquatic existence include the dense, short, waterproof pelage and the hindfeet webbed to the tips of the toes. The forefeet are unwebbed with long, dextrous fingers, clubbed at the end. A well-developed, backwards-opening pouch is present in both sexes and can be sealed whilst the animal is submerged. There are 4 or 5 mammae. Fossils from the Miocene of Argentina have been referred to this genus.

**Cranial characteristics:** Recalls that of *Philander*. Long rostrum, rounded braincase and broadly flared zygomatic arches. Palate with a single pair of maxillopalatine fenestrae opposite the molars. Small palatine fenestrae are absent.

**Paraguayan Species:**

*Chironectes minimus* - Water Opossum



# 8

## Water Opossum *Chironectes minimus*

- Lutra minima* Zimmerman 1780:317. Type locality "Gujana". Restricted by Cabrera (1958) to Cayenne, French Guiana.
- [*Lutra*] *menina* Boddaert 1784:160. Incorrect spelling.
- M[*Mustela*] (*Lutra*) *guianensis* Kerr 1792:194. Based on translation of Buffon (1776). Type locality "Cayenne", French Guiana.
- M[*Mustela*] (*Lutra*) *paraguensis* Kerr 1792:194. Based on translation of Buffon (1776). Type locality Rio de la Plata.
- L[*Lutra*]. *gujanensis* Link 1795: 84. Based on Buffon (1776) by implication. Type locality Cayenne, French Guiana by patrimony.
- Lutra saricovienna* Shaw 1800: 447. Based on Buffon (1776) and Pennant (1781: 82).
- [*Mustela*] *Cayennensis* Turton 1802: 58. Based on Buffon (1776). Type locality Cayenne, French Guiana.
- Didelphis palmata* Daudin in Lacépède 1802: 152. Based on Buffon (1776).
- Lutra memia* Desmarest 1803:147. Incorrect spelling.
- Lutra memmina* Desmarest 1804:507. Incorrect spelling.
- Didelphis memmina* Desmarest 1804:147. Name combination and incorrect spelling.
- Chironectes variegata* Illiger 1811 (1815:107). Name combination.
- Chironectes variegatus* Illiger 1815:107. Nomen nudum.
- Didelphis lutreola* Oken 1816:1134. Name unavailable.
- Cb[*Chironectes*] *variegatus* Olfers 1818:206. Type locality "Sudamerika".
- S[*arigua*]. *memmina* Muirhead 1819:329. Name combination and incorrect spelling.
- Chironectes yapock* Desmarest 1820: 261. Type locality "Les bords de l'Yapock, grande rivière de Guyane" French Guyana.
- Chironectes memina* F.Cuvier 1825:252. Incorrect spelling and gender.
- Chironectes palmata* Griffith, Hamilton-Smith & Pidgeon 1827:25. Name combination.
- Chironectes langsdorffi* Boitard 1842: 288. Type locality near Rio de Janeiro, Brazil.
- Chironectes panamensis* Goldman 1914: 1. Type locality Santa Cruz de Caña, Darién, eastern Panama.
- Chironectes menima bresslaui* Pohle 1927: 242. Type locality "Therezopolis" Rio de Janeiro, Brazil. Incorrect spelling.
- Chironectes argyrodites* Dickey 1928:15. Type locality Rio Sucio, La Libertad, El Salvador.
- Chironectes minima* Krumbiegel 1940:66. Incorrect gender.
- Chironectes minimus* Cabrera 1958:43. First use of current name combination.

***Chironectes minimus*****(Zimmerman 1780)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae; Tribe Didelphini (Myers et al 2006). The genus *Chironectes* contains a single species. *Chironectes* is derived from the Greek meaning "hand swimmer", *minimus* refers to "least", the species originally being thought to be a small otter (Marshall 1978). There are four subspecies, that present in Paraguay is *C.m.paraguensis* (Kerr 1792) Type Locality "Rio de la Plata". In the 18th Century "La Plata" was a commonly used term for the area from Buenos Aires north to Paraguay, encompassing Uruguay and southern Brazil. Paraguay was selected as the type locality by Gardner (2007) on account of the patronymic nature of the name. Marshall (1978) used the name *C.m.bresslaui* Pohle 1927 for this population. The species was described in part based on the "Saricovienne" of Smellie's (1780) translation of Buffon (1776).



*Mustela lutris* Lacépède 1803:164 (actually Daudin in Lacépède 1802) was listed in the synonyms by Marshall (1978) as based on Buffon (1776). However Buffon's "sarcovienne" is a composite of river and sea otters, whilst Pennant's (1781) "sarcovienne" is clearly an opossum. *Didelphys alboguttata* (= *Microdelphys alboguttata* Burmeister 1854) has sometimes been synonymised with this species with type locality "forested regions of Brazil", though Goeldi (1894) considered it to be based on the Australian Dasyurid *Dasyurus viverrinus*. Synonyms adapted from Marshall (1978) and Gardner (2007).

**ENG:** Water Opossum (Gardner 2007), Yapok

**ESP:** Lámpara de agua (Villalba & Yanosky 2000), Comadreja acuática (Parera 2002), Zarigüeya de agua (Emmons 1999), Cuica de agua (Emmons 1999, Villalba & Yanosky 2000), Zorro de agua (Emmons 1999), Lobito overo (Massoia et al 2000), Guayquica overa (Massoia et al 2000), Gato de agua (Zetek 1930).

**GUA:** Y'apo **PMA** (Villalba & Yanosky 2000), Mbujá **Ac** (Villalba & Yanosky 2000), Joype **Ac** (Esquivel 2001), Yapó (Parera 2002, Emmons 1999).

**DES:** Pelage is waterproof, dense and velvety. The top of the head and dorsum are mostly blackish with ornate greyish bands giving a "marbled impression", the throat, cheeks and dorsum are whitish. Grey "eyebrows" run from the base of the ears and may or may not join on the forehead between the eyes. The ears are pinkish basally and black on the outer half, the eyes are medium-sized and blackish. The metatragus is small and anterior basal projections are rudimentary. The chin, black nose and mouth area are naked. In addition to usual facial bristles there are long, stiff supernumerary whiskers sprouting from tufts above each eye, on the cheek below and in front of the ear and a median tuft on the chin. Rhinarium with short backward extension on upper side of muzzle. A greyish nuchal band runs across the nape and down the anterior section of the forelegs, whilst, when viewed laterally, the three broad grey lateral bands form a wide W-shape on the pelage, the hindmost running along the frontal part of the hind legs. The bands from either side of the body do not unite along the medial line of the back which is black. The pinkish forefeet lack webs, have greatly reduced claws, and possess long toes with a padded ending. The palm of the forefeet is rugose, assisting in the gripping of slippery prey, and there is a bony growth near the wrist which gives the appearance of a "sixth finger". The hind feet are larger, with the digits completely united by an interdigital membrane. The hallux is enlarged so that the hind foot is almost symmetrical. The tail is black, furred for the basal 10%, but then naked with large scales and a small yellowish-white tip. The tail is cylindrical, tapering towards the tip and acts as a rudder when swimming - it is proportionately shorter than in most other Didelphids. A pouch is present in both sexes but only the female is able to hermetically seal the pouch. The scrotum of the male is mustard-coloured. Females in Venezuela possess four or five nipples. Juveniles are similar to adults but somewhat darker. **CR** - Nasals expanded posteriorly. Temporal ridges form a sagittal crest with increased age. Prominent post-orbital processes. Inter-orbital broad,

flattened and with square edges. Robust zygomatic arches expand laterally. Posterior palate with single pair of vacuities opposite molars, lacking the second pair present in other Didelphids. Posterior nares narrow. *Skull Length*: 68.2-81mm; *Zygomatic Width*: 38-45.2mm; *Length of Nasals*: 26.3-37.5mm; *Interorbital Width*: 11.1-16.9mm (Marshall 1978). **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. *Length P1-M4 on Upper Row*: 23-34.2mm; *Length M1-M3*: 10.9-13.3mm; *Length of P1-M4 on Lower Row*: 24.8-32mm (Marshall 1978). **CN**: 2n=22. Karyotype with 10 uni-armed autosomes with terminal centromeres, an acrocentric X and a minute Y. Sex-determined by XX/XY mechanism (Marshall 1978).

**TRA**: Prints are distinctive on account of the unwebbed, "hand-like" forefeet in tandem with the extensively webbed hindfeet. Forefeet have long "fingers" with an expanded ending. A bony tubercle at the wrist frequently leaves an impression resembling a "sixth digit" approximately perpendicular to the rest of the hand. The tail is dragged behind the body and leaves a visible impression in soft mud. Prints are most frequently encountered on the muddy banks of forested streams. **FP**: 4.3 x 4cm; **HP**: 7 x 5.5cm; **PA**: 15cm. (Villalba & Yanosky 2000).

**MMT**: A medium-sized Didelphid with tail approximately 1 to 1.5x the head and body length. **TL**: 64.1cm (58-75cm); **HB**: 28.9cm (25-40cm); **TA**: 35.2cm (30-45cm); **FT**: 6.45cm (6-7.4cm); **EA**: 2.65cm (2-3.2cm); **WT**: 500-1300g though rarely more than 700g in the wild state (Massoia et al 2001, Parera 2002, Emmons 1999, Redford & Eisenberg 1992, Marshall 1978).

**SSP**: Unlikely to be confused if seen well. This is the only aquatic Didelphid and its distinctive pelage is quite unlike any related species.

**DIS**: Widely distributed in the Neotropics, south from Oaxaca and Tabasco in Mexico, through South America (at elevations of up to 1800m), eastern Paraguay and extreme northern Argentina in Provincia Misiones and Corrientes. There are also recent records from northern Uruguay. Distribution is local and the species is nowhere common. Brown (2004) listed the following specimens for Paraguay: Departamento Cordillera; Salto de Pirareta, 10 km S of Piribebuy, not located (Myers, 1973, UMMZ); Departamento Paraguari; Piribebuy (Myers, 1976, UMMZ); Parque Nacional Ybycuí (Creighton, 1979, UMMZ; Dobson, 1979, UMMZ; Myers, 1979, MZUM); Departamento Itapúa; PN San Rafael, 2 km NNW (Myers, 1978, UMMZ); Departamento Canendiyú; Curuguaty, 6.3 km N (Myers, 1976, UMMZ). Marshall recognised four subspecies based on four "loci" of distribution: *C. minimus paraguensis* (Kerr 1792), inhabiting northern Argentina, eastern Paraguay, southern Brazil and northern Uruguay. The remaining subspecies are *C. m. minimus* (Zimmerman 1780) in northeastern South America from the Guianas to the Orinoco and Amazon Basins of Brazil; *C. m. panamensis* (Goldman 1914) from Nicaragua south through western South America to Peru and east to Venezuela and possibly Trinidad; *C. m. argyrodytes* (Dickey 1928) in southern Mexico through the mountains of El Salvador to eastern Honduras.

**HAB**: Restricted to water courses in forested areas. It is able to colonise both sluggish and relatively fast-flowing streams provided there is sufficient prey available. It is usually absent from rivers choked with sediment (Emmons 1999). Galliez et al (2009) states that animals in the Atlantic Forest of Rio de Janeiro, Brazil were found only on fast-flowing streams with stony bottoms and preserved riparian forest.

**ALI**: Water Opossums swim using the hindfeet as paddles and the tail as a rudder whilst exploring the substrate with the forefeet in search of food stuffs. The forefeet are extremely nimble and they are capable of manipulating items with great dexterity. The long whiskers also act to detect potential food items whilst under water. The diet is largely carnivorous, the favoured prey appears to be slow-moving, bottom-dwelling fish (eg Silurids and *Cichlids*) and freshwater crustacea (Zetek 1930). These are captured by the hands or mouth and transferred to the river bank where they are consumed by the animal whilst sat on its rear legs and manipulating the prey with its forefeet. They will take invertebrates such as molluscs, aquatic insects and worms, as well as amphibians (Parera 2002). It has also been reported that they take fruits and aquatic vegetation (Hunsaker 1977) but this would seem to be unusual. Cimardi (1996) states that they are particularly fond of fish eggs during the spawning season. Captive individuals at the New York zoo thrived on slices of butterfish and a meat mix with special ingredients to assist oil production for the pelage whilst another individual lived for almost three years fed on ground bone meal and chopped raw meat lubricated with cod-liver oil (Marshall

1978). Captive adults have also been fed on mice, pink to weaned rats and chicks up to 14 days old and consumed everything including fur, feathers and extremities, though wetting of such items greatly facilitated feeding. They show agonistic behaviour when feeding. Galliez et al (2009) captured this species in Tomahawk traps placed in rivers so that the trap pan stood out of the water and baited with shrimp *Litopenaeus vannamei* or fish (Engraulidae).

**REP:** Distribution of male territories and sex bias is conspicuous with a promiscuous or polygynous mating system, though Galliez et al (2009) found that males were sometimes found in or near dens with female's bearing offspring that apparently contradicts that theory. The female enters oestrus once a year but no reproductive data exists for Paraguayan populations. Captive individuals have been reported to be polyestrous. (Marshall 1978). However, during a study of wild individuals in the Atlantic Forest of Brazil, Galliez et al (2009) found that this species did not follow the normal Didelphid pattern of seasonal breeding and that breeding could take place throughout the year, with time of breeding being defined by habitat type and prey availability. Juveniles were captured in both the wet and dry seasons and there was no evidence of seasonality on recruitment. They found that sex ratio was male-biased (38 of 47 captures) and that wandering males competed for resident females. In Brazil births have been recorded in December and January, and in Argentina young have been found in August (Galliez et al 2009). Pre-copulatory behaviour involves the male circling or following the female and oral-genital contact (Marshall 1978). During copulation the male pulls the female towards him. Litters typically consist of 2 to 5 barely-developed young (mean 3.5, usually 2 or 3). Galliez et al (2009) captured two females with three young each in Rio de Janeiro, Brazil. The young make their way to the marsupium (pouch) where they complete their development faster than any other Didelphid. The female swims with the young in her pouch and it has a unique hermetic seal which prevents the developing young from drowning. However some water does enter and the pouch produces an oily solution which acts to repel water. The young also show adaptations for a low oxygen environment created when the adult is submerged. (Parera 2002). The scrotum of the male is similarly "stored" in the pouch when swimming. (Emmons 1999). Pelage begins to grow around day 22 and pigmentation appears on day 28 with colour bands appearing six days later. Eyes begin to open on day 38 and are fully open by day 43. By day 40 the young are too large to fit fully into the pouch and females nurse on their side. They leave the pouch around day 48 but return to it to suckle, sleeping alongside the female and climbing onto her back to be carried (Marshall 1978). Sexual maturity in captive individuals occurs at 10 months (Villalba & Yanosky 2000, Eisenberg & Redford 1999). The species has been successfully raised in captivity (Marshall 1978).

**BEH:** *Activity Levels* Nocturnal, solitary and unobtrusive, this is the only opossum specialised for an aquatic existence. Typically the species is encountered at night by the yellow reflection of a pair of eyes floating just above the water surface. Galliez et al (2009) stated that though the species was active throughout the night, the most intensive activity was during the first six hours after dark. *Locomotion* Fish (1993) documented the swimming technique of this species under laboratory conditions. He noted that the species swam at the surface at speeds of 0.19-0.72 m/s and that the entire head and dorsum was above the water surface. The body was held close to horizontal, with a mean incline of 3.4° (+/-0.7) due to high levels of buoyancy as a result of air bubbles trapped in the velvety pelage. Propulsion is provided entirely by rhythmic, alternate, rotational paddling of the hindlimbs, the forelimbs being held outwards in front of the body with digits outstretched. Digits of the hindlimbs were extended and fully abducted during the power strokes and adducted during the recovery stroke. The recovery phase was 1.8x as long as the power phase. On land the back is noticeably curved, and curiously the animals retain the custom of feeling with the forefeet as they walk. Captive individuals have been observed to climb and to jump for distances of 60cm, but the tail is prehensile but is too thick to be of effective use when climbing (Nowak 1991). *Home Range* Galliez et al (2009) calculated home ranges of adults in the Atlantic Forest of Rio de Janeiro to vary between 844 and 3742m of stream with a population density of 0 to 1.34 individuals/km of river. Males maintained territories up to 4x larger than those of females and there was overlap in both male-male and male-female territories. Males had between 19-41.2% of their home range overlapped by females, and females between 44.2 and 49.3% of their home range overlapped by males. *Roosts* Water Opossums spend the day in

small riverside caves, built close to the water level and with an entrance diameter of 10-12cm (Parera 2002). Nests may be holes in riverbanks, under tree roots or rarely on the surface. (Emmons 1999). Of 21 nests located by Galliez et al (2009), 15 were at the river margin with an entrance formed by stones and tree roots, 3 in holes at the river margin formed only by tree roots, and 3 formed by tree roots but away from the river margin. A single male was found to use as many as seven different dens, though favoured two which were used on 63.7% of occasions. One excavated nest in Panama had a tunnel of 0.6m in length descending at a 45° angle and terminating in a nest chamber (Zetek 1930). The nest cavity is lined with leaves and other plant material and adults may even bite off grass stems specifically for this purpose. Individuals have been seen to transport such material by pushing it under the body with their forefeet and holding it with their tails (Redford & Eisenberg 1992, Marshall 1978). One ground nest occupied by a male was found close to a stream bank with a diameter of 15cm and lined with dry leaves. When disturbed the occupying male dived, emerging on the other side of the stream and entering a hole in the bank (Marshall 1978). Captive individuals did not defecate in the nest chamber, but nor did they attempt to remove soiled materials. Zetek (1930) reports that a nest found in Panam was littered with remains of crustaceans. *Defensive Behaviour* Captured individuals can be aggressive, periodically opening and snapping the jaws and animals at the Lincoln Park Zoo attempted to bite when handled (Marshall 1978). Zetek (1930) reports that a captured individual in Panama hunched itself as if to jump when approached and hissed and snapped the jaws, but by the fourth day of captivity allowed itself to be handled. *Enemies* No data is available for Paraguay. In Argentina it has been noted in the diet of large eagles such as Hawk-eagles *Spizaetus*, but these eagles are rare in Paraguay and likely have very limited impact on the population of the species. Felines such as Ocelot, Jaguar and Puma would also be likely to take this species. (Parera 2002). *Parasites* Arthropods (*Doloiisia*, *Rhopalia*, *Stenopsylla*, *Tritopsylla*); Tapeworms (*Ligula*, *Sparganum*); Flukes (*Amphimerus*). (Marshall 1978). *Longevity* The longevity record for a captive individual is 2 years and 11 months (Nowak 1991, Marshall 1978).

**VOC:** Emits dry screeches when threatened (Emmons 1999).

**HUM:** There are no known human uses of this species in Paraguay. It does not appear to be hunted for food and despite its attractive pelage it has only recently been exploited for the fur trade in Peru (Nowak 1991). Its preference for forested habitats and specialised mode of life mean that it has little contact with humans.

**CON:** Globally considered to be of Low Risk Near Threatened by the IUCN, (see [www.iucnredlist.org/search/details.php/4671/all](http://www.iucnredlist.org/search/details.php/4671/all)) for the latest assessment of the species. The Centro de Datos de Conservación in Paraguay consider the species to be rare in Paraguay, giving it the code **N3**. The species is local and rarely observed, yet its secretive, nocturnal habits afford it some protection. The major threats appear to be habitat destruction, water pollution as a result of pesticide run-off from agriculture, introduction of exotic species and the continuing trend for damming projects which are consistently and irreversibly altering the river systems of Paraguay. Currently there has been no commercial exploitation of its pelage and any systematic persecution of the species would likely have catastrophic effects on its population. Galliez et al (2009) suggested that this species is sensitive to changes in river microhabitat and might be a useful indicator species for changes in river status.

**Online Account:** [www.faunaparaguay.com/chiminhb.html](http://www.faunaparaguay.com/chiminhb.html).

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**Water Opossum** *Chironectes minimus*. Adult at night Mbacarayú Biosphere Reserve, Departamento Canindeyú. Photograph courtesy of Alberto Esquivel, undated.



**Water Opossum** *Chironectes minimus*. Adult PN Ybycuí, Departamento Paraguari. Photograph courtesy of Philip Myers, undated.



# 9

## Genus *Didelphis* Linnaeus, 1758

Five species, two of which occur in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* Linnaeus 1758:54. Type species *Didelphis marsupialis* Linnaeus (1758).

*Didelphys* Schreber 1777:532. Unjustified emendation.

*Opossum* Schmid 1818:115. In part. *Didelphis marsupialis* Linnaeus (1758).

*Sarigua* Muirhead 1819:429. In part.

*Didelphus* I. Geoffroy St.Hilaire 1831:139. Incorrect spelling.

*Thylacotherium* Lund 1839:233. Type species *Thylacotherium ferox* Lund (1839). Preoccupied by *Thylacotherium* Valenciennes 1838.

*Micoureus* Lesson 1842:186. In part.

*Didelphus* Lapham 1853:337. Incorrect spelling.

*Gamba* Liais 1872:329. In part.

*Gambatherium* Liais 1872:331. Replacement name for *Thylacotherium* Lund (1839).

*Dasyurotherium* Liais 1872:331. Replacement name for *Thylacotherium* Lund (1839).

*Dimerodon* Ameghino 1889:277. Type species *Dimerodon mutilatus* Ameghino (1889) by monotypy.

*Leucodidelphis* Ihering 1914:347. Type species *Didelphis paraguayensis* Oken (1816). Name not available. Proposed as subgenus of *Didelphis*.

*Leucodidelphys* Krumbiegel 1941:34. Unjustified emendation.

*Leucodelphis* Cabrera 1958:41. Incorrect spelling.

**General characteristics:** Two species of "typical" opossum with pointed snout, large, naked, rounded ears and long, prehensile tail furred at base and white towards the tip. This genus includes the largest of New World marsupials. Females have a well-developed pouch with 11 to 13 teats. Pelage is soft and dense with long, coarse guard hairs. Semi-arboreal in behaviour. Fossils from the middle Pleistocene of South America have been referred to this genus

**Cranial characteristics:** Well-developed sagittal crest in adults. Narrow braincase with interorbital width greater than the postorbital constriction.

**Paraguayan Species:**

*Didelphis albiventris* - White-eared Opossum

*Didelphis aurita* - Southern Black-eared Opossum

# 10

## White-eared Opossum

### *Didelphis albiventris*

[*Didelphis*] *albiventris* Lund 1839:233. Nomen nudum.

*Didelphis albiventris* Lund 1840:18. Type locality "Rio das Velhas", Lagoa Santa, Minas Gerais, Brazil.

*Didelphis poecilotus* JA Wagner 1842:358. Type locality "Angaba" (=Cuiabá), Matto Grosso, Brazil.

*Didelphis* [*Didelphys*]. *poecilonota* Schinz 1844:504. Type locality "Angaha in Brazilien" (=Cuiabá), Matto Grosso, Brazil.

*Didelphis azarae* Tschudi 1845:143. In part, not *D.azarae* Temminck 1824.

*Didelphis poecilotis* JA Wagner 1847:126. Spelling emendation

*Didelphis leucotis* JA Wagner 1847:127. Based on "Le Micouré Premier" of de Azara (1801) with type locality "Paraguay".

*Gamba aurita* var. *brasiliensis* Liais 1872:329. In part. Implied type locality Brazil.

*Didelphis marsupialis* var. *azarae* O.Thomas 1888:129. Name combination. Not *Didelphys azarae* Temminck (1824).

*Didelphis marsupialis azarae* Cope 1889:129. Name combination. Not *Didelphys azarae* Temminck (1824).

*Didelphys Azarae* m[utación]. *antiqua* Ameghino 1889:278. Type locality "Barrancas del Río Primero", Córdoba, Argentina.

*Didelphys lechei* Ihering 1892:98. Type locality "Sul do Río Grande" Rio Grande do Sul, Brazil.

*Didelphis marsupialis* var. *albiventris* Winge 1893:7. Name combination.

[*Didelphys* (*Didelphys*) *marsupialis*] *Azarae* Trouessart 1898:1235. Name combination.

*Didelphis* [*Didelphis*] *paraguayensis* JA Allen 1902:251. Based on *Didelphis paraguayensis* of Oken (1916) in turn based on de Azara (1801) with type locality "Asunción, Paraguay"

[*Didelphys* (*Didelphys*)] *paraguayensis* Trouessart 1905:853. Name combination.

[*Didelphis* (*Didelphis*)] *poecilotis* Matschie 1916:268. Name combination.

[*Didelphis* (*Didelphis*)] *albiventris* Matschie 1916:268. Name combination.

[*Didelphis* (*Didelphis*)] *lechei* Matschie 1916:268. Name combination.

*Didelphis* [*Didelphis*] *opossum* Larrañaga 1923:346. Name combination. Not *Didelphis opossum* Linnaeus, 1758.

*Didelphis paraguayensis bonariensis* Marelli 1930:2. No type locality, but subsequently restricted to Provincias Buenos Aires and Santa Fé, Argentina by Marelli (1932).

*Didelphis paraguayensis dennleri* Marelli 1930:2. No type locality, but subsequently restricted to Provincia Buenos Aires, Argentina by Marelli (1932).

*Didelphys azarai* Ringuelet 1954:295. Incorrect spelling of, but not *Didelphys azarae* Temminck. 1824.

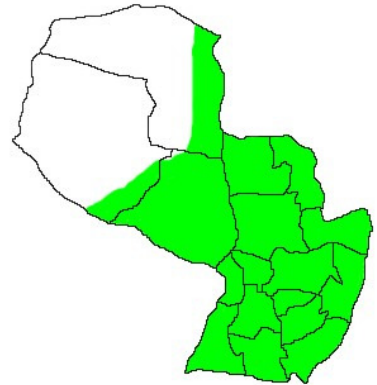
*Didelphis lechii* Vieira 1955:345. Incorrect spelling.

*Didelphis azarae azarae* Cabrera 1958:41. Name combination, not *Didelphys azarae* Temminck. 1824.

*Didelphis albiventris* Hershkovitz 1969:54. First modern use of current name.

## ***Didelphis albiventris* Lund 1840**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Didelphini (Myers et al 2006, Gardner 2007). The genus *Didelphis* was defined by Linnaeus, 1758. There are four known species according to the latest revision (Gardner 2007) two of which are present in Paraguay. The generic name *Didelphis* is from the Greek meaning "double womb", and *albiventris* is derived from the Latin for "white-bellied". The species is monotypic (Gardner 2007). Only recently is the name *D.albiventris* gaining widespread acceptance for this species, with the names *D.azarae* Temminck (1824) and *D.paraguayensis* JA Allen (1902) being frequently the most frequently used. The former name was rejected by Hershkovitz (1969) who pointed out that Temminck's description is based on several "black-eared opossums" and not this species. The latter name comes from Oken (1816) and given that his names were deemed non-Linnean



by the ICZN it is unavailable for usage. The next oldest available name for the species is *D.albiventris* Lund (1840). This species was "Le Micouré Premier" of de Azara (1801). Synonyms adapted from Gardner (2007).

**ENG:** White-eared Opossum (Gardner 2007), Azara's Opossum (Eisenberg 1989), White-belly Opossum (Nogueira 1988), Cassaco (Gardner 2007).

**ESP:** Comadreja común (Esquivel 2001, Massoia et al 2000), Zarigüeya común de orejas blancas (Emmons 1999, Esquivel 2001), Comadreja overa (Massoia et al 2000, Parera 2002, Eisenberg 1989), Comadreja mora (Massoia et al 2000, Emmons 1999), Picaza (Massoia et al 2000), Carachupa oreja blanca (Cuéllar & Noss 2003), Comadreja negra (Marelli 1930).

**GUA:** Ngure (Esquivel 2001), Mykure **PMA** (SEAM et al 2001, Villalba & Yanosky 2000), Guné **Ac** (Villalba & Yanosky 2000), Mbicuré (Parera 2002), Mbikuré eté (Massoia et al 2000), Karachupa (Cuéllar & Noss 2003).

**DES:** A robust marsupial, the largest in Paraguay. Males are larger than females with more prominent canines. Triangular head with pronounced, pointed snout and fairly large, rounded white ears. The nose is pink and the eyes are brown. Head mostly white with a black medial stripe and black patches around the eyes. Pelage dense and usually grey (88% of individuals) darker along the medial line, and often appearing somewhat unkempt due to the presence of different length hairs. A rare dark phase makes up about 12% of individuals. Unique amongst opossums is that *Didelphis* possess long, white-tipped guard hairs. Basally the pelage is often paler and greyer, though there is great variation amongst individuals and some are distinctly dark. Ventrally somewhat paler. The tail is furred basally and naked for the rest of its length save for a few scarce hairs. Naked area of the tail is black on the basal half and white on the distal half. Young animals are similar but have less obviously white ears. Albinism has been reported but is rare. Females possess a marsupium (pouch) in which the teats are contained, arranged in a circle with one in the middle. The number of teats is variable but commonly there are 13 (Eisenberg 1989). Sexual organs of both species are linked to the anal duct in their latter half and both exit via an external cloaca. The mostly naked tail is prehensile and the thumb is opposable, adaptations for an arboreal existence. **CR** - Occipitonasal length 84mm. Robust cranium with long, broad snout. Well-developed sagittal and lamboidal crest in adults. Interorbital ridge thin with a long postorbital constriction behind the postorbital process. Broad zygomatic arch only slightly expanded. Brain case small. (Díaz & Barquez 2002). Abdala et al (2001) described the postweaning ontogeny of the skull of this species and defined the following characteristics as useful for distinguishing between juvenile (<8 months old) and adult (>9.5 months old) skulls: Supraorbital border of frontal, postorbital constriction, secondary foramen ovale and groove for petrosal sinus are all present in the adult and absent in juvenile; Gyrus of anterior semicircular canal is narrow in juvenile and wide in adult; Cavum

supracochlear floor is incomplete in juvenile and complete in adult; Petrosal, promontorium and tympanic process of the petrosal relatively large in juvenile and relatively small in adult; Fossa subarquata and internal acoustic meatus relatively large in juvenile and relatively small in adult; Dorsal margin of foramen magnum formed by interparietal in juveniles and exoccipitals in adults; Exoccipital and basioccipital partially fused in juveniles and completely fused in adults; Petrosal fixed to squamosal in juveniles, loosely attached in adults; Sphenorbital fissure and foramen rotundum almost adjacent in juvenile but separated by wall of alisphenoid in adults; Sphenorbital fissure and foramen ethmoidal almost adjacent in juvenile but separated by wall of orbitosphenoid in adults. **DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. P1 small, P2 and P3 similar in size (Díaz & Barquez 2002). P3 not peg-like and narrow with a pronounced posterior-labial groove. (Lemos & Cerqueira 2002). Tyndale-Biscoe & MacKenzie (1976) summarised ageing in *Didelphis* opossums based on dental wear by defining 7 age classes as follows: *Dental Class 1:* (<4 months) dP3 M1 no cusp wear; *Dental Class 2:* (4-6 months) dP3 M2 no cusp wear; *Dental Class 3:* (5-7 months) dP3 M3 no cusp wear; *Dental Class 4:* (6-11 months) P3 M3 no cusp wear; *Dental Class 5:* (9-16 months) P3 M4 no cusp wear; *Dental Class 6:* (15-23 months) P3 M4, cusp wear on P3 and M1-2; *Dental Class 7:* (>22 months) P3 M4, cusp wear on P3 and M3-4. **CN:** 2n=22. Karyotype with 10 uni-armed autosomes with terminal centromeres, an acrocentric X and a minute Y.

**TRA:** Prints are characteristically wider than they are long with a notably uneven appearance, especially on the hindfoot which shows fore toes displaced to one side and the opposable thumb on the other side. The tail being dragged behind the body often leaves an impression. It is apparently not possible to distinguish the prints of Southern Black-eared Opossum from this species. **FP:** 4.3 x 5cm; **HP:** 3.2 x 6cm; **PA:** 12cm. (Villalba & Yanosky 2000).

**MMT:** A large and robust Didelphid with tail approximately the same length as the head and body. **TL:** 76.3cm (59-89.2cm); **HB:** 30-44.2cm; **TA:** 37.3cm (29-45cm); **FT:** 5.96cm (4.2-6.8cm); **EA:** 5.4cm (4.1-6.5cm); **WT:** 1560g (500-2500g); **WN:** 0.15g (Massoia et al 2001, Parera 2002, Emmons 1999, SEAM et al 2001, Redford & Eisenberg 1992).

Cáceres & Monteiro-Filho (1999) noticed a correlation between head length and age class, and stated that the measurement may be used to estimate body length. Mass was noted to increase during autumn in preparation for the winter season with fewer resources, and older adults showed tendencies towards obesity. Adult size is reached about 10 months. They gave the following external body measurements for differing age classes of males and females from southern Brazil:

**Infant** (4-6 months old, dental class 2): **Head:** male 7.4cm (+/-0.6) female 7.1cm (+/-0.6); **WT:** male 222g (+/-84) female 200g (+/-88).

**Young** (5-7 months old, dental class 3): **Head:** male 9.8cm (+/-0.7) female 9.7cm (+/-0.5); **Body:** male 23.5cm (+/-1.7) female 25.2cm (+/-1.9); **FT:** male 4.7cm (+/-0.3) female 4.8cm (+/-0.6); **WT:** male 623g (+/-210) female 809g (+/-154).

**Subadult** (6-11 months old, dental class 4): **Head:** male 11.2cm female 11.2cm (+/-1.1); **Body:** male 30.9cm female 28.9cm (+/-0.4); **FT:** male 5.1cm female 5.6cm (+/-0.3); **WT:** male 1180g female 1042g (+/-194).

**Young adult** (9-16 months old, dental class 5): **Head:** male 13.3cm (+/-0.7) female 12cm (+/-0.2); **Body:** male 35.2cm (+/-0.6) female 33.9cm (+/-1.9); **FT:** male 5.8cm (+/-0.3) female 5.6cm (+/-0.4); **WT:** male 1673g (+/-54) female 1377g (+/-202).

**Adult** (15-23 months old, dental class 6): **Head:** female 13.8cm (+/-0.7); **Body:** female 38cm (+/-2.6); **FT:** female 6.1cm (+/-0.4); **WT:** female 1786g (+/-182).

**Senile adult** (>22 months old, dental class 7): **Head:** female 14.1cm (+/-1); **Body:** female 38.1cm (+/-0.2); **FT:** female 6.1cm (+/-0.1); **WT:** female 2020g (+/-78).

**SSP:** This is generally the most commonly encountered and widespread Paraguayan marsupial. It is most likely to be confused with the *Didelphis aurita*, which is smaller, much blacker in overall colouration and more strictly associated with humid forest habitat - ie. they are much less tolerant of human presence. As suggested by the common name this species can most easily be identified by its white as opposed to black ears. The fur at the base of the tail extends further down the tail in this species than in the Black-eared Opossums. White ear colour is much less pronounced in juveniles and so care must be taken in their identification. (Redford & Eisenberg 1992).

**DIS:** Widely distributed east of the Andes from Colombia and western Venezuela south to Provincia Rio Negro (41°S) in Argentina, north to the Atlantic coast of Brazil, though absent from the Amazon Basin where it is replaced by other species. In Paraguay the species is widely distributed throughout eastern Paraguay where it even occurs in the suburbs of Asunción, and also through the Humid Chaco and Pantanal region, being absent only from the Dry Chaco ecotone. (Parera 2002, SEAM et al 2001).

**HAB:** An adaptable habitat generalist able to tolerate a large degree of habitat disturbance and actively seeking human habitation and exploiting them for food resources in rural areas. White-eared Opossums occur in humid forest and edge (ECOSARA Biodiversity Database) being most common where degraded or affected by human activity, but are equally at home in cerrado and relatively open grassland areas provided that sufficient food and sleeping places are available. They tend to prefer areas in close proximity to water and trees and are apparently absent from the driest areas of the Chaco (Parera 2002, SEAM 2001), though they are present and common in the Chaco and Chiquitania of Bolivia (Cuéllar & Noss 2003).

**ALI:** Omnivorous and opportunistic, able to exploit a wide range of food sources from plant matter including fruit, leaves and seeds, to animal matter such as invertebrates, small mammals and birds. When a particular foodstuff is abundant it is typically exploited repeatedly until it is exhausted. In Misiones, Argentina stomachs contained worms, ants, small birds, eggshell and plant matter (Redford & Eisenberg 1992). Cáceres (2002) investigated diet and the species role as seed dispersers through fecal analysis in Curitiba, Brazil. He found the species to be strongly omnivorous and that diet did not vary with age. Invertebrates occurred in 100% of scats, fruits in 76%, vertebrates in 58% and refuse 8%. Fruit consumption and the consumption of some animal prey (eg reptiles and coleoptera) increased during the wet season, whilst other fruits and different animal prey (eg birds and diplopods) were more prominent during the drier part of the year. Animal prey consisted largely of species occurring in leaf litter, suggesting predominately terrestrial foraging. The following items were recorded in scats, with percentages representing the percentage of scats which contained the given item: Vertebrates (58%) - Birds 28%, Reptiles 19% (wet season only and mainly *Liotyphlops beui*), Mammals 15% and Fish 1%. Invertebrates (100%) - Coleoptera 76%, Opiliones 60%, Blattaria 44%, Diplopoda 41%, Pulmonata 41%, Hymenoptera (mainly ants) 31%, Isopoda 13%, Lepidoptera (larvae) 10%, Decapoda 8%, Orthoptera 4% and Hemiptera 1%. Fruits taken were mainly coloniser species emphasising the role of the species as important dispersers and included the following families - Solanaceae (*Solanum sanctaecatharinae* 18%, *S. cf maioranthum* 9%, *Vassobia breviflora* 7%, *Solanum* sp 4%, *Cyphomandra corymbiflora* 1%), Passifloraceae (*Passiflora actinia* 18%, *Passiflora* sp 1%), Moraceae (*Morus nigra* 11%), Rosaceae (*Rubus erythrocladus* 11%, *Rubus rosifolius* 4%), Piperaceae (*Piper gaudichaudianum* 6%), Cucurbitaceae (*Melothria cucumis* 7%, *Cucumis* sp 6%), Arecaceae (*Syagrus romanzoffiana* 3%), Poaceae 3%, Myrtaceae (*Psidium guajava* 1%), Rutaceae (*Citrus* sp. 1%), Melastomataceae (*Leandra australis* 1%) and Erythroxylaceae (*Erythroxylum deciduum* 1%). All seeds that passed through the digestive system of the animal undamaged were less than 0.8cm long in adults and less than 0.4cm long in juveniles. Larger seeds were either destroyed, or in the case of very large seeds (eg *Syagrus romanzoffiana*) discarded without being consumed. Cáceres & Monteiro-Filho (2007) examined germination rates of seeds consumed by *Didelphis* opossums in southern Brazil, finding that germination rates of seeds that had passed through opossum guts were similar to those of control groups for thirteen species of pioneer plants, with the exception of *Rubus rosifolius* which required gut passage for germination. Alessio et al (2005) documented feeding on tree gum by this species in the northeastern Atlantic Forest of Brazil, with opossums taking advantage of "jellified gum balls" in holes on the trunk of a *Tapirira guianensis* tree (Anacardiaceae), a resource also exploited by the gum-feeding primate the Tufted Marmosets *Callithrix jacchus*. In areas close to human habitation they take advantage of agriculture, orchards and even refuse. (Massoia et al 2000, Smith 2007). At Pro Cosara, San Rafael National Park, they have been seen feeding on mandarin fruits (*Citrus* sp.), fruits of the Pindó Palm (*Syagrus romanzoffiana*) and frequently raid the area around the house in search of chicken and quail eggs from the coup, occasionally killing adult birds without consuming them (Hans Hostettler pers. comm., Smith 2007) - the Spanish name Comadreja overa refers to their fondness for birds eggs.

**REP:** Breeding activity takes place from August to March. Two reproductive cycles have been reported during the course of the year in the Argentinian Chaco but in the Brazilian caatinga only one period of oestrus is recorded annually, timed to coincide with the rains. A female in Colombia which had its pouched young removed was in oestrus again when captured 14 days later. However females maintained in captivity after removal of their young did not return to oestrus and maintenance in captivity may impede the normal oestral cycle. (Tyndale-Briscoe & MacKenzie 1976). Peaks of reproduction in Provincia Buenos Aires are at the beginning of September and in December (Parrera 2002). Regardless of the limited period of female fertility, males seem to be in a constant search for copulation, being violently rejected by non-receptive females for much of the year. However Nogueira (1988) challenged that view and suggested that males show subtle differences in their genital systems throughout the year and can reproduce opportunistically. Receptive females cede to a brief copulation before chasing the male away and returning to a solitary existence. The gestation period is short, lasting 12-14 days (Tyndale-Bisocce & MacKenzie 1976). Females give birth to 4-13 young in a still embryonic state and less than 15mm in length, these immediately making their way to the pouch and attaching themselves to a teat (Esquivel 2001, Parera 2002, Redford & Eisenberg 1992). The number of young may exceed the number of available teats and those that are unable to feed quickly die. Average litter sizes of 6.2 (Brazilian caatinga), 4.2 (Colombia), 7.1 (Argentina) and 9.4 (Uruguay) have been reported (Parera 2002, Redford & Eisenberg 1992). Older females apparently produce smaller litters (Eisenberg 1989). During their second month the juveniles leave the pouch and cling to the back of the female, returning only to suckle and are weaned at 3 to 4 months. The testicles of young males descend at the time of weaning (Eisenberg & Redford 1999).

**BEH:** *Activity Levels* Though captive individuals have exhibited remarkable social behaviours, wild White-eared Opossums are solitary animals and generally nocturnal in behaviour. *Locomotion* Cunha & Vieira (2002) note that *Didelphis* opossums move on thin limbs even when broader and apparently more stable limbs are available, distributing their weight across all four limbs and using the prehensile tail as a fifth limb. All levels of the forest strata are utilised and they are also capable of swimming short distances and frequently do so to cross streams. (Massoia et al 2000). *Home Range* Though they are not strictly territorial and even slightly nomadic in behaviour, adults will defend the area occupied at any given time (Novak 1991) and there is apparently a greater tendency towards territoriality in areas of sympatry with Black-eared Opossums (Parera 2002). Home ranges in Argentina averaged 0.57ha (Eisenberg 1989). Nest holes are changed with regularity. *Roosts* Adults spend the day in a hollow trunk or other suitable nest hole lined with grass, fur and feathers and emerge at sunset to begin the daily routine. *Defensive Behaviour* White-eared Opossums prefer to flee to trees or holes in trunks when they feel threatened. An individual at Pro Cosara hid itself within a bunch of fruits and palm fronds in a Pindó Palm on the approach of an observer and watched quietly (Smith 2007). Though capable of running fairly rapidly on level ground they are agile but somewhat slow movers in the branches of trees and when approached closely threaten with the mouth open (Smith 2007), sometimes also producing a disagreeable smelling glandular secretion from the cloaca. On rare occasions captured individuals may briefly "play possum", lying prone with the mouth open as though dead (Massoia et al 2000, Parera 2002, Smith 2007), but this is less common than in the North American Virginia Opossum *Didelphis virginiana*. If held by the tail with the front feet on the ground they attempt to escape by walking, apparently oblivious to the hand holding their tail. However if the animal is lifted from the ground they immediately attempt to bite, using the powerful prehensile tail to curl the body upwards (Smith 2007). A more common defence is to threaten with the mouth open. *Enemies* This species is frequently preyed upon by felines, foxes, raptors (including *Rupornis magnirostris* and *Tyto alba*) and large snakes such as *Eunectes notaeus* and *Boa constrictor* (Parera 2002). In a roadkill study in Santa Catarina, Brazil this species was found to be the second most common victim of traffic consisting of 17.1% of the 256 individuals of 20 species sampled (Cherem et al 2007). In other similar studies in Brazil, on the B2-277 bordering PN Iguacu in Paraná State, Brazil *D. aurita* and *D. albiventris* represented 16.2% of the mammals hit by cars (Lima & Obara 2004), whilst this species represented 48.9% of all the roadkill on the RS-040 (Rosa & Mauhs 2004) and 28.8% of roadkill on six rodavias in São Paulo State (Prada 2004).

**HUM:** This common marsupial comfortably tolerates the close proximity of humans and in some areas may even actively seek human dwellings for access to food resources. It is likely that human activity has enabled them to considerably extend their range, with deforestation creating optimal habitat (Parera 2002). The species is frequently seen dead on roads. It is used as an example of good parenting for educational purposes on account of the way the young are maintained close to the mother by being raised in a pouch (SEAM et al 2001). Considered a pest species in some areas as they regularly break into to chicken coups to steal eggs and birds (Hans Hostettler pers. comm.). They are attracted to fruiting trees in orchards and gardens where they likely have a low impact on yield (Smith 2007). Though the species is appreciated for its white meat in the area of Santiago del Estero in Argentina (Parera 2002) it has not been registered in the diet of indigenous tribes in Paraguay (Cartés 2007). In certain areas in Argentina the meat is considered to have curative properties, whilst a skin kept under the bed or a stew made with the tail are both believed to assist in a smooth birth (Massoia et al 2000). A high incidence of infection with *Trypanosoma cruzi*, the parasite responsible for Chaga's disease, was recorded in Santiago del Estero, Argentina (Parera 2002).

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/search/details.php/40489/all](http://www.iucnredlist.org/search/details.php/40489/all) for their latest assessment of the species). The Centro de Datos de Conservación in Paraguay consider the species to be secure and under no threat in Paraguay, giving it the lowest risk code **N5**. The species is not listed by CITES. This species is widespread, adaptable and frequently common. Densities of 0.4-4.4 per hectare have been recorded in the Caatinga of Brazil and 2.5 per hectare in Tucuman Argentina. In Paraguay three separate individuals were killed raiding the same chicken coup in Alto Verá, Departamento Itapúa during the course of December 2006 (Hans Hostettler pers. comm.). A study in Tucuman, Argentina found the average home range to be 5,700m<sup>2</sup> for six animals (Redford & Eisenberg 1992).

**Online Account:** [www.fauparaguay.com/didalbhb.html](http://www.fauparaguay.com/didalbhb.html).

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**White-eared Opossum** *Didelphis albiventris*.

Head detail of adult. Estancia Nueva Gambach, PN San Rafael, February 2007

Photo Paul Smith, courtesy of ECOSARA Biodiversity Database.

**White-eared Opossum** *Didelphis albiventris*.

Adult. Estancia Nueva Gambach, PN San Rafael, February 2007.

Photo Paul Smith, courtesy of ECOSARA Biodiversity Database.



**White-eared Opossum** *Didelphis albiventris*.

Juvenile. PN San Rafael.

Photo courtesy of Teatske Nieuborg and ECOSARA Biodiversity Database.



**White-eared Opossum** *Didelphis albiventris*.

Footprints. Mbaracayú Biosphere Reserve, Departamento Canindeyú.

Photo Paul Smith October 2008.



# 11

## Southern Black-eared Opossum

### *Didelphis aurita*

*Didelphis azarae* Temminck 1824:30. Type locality "Bresil".

*D[idelphys] marsupialis* Wied-Neuwied 1826:387. In part. Name combination.

*D[idelphys] aurita* Wied-Neuwied 1826:395. Type locality "Villa Viçosa an Flusse Peruhype", Bahía, Brazil.

*Didelphys azarae* JA Wagner 1843:38. Name combination.

*Didelphys cancrivora* JA Wagner 1843:41. Not *D.cancrivora* Gmelin (1788).

*Gamba aurita* var. *brasiliensis* Liais 1872:329. Implied type locality Brazil.

*Didelphys marsupialis aurita* Cope 1889:129. Name combination.

*Didelphis koseritzi* Ihering 1892:99. Type locality "Colonia do Novo Mundo" Rio Grande do Sul, Brazil.

[*Didelphys (Marmosa)*] *koseriti* Trouessart 1898:1240. Name combination and incorrect spelling.

[*Didelphys (Didelphis) marsupialis*] *aurita* Trouessart 1898:1234. Name combination.

*Didelphys masrupialis cancrivora* Bertoni 1914:68. Name combination.

[*Didelphis (Didelphis)*] *leucoprymnus* Matschie 1916:268. Nomen nudum.

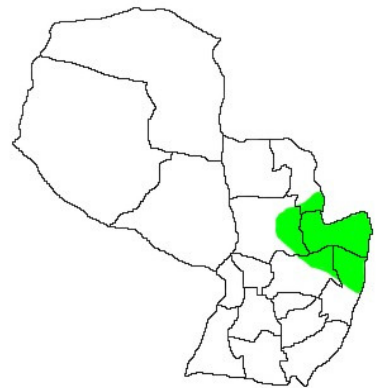
*Didelphis aurita longipilis* A.Miranda-Ribeiro 1935:35. Type locality "Côlonia Alpina" 16km N of Teresópolis, Rio de Janeiro, Brazil.

*Didelphis aurita malanoidis* A.Miranda-Ribeiro 1935:40. Type locality "Therezópolis" restricted to Côlonia Alpina, 16km N of Teresópolis, Rio de Janeiro, Brazil by Ávila-Pires (1968).

*Didelphis aurita longigilis* Ávila-Pires 1968:169. Incorrect spelling.

### ***Didelphis aurita* Wied-Neuwied, 1826**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Didelphini (Myers et al 2006, Gardner 2007). The genus *Didelphis* was defined by Linnaeus, 1758. There are five known species according to the latest revision (Gardner 2007) two of which are present in Paraguay. The generic name *Didelphis* is from the Greek meaning "double womb", and *aurita* is derived from the Latin for "long-eared". The species is monotypic (Gardner 2007). *Didelphis aurita* was long considered conspecific with the Northern Black-eared Opossum *Didelphis marsupialis* Linnaeus 1758, but the distributions are disjunct, with this species very tightly associated with the Atlantic Forest biome of eastern Brazil, eastern Paraguay and northern Argentina. Cerqueira (1985) considered the two forms to be part of a superspecies complex, and Cerqueira & Lemos (2000) demonstrated clear morphometric differences between the two



populations to support their specific status. Lemos, Marriog & Cerqueira (2001) demonstrated a Pleistocene cladogenesis through rapid differentiation of the two species. The name *Didelphis azarae* Temminck 1824 was clearly applicable to this species given that the written description specifically mentions black ears. However this name has been misapplied almost since its inception in reference to *Didelphis albiventris*, and though it predates Wied-Neuwied's name *Didelphis aurita*, the confusion caused by its misapplication means that *D.aurita* is the now most frequently used name in the interests of maintaining stability (Gardner 2007). Synonyms adapted from Gardner (2007).

**ENG:** Southern Black-eared Opossum, Black-eared Opossum (Redford & Eisenberg 1992, Canevari & Vaccaro 2007), Big-eared Opossum (Gardner 2007), Gambá (Gardner 2007), Common Opossum (Esquivel 2001).

**ESP:** Comadreja orejuda, Zarigüeya orejuda (Canevari & Vaccaro 2007), Zarigüeya común del sudeste (Emmons 1999), Comadreja grande (Redford & Eisenberg 1992), Comadreja de orejas negras (Chebez 1996, Massoia et al 2000), Mbicuré orejudo (Chebez 1996, Massoia et al 2000), Mbicuré negro (Chebez 1996), Mbicuré cangrejero (Chebez 1996, Massoia et al 2000).

**GUA:** **M** Mykuré hu (Villalba & Yanosky 2000), Mbicuré-hú (Chebez 1996, Massoia et al 2000, Canevari & Vaccaro 2007), **Ac** Guné (Villalba & Yanosky 2000), **Ac** Ngure (Esquivel 2001), Mykure (Esquivel 2001), Mbihkuré (Chebez 1996).

**DES:** The smaller of the two *Didelphis* opossums this species is characterised by its blackish pelage and golden-buff facial colour. Dorsal pelage greyish-white strongly variegated with black so that it appears mostly dark. Long guard hairs (80-100mm long) are white to the base and are particularly long on the rump giving a shaggy appearance. Underfur golden-buff basally on the mid back, becoming more yellow-brown basally on the flanks and blackish on the apical third to half throughout. Ventral pelage shorter and woollier, brownish-white basally and tipped blackish-brown with scattered golden-buff hairs. Hairs bordering the marsupium darker brown to blackish-chestnut. Indistinct whitish patch on mid-chest. The rostrum is slightly elongated and somewhat triangular. Chin and throat golden-buff with hairs tipped dark brown except for on the lower throat. Head pattern indistinct with dark blackish median line and patches around the eyes offset against a golden-buff background of the rest of the head. Median line begins between the eyes and widens towards the nape. Eye patches begin halfway between the nose and eyes and reach almost to the base of the ears, being less well-defined and broader behind the eyes than in front. Head markings are typically more distinct on younger specimens. Ears are large, rounded and blackish. Limbs black, including the semi-naked toes. Feet are broad and claws are long. Tail slightly shorter than head and body length, furred at the base and naked and bicoloured for the rest of its length. Black on the basal half and flesh-coloured on the distal half. This species is extremely variable in the extent of the dark colouration with some specimens almost black and others paler and dark grey in colour. There is also age variation in colouration, the youngest individuals typically having the strongest facial pattern and whitish or flesh-coloured ears, at which time they may be mistaken for juvenile *Didelphis albiventris*, though the base colour is always yellowish and never white. Ears darken with age, with the basal area assuming dark colouration before the tips. Young individuals may also show less black at the base of the tail than adults. (Allen 1902).

**DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. Tyndale-Biscoe & MacKenzie (1976) summarised ageing in *Didelphis* opossums based on dental wear by defining 7 age classes as follows: *Dental Class 1:* (<4 months) dP3 M1 no cusp wear; *Dental Class 2:* (4-6 months) dP3 M2 no cusp wear; *Dental Class 3:* (5-7 months) dP3 M3 no cusp wear; *Dental Class 4:* (6-11 months) P3 M3 no cusp wear; *Dental Class 5:* (9-16 months) P3 M4 no cusp wear; *Dental Class 6:* (15-23 months) P3 M4, cusp wear on P3 and M1-2; *Dental Class 7:* (>22 months) P3 M4, cusp wear on P3 and M3-4. **CN:** 2n=22.

**TRA:** Prints are characteristically wider than they are long with a notably uneven appearance, especially on the hindfoot which shows fore toes displaced to one side and the opposable thumb on the other side. The tail being dragged behind the body often leaves an impression. It is apparently not possible to distinguish the prints of the White-eared Opossum from this species. **FP:** 4.3 x 5cm; **HP:** 3.2 x 6cm; **PA:** 12cm. (Villalba & Yanosky 2000).



**MMT:** The smaller of the two Paraguayan *Didelphis*. Allen (1902) gave the following measurements for 3 adult males and six adult females from Brazil: **TL:** male 77.77cm (range 74.5-80.6cm) female 74.42cm (range 67.8-77cm); **HB:** male 41.7cm (range 40.5-42.6cm) female 39.38cm (range 35.8-41cm); **TA:** male 36.07cm (range 34-38cm) female 35.36cm (range 32-38.8cm); **FT:** male 5.43cm (range 4.8-6.1cm) female 5.38cm (range 4.1-6.1cm); **EA:** male 4.8cm (range 4.6-5cm) female 5.15cm (range 3.9-6cm). Vieira (1997) gave the following mean measurements for the species (n=25): **HB:** 38.28cm; **TA:** 31.72mm; **FT:** 4.73cm; *Foot* 3.96cm; *Width Claw* 0.47cm; *Arm* 6.66cm; *Forearm* 7.42cm; *Leg* 7.72cm; *Foreleg* 8.47cm; *Forelimb* 14.08cm; *Hindlimb* 16.16cm; **WT:** 1098g (range 670-1560g). He noted that the relatively long forelimbs, long claws and broad feet were associated with a terrestrial/arboreal existence and a walking means of locomotion. More ponderous animals require sturdier forelimbs when climbing. The following mean post-cranial measurements were noted by Carvalho et al (2000) for Brazilian specimens (n=5): *Ulna* 67.3mm; *Forearm* 78.7mm; *Humerus* 59mm; *Tibia* 72.2mm; *Foreleg* 95.1mm; *Femur* 70.2mm.

Cáceres & Monteiro-Filho (1999) noticed a correlation between head length and age class, and stated that the measurement may be used to estimate body length. Mass was noted to increase during autumn in preparation for the winter season with fewer resources. Males undergo more rapid growth than females and are typically larger and heavier. Adult size is reached about 10 months. They gave the following external body measurements for differing age classes of males and females from southern Brazil:

**Young** (6-7 months old, dental class 3): **Head:** male 11.0cm female 10.4cm (+/-0.3); **Body:** male 26.7cm female 26cm (+/-2.3); **FT:** male 5.2cm female 4.9cm (+/-0.2); **WT:** male 760g female 726g (+/-126).

**Subadult** (7-11 months old, dental class 4): **Head:** male 12.8cm female 10.9cm (+/-0.1); **Body:** male 30cm female 29.7cm (+/-0.3); **FT:** male 5.7cm female 5.1cm (+/-0.1); **WT:** male 1250g female 900g (+/-80).

**Young adult** (10-16 months old, dental class 5): **Head:** male 13.3cm (+/-0.4) female 11.8cm (+/-0.3); **Body:** male 35.8cm (+/-2.9) female 32.4cm (+/-1.5); **FT:** male 6cm (+/-0.3) female 5.5cm (+/-0.2); **WT:** male 1643g (+/-158) female 1116g (+/-95).

**Adult** (15-23 months old, dental class 6): **Head:** male 14.6cm (+/-0.1) female 12.5cm (+/-0.1); **Body:** male 38.5cm (+/-1.1) female 33.5cm (+/-0.6); **FT:** male 6.2cm (+/-0.3) female 5.6cm (+/-0.1); **WT:** male 1793g (+/-135) female 1303g (+/-133).

**Senile adult** (>22 months old, dental class 7): **Head:** female 13.1cm (+/-0.3); **Body:** female 34.4cm (+/-0.1); **FT:** female 5.7cm (+/-0.1); **WT:** male 1643g (+/-158) female 1353g (+/-30).

**SSP:** The smaller representative of the genus *Didelphis* in Paraguay, these are large opossums with pointed snouts, dense, shaggy pelage and large, rounded ears. This species could only be confused with *Didelphis albiventris* but is easily separated on account of its much darker, almost blackish body colouration, dark blackish ears (as opposed to pinkish-white in the "White-eared Opossum") and its strict preference for humid forested environments - as opposed to the catholic habitat preference of the White-eared Opossum which is frequently in dry, scrubby habitats and even in areas of human habitation. Furthermore note that the black head markings are much less distinct in this species and that the ground colour is golden-buff as opposed to pure white. This latter character is the most reliable when distinguishing juveniles, as young individuals of this species may have more or less pale-tipped ears (the ears being wholly pale in the youngest individuals) and more strongly-marked facial patterns than adults, but they never have a white ground colour to the head as in *D.albiventris*.

**DIS:** Distributed in the Atlantic Forest of Brazil, Argentina and Paraguay. In Argentina they are confined to Provincia Misiones. There is an isolated population in north-west Brazil in Alagoas and Pernambuco. In Paraguay the distribution is limited to central-eastern Paraguay and is greatly reduced following the disappearance of much of the Alto Paraná Atlantic Forest. The species is known to occur in Departamentos Alto Paraná, Caazapá, eastern San Pedro, northern Caaguazú and southern Amambay (Brown 2004, Esquivel 2001, Gardner 2007).

**HAB:** An Atlantic Forest endemic species, this species is confined to primary and secondary humid forests where it is frequently found in the vicinity of streams or waterways. In Brazil it also occurs in

*Araucaria* forests. The species is able to tolerate some degree of human interference in its habit, but shows much lesser affinity for areas of human habitation than *Didelphis albiventris*. (Gardner 2007). Moura et al (2005) found that the species showed an affinity for rocky areas in PN Serra dos Orgãos, Brazil.

**ALI:** Omnivorous, opportunistic and scansorial. Fecal samples of two individuals at Poço das Antas, Brazil contained invertebrates from the orders Orthoptera, Arachnida, Coleoptera, Diptera and Hymenoptera, and some unidentified seeds (Carvalho et al 1999). Given its efficient digestive rates, this species is an important disperser of Atlantic Forest plants with the bulk of foods consumed passing through the digestive system within 24 hours (Grelle & García 1999). Cáceres & Monteiro-Filho (2007) examined germination rates of seeds consumed by *Didelphis* opossums in southern Brazil, finding that germination rates of seeds that had passed through opossum guts were similar to those of control groups for thirteen species of pioneer plants, with the exception of *Rubus rosifolius* which required gut passage for germination. Fruits of Solanaceae, Cecropiaceae, Rosaceae, Myrtaceae, Moraceae, Rhamnaceae, Cucurbitaceae, Flacourtiaceae, Passifloraceae, Piperaceae and Araceae are consumed and effectively dispersed by this species (Cunha & Vieira 2005). Cáceres (2003) noted that the consumption of *Solanum sanctaecatharinae* increased greatly when the plant was in fruit in Curitiba, southern Brazil. Grelle & García (1999) noted that the fruits of *Cecropia hololeuca* are consumed from the ground rather than taken directly from the trees. Moura et al (in press) consider the species an intraguild predator and though it rarely preys on small mammals its presence is enough to promote avoidance of it by other small mammals. Astúa et al (2006) caught individuals at Rio Doce State Park, Minas Gerais, Brazil using ground Tomahawk traps baited with bacon and peanut butter.

**REP:** Polygynous with males dispersing in order to maximise their mating opportunities with the largely resident females. Presence of wounds on males during periods of high density suggests they react agonistically to each other when in search of a mate. (Mendel et al 2008). Females in Curitiba, Brazil had pouched young in August (Cáceres 2003). Kajin et al (2008) found reproduction to be seasonal in PN Serra dos Orgãos, Brazil, with breeding beginning in July (mid- dry season) and most females with pouched young in August. By February (end of the wet season) the breeding period was over but females were still lactating. Loretto & Vieira (2005) noted two breeding attempts in any one year in the same region, with the first matings taking place in June and second matings in November. Reproductive success is linked to rainfall and resource availability. Females began breeding at approximately 170 days old. Mean litter size was 7.33, with a range of 6-10 (n=16). Fecundity was greater in adults than subadults, but increased reproduction was found to reduce survival rate. Generation time was between 231.4 to 469 days.

**BEH:** *Activity Levels* Predominately nocturnal, terrestrial and scansorial. Using a spool and line technique in Serra dos Orgãos, Brazil Cunha & Vieira (2005) detected no increase in arboreal behaviour during the wet season when plentiful fruit crops might have been expected to alter the foraging strategy. Juveniles were found to be slightly more arboreal than adults and it was hypothesised that this may be related to their increased vulnerability to ground-based predators. Individuals were observed to reach a maximum height of 20m in the canopy. *Locomotion* The species is an excellent climber and able to climb vertical tree-trunks, reversing the hind feet and using the claws to grip. Cunha & Vieira (2002) note that *Didelphis* opossums move on thin limbs even when broader and apparently more stable limbs are available, distributing their weight across all four limbs and using the prehensile tail as a fifth limb. Delciellos & Vieira (2006) studied arboreal locomotion of this species on horizontal branches in PN Serra dos Orgãos, Rio de Janeiro State, Brazil. A maximum velocity of 2.49 (+/-0.74) x body length/second was recorded on support branches of 10.16cm diameter, and a minimum velocity of 1.95 (+/-0.07) x body length/second was recorded on support branches of 5.08cm diameter. Minimum number of strides per second was 2.22 (+/-0.05) on support branches of 5.08cm and maximum number of stride lengths per second was 2.93 (+/-0.15) on a flat surface. Range of stride length was from 0.82 to 0.95 x body length. Maximum velocity is reached by increasing stride frequency rather than increasing stride length, this likely being related to maintaining the stability of a large animal on a thin branch being of greater importance than final velocity (Delciellos & Vieira 2007). Delciellos & Vieira (2009) investigated climbing performance of this

species on nylon ropes of three diameters 0.6cm, 0.9 and 1.25cm. Respective velocities (stride length x stride frequency) of 0.24 (+/-0.17), 0.36 (+/-0.20) and 0.42 (+/-0.16) were recorded for the three rope diameters. Number of strides per second respectively were 0.80 (+/-0.27), 0.93 (+/-0.19) and 1.01 (+/-0.10) for the three rope diameters. Stride length when related to body length was 0.29 (+/-0.10), 0.38 (+/-0.12) and 0.42 (+/-0.14) respectively. *Home Range* Cáceres (2003) studied space use and territoriality in a mark-recapture study in Curitiba, southern Brazil. He noted that territories are established in aggregated patterns with low levels of overlap. Four female individuals were responsible for 68% of the 190 recaptures leading to the conclusion that females hold year-round territories. Males were considered migratory or residents of neighbouring forest patches that only occasionally made incursions into the study area. Home range size of males (2.3-2.7ha) were larger than those of females (0.6-1.7ha). Additionally larger range size was correlated to greater age and body mass in females. Loretto & Vieira (2005) demonstrated that males used larger areas in a less intensive manner during the breeding season and that females used larger areas less intensively during the dry season than they did during the wet season. Vieira & Cunha (2008) found home range size and intensity of use to be correlated to body mass. Female territories were estimated to overlap by 15% in the non-breeding season, but this figure reduced to 6% during the breeding season. Davis (1945) had earlier found that males wander more than females during a study of the species in Teresópolis, Brazil and that individual territories overlap. Loretto & Vieira (2005) correlated movements of males with reproductive effort whilst movement of females was associated with resource availability. Greater mobility of males can lead to greater oscillations in their density when compared with females (Mendel et al 2008). *Enemies* On the B2-277 bordering PN Iguacu in Paraná State, Brazil *D. aurita* and *D. albiventris* represented 16.2% of the mammals hit by cars. (Lima & Obara 2004). *Longevity* Kajin et al (2008) found the longest lived individual in their nine-year study at PN Serra dos Orgãos, Brazil to have survived 600 days. The species experiences high mortality whilst in the pouch and shortly after weaning. Life expectancy thus increases after weaning, but declines again through life. Few adults survive more than one breeding season and population turnover is high.

**VOC:** No information.

**HUM:** The species is hunted for sport and food in some areas of Brazil, and as with other *Didelphis* opossums is persecuted for its supposed taste for domestic poultry. Limited commercial hunting for the fur trade has little impact on the species.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN, (see [www.iucnredlist.org/details/40500](http://www.iucnredlist.org/details/40500) for the latest assessment of the species) because of its wide distribution, occurrence in protected areas and large population. The Centro de Datos de Conservación in Paraguay consider the species to be in danger in Paraguay giving it the code **N2**. The species is not listed by CITES. In Paraguay the distribution is confined to remaining patches of Atlantic Forest in a relatively small area of the north-central and northeastern Orient. Fragmentation of the Atlantic Forest has been severe in this area and the species has undoubtedly declined as a result. It is considerably less numerous than the related *Didelphis albiventris* (which likely out-competes it) and it does not tolerate the same degree of human disturbance of its habitat - though it apparently does so in Brazil in areas where *D.albiventris* does not occur. Typically the two species do not occur together and where they do this species is found in denser, more forested habitat, whilst *D.albiventris* is in more open and disturbed areas. Mendel et al (2008) found that the population density of females depends to some extent on litterfall and the associated macroarthropods that occur within it, with a delay of 6 to 7 months after the initial fall during which time the arthropod and hence opossum populations respond to the increased litter levels. Moura et al (in press) consider the species a key intraguild predator in Brazil, with its presence having a direct effect on the small mammal communities that share its habitat. The species is probably of national conservation concern given its dependence on undisturbed forest and the rapid expansion of *Didelphis albiventris* into perturbed areas.

**Online Account:** [www.faunaparaguay.com/didaurhb.html](http://www.faunaparaguay.com/didaurhb.html).

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**Southern Black-eared Opossum** *Didelphis aurita*.  
Adult Kurugaty, Departamento Canindeyú. Photo courtesy of Philip Myers.

# 12

## Genus

### *Lutreolina*, O.Thomas 1910

This is a monotypic genus. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* Desmarest 1804:19. In part. Not *Didelphis* Linnaeus (1758).

*Didelphys* Olfers 1818:204. In part. Incorrect spelling.

*Sarigua* Muirhead 1819:429. In part.

*Peramys* Lesson 1842:261. In part.

*Micoureus* P.Gervais 1855:287. In part. Not *Micoureus* Lesson (1842).

*Philander* Gerard 1862:139. In part. Not *Philander* Brisson (1762).

*Metachirus* Hensel 1872:121. In part. Proposed as a subgenus of *Didelphis*. Not *Metachirus* Burmeister (1854).

*Lutreolina* O.Thomas 1910:247. Type species *Didelphis crassicaudata* Desmarest (1804) by monotypy.

**General characteristics:** *Lutreolina* bears a superficial resemblance to a small otter or weasel, with a thick, non-prehensile tail furred to approximately half its length. Pelage is uniformly-coloured, thick and dense but not waterproof. Living or freshly-killed specimens fluoresce red-orange under UV light. The snout is short and the ears small and rounded. The legs are short and strong. This species possesses only a slight pouch. Hallux is not fully opposable. Fossils from the Pliocene of Argentina have been referred to this genus

**Cranial characteristics:** Distinctive amongst Didelphids on account of the shortened rostrum, narrow braincase and zygomatic arches. The nasals taper evenly.

**Paraguayan Species:**

*Lutreolina crassicaudata* - Thick-tailed Opossum

# 13

## Thick-tailed Opossum *Lutreolina crassicaudata*,

- Didelphis crassicaudata* Desmarest 1804:19. Based on de Azara (1801). Type locality restricted to Asunción, Paraguay by Cabrera (1958).
- Didelphys crassicaudis* Illiger 1815:107. Nomen nudum.
- D[idelphys]. crassicaudis* Olfers, 1818:206. Type locality “Paraguay”. Objective synonym.
- S[arigua]. crassicaudata* Muirhead 1819:429. Name combination.
- Didelphis macroura* Desmoulins 1824:492. Based on Azara (1801).
- Peramys crassicaudata* Lesson 1842:187. Name combination.
- D[idelphys]. crassicaudata* Schinz 1844:257. Name combination.
- Didelphys mustelina* Waterhouse 1846:497. Nomen nudum.
- Micoureus crassicaudatus* P.Gervais 1855:287. Name combination.
- [Didelphys (Metachirus)] crassicaudatus* Hensel 1872:121. Name combination.
- Didelphys turneri* Günther 1879:103. Type locality “Demerara”. Identified as “Better Hope, Demerara” (=Better Hope, Pomeroon-Supenaam, Guyana) by O.Thomas (1888).
- Lutreolina crassicaudata* Thomas 1910:247. New genus and name combination.
- [Didelphis (Peramys)] turneri* Matschie 1916:269. Name combination.
- L.[utreolina] c[rassicaudata]. bonaria* O.Thomas 1923:585. Type locality “Los Yngleses, Ajo” Buenos Aires, Argentina.
- L.[utreolina] c[rassicaudata]. parnalis* O.Thomas 1923:584. Type locality “Las Rosas, Santa Fé” Argentina.
- L.[utreolina] c[rassicaudata]. lutrilla* O.Thomas 1923:585. Type locality “San Lorenzo, Rio Grande do Sul” Brazil.
- L.[utreolina] c[rassicaudata]. turneri* O.Thomas 1923:583. First use of actual subspecific name.
- Didelphis ferruginea* Larrañaga 1923:346. Implied type locality Uruguay. Based in part on de Azara (1802).
- Lutreolina c[rassicaudata]. travassosi* Miranda-Ribeiro 1936:402. Type locality “Guariba, Estado de São Paulo” Brazil.
- Lutreolina crassicaudus* Hildebrand 1961:244. Incorrect spelling.

## *Lutreolina crassicaudata* (Desmarest 1804)

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; *Family Didelphidae*; Subfamily Didelphinae (Myers et al 2006). The genus *Lutreolina*, Thomas 1910, contains a single species. There are two recognised subspecies, that present in Paraguay is *L.c.crassicaudata* (Desmarest 1804) (Type Locality Asunción, Paraguay). Several other subspecies have been described on the basis of differences in size and pelage colour, but these characteristics are highly variable even within a single population and were synonymised with *L.c.crassicaudata* by Marshall (1978). *Lutreolina* is derived from the Greek meaning "otter-like", *crassicaudata* means "thick-tailed", describing the species most obvious physical feature. Desmarest (1804) described the species based on "Le Micouré `a grosse queue" of de Azara (1801). Synonyms adapted from Marshall (1978) and Gardner (2007).



**ENG:** Thick-tailed Opossum (Marshall 1978, Redford & Eisenberg 1992), Little Water Opossum (Redford & Eisenberg 1992), Lutrine Opossum (Gardner 2007), Mink-opossum (Santori et al 2005).

**ESP:** Comadreja colorada (Marshall 1978, Chebez 2001, Massoia et al 2000), Comadreja colorada grande (González 2001), Coligrueso (Marshall 1978, Chebez 2001, Massoia et al 2000), Zarigüeya colorada (Chebez 2001), Cuica (Marshall 1978, Chebez 2001, Massoia et al 2000), Zarigüeya nutria (Emmons 1999).

**GUA:** Mbicuré pytá (Chebez 2001), Mbicuré-pitá (Chebez 2001), Mbihkurê-pihtá (Chebez 2001), Mykure pyta (SEAM 2001), Mbicuré pythá (Parera 2002), Bechi **Ac** (Esquivel 2001).

**DES:** A medium-sized semi-aquatic opossum with a vaguely weasel-like appearance. The dense, smooth pelage is uniformly pale brownish or brownish-red dorsally, lacking any bold markings or distinguishing features and slightly paler ventrally. Pelage colour is extremely variable, and Marshall (1978) notes that captive specimens actually changed colour according to environmental conditions and diet. The pinkish rhinarium has a rounded posterior projection, sharply-defined from the furred part of the face and there is an indistinct dark patch on the snout. The ears are small, rounded with a long basal projection on the inner edge. They are barely visible above the pelage and when laid forward they reach half the distance to the eye. Eyes are dark brown. The metatragus is rounded and well-developed. Legs are short and stout. The feet are dark brown to pinkish, similarly broad with small, narrow pads on the feet and non-opposable hallux and pollex. There are five toes on each foot. The fifth hind toe reaches only to the mid-point of the first phalanx of the fourth toe. Each toe is armed with a long, slender, whitish claw. The tail is extremely thickened at the base, the junction with the body being difficult to discern. It is thickly furred along the basal half and more thinly so over the rest of its length, with the terminal 5cm of the ventral surface naked. Where thinly furred the tail is darker, almost blackish and it is white-tipped. The tail is only moderately prehensile and less so than in other Didelphids. Though the pouch is frequently reported as undeveloped, specimens examined by Lemke et al (1982) had a well-developed pouch and Parera (2002) postulates that the extent of development may in fact vary individually. There are nine mammae. Juveniles are similar to adults but have the tail furred along much of its length, lacking the basal swelling. **CR** - Cranium unique amongst the opossums on account of the long narrow zygomatic and cranial regions when compared to the short rostrum. The nasals are short and narrow, expanding posteriorly. The zygomatic arch is long and high, but robust despite the fact that it is not strongly expanded. Forehead gently domed and brain case long, narrowing in the interorbital region where smoothly rounded. (Marshall 1978). *Condylbasal Length* 68.7mm (54.7-82.5mm); *Transverse Zygomatic Width* 36.5mm (28.6-46.2mm); *Temporal Constriction* 7.9mm (7.2-8-8mm); *Mandibular Length* 53.3mm (43.8-63.7mm) (Marshall 1978).

**DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. *Upper Tooth Row* 28.9mm (22.8-31.3mm); *Lower Tooth Row* 28.9mm (24.1-33.8mm); *Length M1-M3* 10.4mm (9.5-12.2mm) (Marshall 1978). **CN:** 2n=22. (Redford & Eisenberg 1992). X-chromosome is metacentric and Y-chromosome acrocentric (Marshall 1978).

**TRA:** Not dissimilar to sp *Didelphis* in form. Prints are wider than they are long with a "rotated" appearance, the digits appearing angled to the direction of the pace. Hindfoot with opposable thumb almost perpendicular to rest of print and situated so that that region of the print appears "stretched". The other digits on the hindfoot have a more "typical" arrangement, unlike those of *Didelphis* which are skewed over towards the opposite side of the print giving a far more "uneven" arrangement. (Esquivel 2001).

**MMT:** A medium-sized opossum with tail approximately equal to the head and body length. There is considerable variation in size of adults, with some specimens twice the size of others, in part due to the fact that they do not reach maximum size until well after reaching sexual maturity (Marshall 1978). Males are larger than females (Eisenberg & Redford 1999). **TL:** 57.4cm (46.6-78.1cm); **HB:** 28.94cm (19.7-37.8cm); **TA:** 28.19cm (22.1-39cm); **FT:** 4.38cm (3.5-5.4cm); **EA:** 2.63cm (1.8-3.8cm); **WT:** 514.54g (176-1500g). (Redford & Eisenberg 1992, Parera 2002, Marshall 1978).

**SSP:** Unlikely to be confused if seen well. Weasel-like in appearance and behaviour, it is quite unlike any other opossum. The only other opossum that is likely to take to water is the quite different *Chironectes minimus*. There is a vague resemblance to a small otter, but otters are considerably larger with quite different behaviour, are generally active by day and have the tail fully-furred without obvious thickening at the base.

**DIS:** Two widely sympatric populations north and south of Amazonia assigned to two different subspecies. It has been alternatively hypothesised that the species may have historically occurred in the intervening area, or that it does still occur but has yet to be detected because of a lack of sampling (Nowak 1991). The nominate subspecies *L.c.crasicaudata* Desmarest 1804 is the most widespread, found over a wide area of central and southern South America from central Bolivia (not including the Amazonian regions), through eastern Paraguay (including the Pantanal region) and southern Brazil, south to Uruguay and Argentina as far as Provincia Chubut. However despite the wide geographical range it appears to be rather patchily distributed, and it may be absent from much of central Argentina, leaving the population in Provincia Jujuy somewhat isolated - animals in this region are smaller and darker than those of the rest of Argentina, though they are not currently afforded subspecific recognition (Díaz & Barquez 2002). Similarly in Brazil its precise distribution is unclear, though present in the Pantanal and the State of Rio Grande do Sul, its distribution in the region between the two is unclear. However it is not known to occur north of Rio de Janeiro in Brazil, or north of Beni in Bolivia. In Paraguay the distribution is very poorly known and there are few specimen records. The northern subspecies *L.c.turneri* Günther 1879, was for a long time known only from a few specimens in Guyana, though it has since been proven to occur patchily into eastern Venezuela and eastern Colombia (Nowak 1991).

**HAB:** Found in a variety of habitats, typically semi-open and in the vicinity of water, including natural grasslands, gallery woodland (in the Pantanal and cerrado) and palm savannas (in the Humid Chaco). At ECOSARA, San Rafael National Park it has been seen on streams in marshy areas at the intersection of pasture and Atlantic Forest (ECOSARA Biodiversity Database). In Provincia Jujuy, Argentina it occurs in dense humid forests and may do so at least marginally in other areas of the range, including Paraguay.

**ALI:** An aggressive predator and active hunter, exploring crevices and holes in search of prey (Parera 2002). Though best considered an opportunistic omnivore, the diet varies geographically and in some areas the species is almost entirely carnivorous, taking a variety of invertebrate and vertebrate prey, including mammals, small birds and their eggs, fish, reptiles and amphibians. Vertebrate prey is typically killed with a bite to the nape (Emmons 1999). Cáceres et al (2002) studied the diet of this species in secondary Atlantic Forest on Santa Catarina Island, Brazil by analysis of fecal samples. Of 13 fecal samples they found that crabs (54% of samples) and beetles (46%) were the main items in the diet. Other animal items documented were in order of prevalence: Opiliones (31%), Hymenoptera (23%), Lepidoptera (15%), Diptera (15%), Diplopoda (15%), Orthoptera (15%), Birds (15%), Bones (15%). Plant material included *Cecropia glaziovii* (85%), *Piper* sp. (62%), *Ficus* sp. (15%) and unidentified



Aracaceae and Solanaceae (8% each). The species was calculated to drop a mean of 765 (+/-1995) seeds per fecal sample/night. Consumption of plant material was greatest during warm wet months (March to May) and lower or absent in cold months (June to August). The presence of undamaged seeds in fecal samples means that the species is likely an important disperser for early-colonising plants such as *Cecropia*. An individual at ECOSARA, San Rafael NP was observed to swim towards a singing toad *Rhinella ornata*, capture it and eat it at 7pm during April 2008 (David Gill pers. comm.). One stomach contained pieces of mollusc shells and sand, suggesting foraging on river bottoms. Captive individuals at New York Zoological Gardens were maintained on a diet of sliced butterfish, mixed with meat, frogs, earthworms, shrimps and mice (Davis 1966). Elsewhere captive individuals have been fed on fruit and seen to kill mammals up to the size of the wild guinea-pig *Microcavia*. Individuals have been captured in traps baited with mice (Eisenberg & Redford 1999), banana and peanut butter (Cáceres et al 2002) and are also occasionally captured in traps set for Coypu (González 2001).

**REP:** Little known. It would seem that they breed twice a year, once in the spring and again following the independence of the first litter. Gestation period is about two weeks (Nowak 1991). Litter size is between 6 and 11 (Parera 2002, Eisenberg & Redford 1999). The young are raised in a spherical nest of dry grass located in tree holes, amongst rushes or in burrows, either dug by the animal itself or by other species such as armadillos (Massoia et al 2000). They will even utilise bird nests. Initially the young are carried ventrally, either in a pouch or clinging to the underside of the animal, as they grow they cling to the dorsal pelage (Parera 2002).

**BEH:** *Activity Levels* Largely nocturnal, this species is as weasel-like in behaviour as it is in appearance. Cáceres et al (2002) only caught the species on the ground and generally close to creeks. *Locomotion* It is an active, agile and efficient hunter, moving rapidly over level ground, but equally at home climbing in trees and an excellent swimmer. (Parera 2002). When swimming the species dives frequently. Santori et al (2005) found that the species swims with a quadruped, paddling gait and that whilst swimming speed was similar to terrestrial didelphids, the buoyancy and stroke frequency were closer to that of the aquatic *Chironectes minimus*. Under laboratory conditions mean swimming speed was 0.43m/s (+/-0.02). The dorsum, eyes and nostrils were maintained above the water surface and the nose below. Body position was roughly horizontal or slightly inclined and the body and tail made smooth bilateral movements to propel the animal through the water, with greatest propulsion provided by the hindlimbs. During the power stroke the hindlimb was forced backwards with toes extended, and on the recovery stroke the foot was swept forwards with digits adducted. Forelimbs were moved in a rotational motion slower than that of the hindlimbs and provided balance rather than propulsion. They considered that the species was not specialised for aquatic locomotion. On land they move with a trot at low speed, increasing to a gallop at high speed, but the vertebral column is never undulated. Speed during terrestrial locomotion was 1.01m/s. When walking along a horizontal tube a similar gait to low speed terrestrial locomotion was observed with a speed of 0.17 m/s. When walking along an angled trunk the speed increased to 0.35 m/s with step length 0.13m. When climbing the angled trunk only the forelimbs were used to support the animal and the hindlimbs were brought forward to form a bounding motion. When jumping the hindlimbs were brought together with the forelimbs and the animal leans forwards. The spinal column is flexed and the hindlimbs suddenly extended to generate the jumping force. Whilst in mid-air both, the entire body and limbs are extended. *Defensive Behaviour* Captured animals are frequently extremely aggressive (González 2001). *Enemies* Recently independent juveniles fall easy prey to diurnal raptors such as *Bupernis magnirostris* and large owls such as *Bubo virginianus* and *Tyto alba*. Adults undoubtedly fall prey to Canids and Felids. *Parasites* Two nematode species have been recorded *Travassostrongylus chacoensis* and *Hoineffia simplicispicula* (Parera 2002).

**VOC:** Animals maintain contact with a high-pitched whistle. Threatened animals also whistle. (Emmons 1999). A series of postures and olfactory signals also serve purposes of communication (Parera 2002).

**HUM:** Currently the species does not appear to be persecuted for its fur, but in the past skins were used to make mats and as fur trimming for clothing. However the fur rapidly loses its colour and a market for the species never developed (Marshall 1978). Because of the species similarity to the Old



World weasels (Mustelidae), known as "Comadreas" in Spain, it has been hypothesised that its usage for the New World opossums (Didelphidae) originated with this species (Massoia et al 2000). The species was the subject of the children's book "El Casamiento de la Comadreja" by Vigil (1945). In farming areas it is often persecuted for its attacks on domestic birds and their eggs, though it also plays a role in control rodent populations (Parera 2002).

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/search/details.php/40503/all](http://www.iucnredlist.org/search/details.php/40503/all) for the latest assessment of the species). The Centro de Datos de Conservación in Paraguay consider the species to be rare in Paraguay, giving it the code **N3**. Little-recorded because of its unobtrusive, nocturnal habits, this species does not appear to be as rare as records would suggest. In certain areas of Argentina it is even considered abundant (Parera 2002). However, despite its presence in certain semi-urban reserves such as the Costanera Sur in Buenos Aires, it apparently does not tolerate human presence well and likely suffers from drainage associated with agriculture and the conversion of grasslands and marsh habitats into pasture through burning and other means. Two individuals were calculated to have a home range of 800m<sup>2</sup>.

**Online Account:** [www.faunaparaguay.com/lutcrabh.html](http://www.faunaparaguay.com/lutcrabh.html).

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# 14

## Genus

### *Philander*, Brisson 1762

Six species, one of which is present in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* Linnaeus 1758:54. In part.

*Didelphys* Schreber 1777:532. Unjustified emendation.

*Philander* Brisson 1762:13. Type species *Didelphis oposum* Linnaeus (1758).

*Philander* Tiedemann 1808:426. Type species *Philander virginianus* (= *Didelphis oposum* Linnaeus 1758)

*Sarigua* Muirhead 1819:429. In part.

*Metachirus* Burmeister 1854:135. In part. Described as a subgenus of *Didelphis* Linnaeus.

*Gamba* Liais 1872:329. In part.

*Zygolestes* Ameghino 1899:7. In part.

*Metachirops* Matschie 1916:262. Type species *Didelphis quica* Temminck (1824).

*Holothylax* Cabrera 1919:47. Type species *Didelphis oposum* Linnaeus (1758).

*Metacherius* Sanderson 1949:787. Incorrect spelling.

*Phillander* Rivillas, Caro, Caravajal & Vélez 2004:591. Incorrect spelling.

**General characteristics:** Medium to large grey or black opossums with conspicuous pale spots above the eye and in front of the ears. Ears naked. Tails exceeds the head and body length and is mostly naked, though furred at the base. Mature females have a well-developed pouch. Largely terrestrial forest inhabitants, though they do climb well. Diploid chromosome number 22. Fossils are known from the late Pliocene of Argentina and late Quaternary of Brazil.

**Cranial characteristics:** Similar to *Didelphis* in many respects but nasals less expanded laterally at maxillofrontal junction. Rostrum long and slender with broadly flared zygomatic arches. Postorbital constriction is smoothly rounded and narrow and temporal ridges converge to form a well-developed sagittal crest.

**Paraguayan Species:**

*Philander frenatus* - Southeastern Four-eyed Opossum

# 15

## Southeastern Four-eyed Opossum

### *Philander frenatus*

*D[idelphys]. frenata* Illiger 1815:107. Nomen nudum.

*D[idelphys]. superciliaris* Illiger 1815:107. Nomen nudum.

*D[idelphys]. frenata* Olfers 1818:204. Type locality "Sudamerica". Restricted to Bahía, Brazil by JA Wagner (1843).

*D[idelphys]. superciliaris* Olfers 1818:204. Type locality "Sudamerica".

*Didelphis quica* Temminck 1824:36. Type locality "Brésil". Restricted to Sapitiba (=Sepetiba, Rio de Janeiro) by Pelzeln (1883).

*Didelphys [Metachirus] quica* Burmeister 1854:136. Name combination.

*Zygolestes enterianus* Ameghino 1899:7. Type locality "Argentina".

*[Didelphis (Metachirops)] quica* Matschie 1916:268. Name combination.

*[Didelphis (Metachirops)] frenata* Matschie 1916:268. Name combination.

*[Holothylax] quica* Cabrera 1919:48. Name combination.

*Metachirus opossum azaricus* O.Thomas 1923:604 Type Locality "Sapucay" (=Sapucaí), Departamento Paraguari, Paraguay.

*Metachirops quica* Bresslau 1927:215. Name combination.

*Metachirops opossum quica* A Mirando-Ribeiro 1935:37. Name combination.

*Met[achirops]. opossum quichua* Krumbiegel 1941:200. Name combination and incorrect spelling.

*Met[achirops]. opossum azaricus* Krumbiegel 1941:203. Name combination.

*Met[achirops]. opossum frenatus* Krumbiegel 1941:206. Name combination.

*Philander opossum azaricus* Cabrera 1958:34. Name combination.

*Philander opossum quica* Cabrera 1958:36. Name combination.

*Philander enterrianus* Reig 1957:220. Name combination and incorrect spelling.

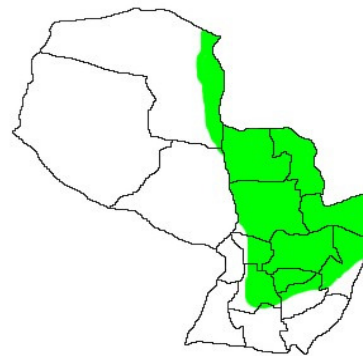
*Philander opossum azarica* Patton & da Silva 1997:97. Name combination and incorrect gender.

*Philander opossum frenata* Patton & da Silva 1997:90. Name combination and incorrect gender.

*Philander frenata* Patton & da Silva 1997:90. Name combination and incorrect gender.

***Philander frenatus* (Olfers 1818)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae (Myers et al 2006). Six species are recognised in this genus (Patton & da Silva 1997, Lew 2006, Gardner 2007), one is currently documented as being present in Paraguay. The species is monotypic. The generic name is derived from the first vernacular name "Philander opossum, sive Carigüeja" used by Seba (1734). The specific name *frenatus* is from the Latin meaning "bridled" in reference to the distinctive face pattern. The genus *Philander* was defined by Brisson (1762), though it is often credited to Tiedemann (1808). However Tiedemann clearly used the name when referring to the *Didelphis* of Linnaeus (JA Allen 1900). In 1998 the International Commission on Zoological



Nomenclature determined that Brisson's name had priority over that of Tiedemann. There has been considerable debate as to which generic name should take precedence for this species with Pine (1973) arguing that *Metachirops* Matschie 1916 is the correct designation for this species and that *Philander* should apply to the Brown Four-eyed Opossum here referred to *Metachirus* Burmeister 1854. However his arguments failed to gain widespread support and *Philander* is the most widely accepted generic name for this species (Nowak 1991, Redford & Eisenberg 1992, Emmons 1999). Based on mtDNA cytochrome-b gene sequences and DNA-DNA hybridisation data *Philander* is the sister group of *Didelphis*. (Castro-Arellano et al. 2000). Following a number of molecular studies there has been a recent tendency to raise several forms formerly treated as subspecies of *Philander opossum* to species level. Patton & da Silva (1997) first raised *Philander frenata* (= *P. frenatus*) to species level based on sequences of the cytochrome-*b* gene, finding it highly divergent (14%) from all other forms of *P. opossum* used in their analysis. There is considerable confusion in the recent literature surrounding the nomenclature of the various forms in the genus *Philander*. Three recent detailed reviews of *Philander opossum*, included all the forms now recognised as species but disagreed considerably as to the distribution and nomenclature of the populations involved. In terms of the populations now considered to constitute *Philander frenatus*, Hershkovitz (1997) attributed the southern Brazilian, Paraguayan, Bolivian and eastern Peruvian populations to *P. o. quica* Temminck 1824 and confined *P. o. frenata* (sic) Olfers 1818 to Salvador, Bahía, a separation of taxa which Gardner (2007) considered "inexplicable". Castro-Arellano et al (2000) however applied *P. o. frenatus* to the coastal Atlantic forest subspecies extending from Bahía State in Brazil to Provincia Misiones, Argentina, and used *P. o. azaricus* for the Paraguayan population and animals inhabiting the Pantanal and cerrado of Brazil. Patton & da Silva (1997) considered *P. frenata* to have an entirely Brazilian range that extends from at least the State of Paraná north to Bahía and inland to Minas Gerais and Goiás, but noted that the relationship of *P. frenata* to *P. o. azaricus* (sic) "remains to be determined". They maintained *azaricus* within *P. opossum* without any further justification other than the fact that it is traditionally placed there. Gardner (2007) synonymised *azaricus* with *frenatus*. Synonyms are adapted from Gardner (2007).

**ENG:** Southeastern Four-eyed Opossum, Grey Four-eyed Opossum (in part Castro-Arellano et al 2000)

**ESP:** Comadreja de cuatro ojos (Massoia et al 2000), Comadreja de anteojos (Massoia et al 2000) (Emmons 1999, Esquivel 2001), Guayquica overa (Massoia et al 2000, Parera 2002), Mantequera (Massoia et al 2000), Chucha (Massoia et al 2000, Redford & Eisenberg 1992), Cuica común (Massoia et al 2000), Zorro de cuatroojos (Redford & Eisenberg 1992), Zarigüeya de cuatro ojos gris (Emmons 1991), Carachupa cuatro ojos (Cuéllar & Noss 2003).

**GUA:** Guaikí (Massoia et al 2000, Redford & Eisenberg 1992).

**DES:** Slender with a large head and elongated, conical rostrum. Pelage short, dense and smooth, each hair pale-based with a darker central band and silvery-tip. The dorsum is dark greyish (tinged browner in older individuals), darker towards the mid-dorsum and becoming paler and whiter towards the flanks and creamy-white on the throat, cheeks and venter. The head is uniform with the body with

conspicuous white patches above the eyes (the "spectacles") and less obvious, smaller patches at the anterior base of the ears. The ears are large, rounded and pinkish with blackish borders to the pinnae. The nose, upper lip and feet are naked and pinkish in colour. The prehensile tail is long, furred for the first 5-8cm (approximately 17% of its total length) and greyish at the base with a sharply-demarcated white tip. It is cylindrical, slender, scaly and tapers towards the tip. Hind feet have opposable pollex and hallux, modified for grasping. The marsupium, which opens from the side, is orange in females that have had young. The scrotum of the male is black and breeding males develop a small yellowish patch on the sides in front of the thighs. Females possess between 5 and 9 mammae concealed within the marsupium, usually 7, arranged in two rows of three with a median teat between them (3-1-3). Juveniles are similar to adults with have finer, softer fur. **CR** - Skull is narrow and slender. *Philander* has a relatively large brain in comparison with other Didelphids (Redford & Eisenberg 1992). Bony palate with four fenestrae. Sagittal and occipital crests are well-developed in adults and auditory bullae are small. Hershkovitz (1997) gave the following measurements for his *P.o.quica* which refers in part to this species: *Condylbasal Length*: male 66.4mm (60-76.4mm, n=78), female 62.8mm (57.1-72.4mm, n=76); *Zygomatic Width* male 35.5mm (30.7-43.7mm, n=75), female 31.1mm (28-38.3mm, n=67); *Preorbital Width*: male 12.6mm (10.8-15.7mm, n=36), female 11.6mm (9.7-14.7, n=42); *Postorbital Width*: male 8.4mm (7.4-9.1mm, n=77), female 8.4mm (7.5-9.9mm, n=67); *Braincase Width*: male 20.2mm (18.2-23.1mm, n=71), female 19.7mm (18-21.9mm, n=67); *Palate Length*: male 38.3mm (34.1-44.8mm, n=75), female 39.2mm (35.1-44.6mm, n=71). **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. First incisor largest on upper row, absent on lower mandible. Upper canine long, slender and decurved, lower canine similar but smaller. Premolars unicuspid with two roots. Upper P1 about half the size of P2, and P3 deciduous. Young at weaning lack molars, the molars then begin to appear in sequence. Upper M1 longer and larger than M2. Upper M4 about half the size of M3. Lower M2 or M3 largest, lower M4 smallest. The appearance of M4 is accompanied by the loss of P3. Dentition is complete at 1 year of age. From this point on age can be determined by tooth wear. Body mass continues to increase after full eruption of molars (Hershkovitz 1997). Hershkovitz (1997) gave the following measurements for his *P.o.quica* which refers in part to this species: *Length i-m4*: male 34.4mm (32-37.7mm, n=78), female 32.9mm (30.5-38mm, n=71); *Length m1-m4*: male 12.7mm (11.6-14.4mm, n=80), female 12.5mm (11.2-14.5mm, n=78). **CN**: 2n=22. FN=20. Karyotype with 10 uni-armed autosomes with terminal centromeres, an acrocentric X and a minute Y (Castro-Arellano et al. 2000).

**TRA**: No information.

**MMT**: A large and robust, cat-like Didelphid, with tail slightly longer than the head and body. Males initially the same size of females, but outgrow them by maturity. Captive individuals may reach much larger sizes than wild individuals, and largest wild individuals are not necessarily the oldest. Dental size, fixed at eruption, is the true indicator of body size (Hershkovitz 1997). Vieira (1997) gave the following mean measurements for 15 specimens from Rio de Janeiro and Teresópolis, Brazil: **HB**: 26.53cm; **TA**: 26.90cm; **FT**: 3.46cm; *Claw* 0.17cm; *Foot Width* 2.62cm; *Arm* 4.37cm; *Forearm* 4.94cm; *Leg* 4.09cm, *Foreleg* 5.09cm; *Forelimb* 9.31cm; *Hindlimb* 11.05cm; **WT**: 398g (220-680g). Vieira et al (2008) noted **WT**: 292g (+/-155g, range 85-595g) for 14 individuals (9 males and 5 females) in the Serra do Mar, Brazil. The following mean post-cranial measurements were noted by Carvalho et al (2000) for Brazilian specimens (n=7): *Ulna* 40.2mm; *Forearm* 43.9mm; *Humerus* 33.2mm; *Tibia* 42.1mm; *Foreleg* 50.7mm; *Femur* 39.2mm. Hershkovitz (1997) gave the following measurements for his *P.o.quica* which refers in part to this species: **HB**: male 26cm (20-30cm, n=60), female 25.5cm (22-33cm, n=57); **TA**: male 29.2cm (19.5-35.5cm, n=63), female 27.59cm (22-31cm, n=55); **FT**: male 4cm (2.9-4.8cm, n=64), female 3.8cm (3.2-4.6cm, n=53); **EA**: male 3.4cm (2.2-4.2cm, n=44), female 3.3cm (2.2-4.3cm, n=46).

**SSP**: The only other species to share the "eyes" of this species is *Metachirus nudicaudatus*, which is most easily distinguished by its brownish pelage. When viewed frontally note that the white spots above the eyes are smaller and more widely-spaced in *Metachirus*. The second pair of "eyes" are much reduced and located in front of the ears in this species, those of the *Metachirus* being more extensive and located behind the ears. The tail of *Philander* is proportionately shorter and furred at the base for the first 6 to 8 cm, as well as being bicoloured with a clearly demarcated tip - that of *Metachirus* is naked to the base and becomes gradually paler along its length. Structurally the snout is more pointed and the legs

are longer in *Metachirus* than in this species. Female *Metachirus* do not possess a pouch. Finally note that *Metachirus* is almost exclusively terrestrial in behaviour, whilst *Philander* freely takes to the trees when foraging.

**DIS:** This species is found in Paraguay, northern Argentina (Provincia Misiones, and records from PN Pilcomayo and PN Chaco may also refer to this species) and southwestern Brazil (coastally from Bahia to Rio Grande do Sul at least as far south as Marica). In Paraguay it is scantily distributed through eastern Paraguay and the eastern part of Departamento Alto Paraná, the Paraguayan Pantanal. Brown (2004) listed the following specimens for Paraguay: Departamento Concepción; Rio Aquidaban, Paso Horqueta (Creighton, 1979, UMMZ); Aca Poi (Wharton, 1950, USNM); Departamento Cordillera; Tobati, 12 km N (Myers, 1973, MVZ); Departamento Central; Luque, 17 km E (Koford, 1972, MVZ; Myers, 1976, UMMZ).

**HAB:** Essentially an Atlantic Forest species, this opossum has proved itself to be adaptable and able to colonise a variety of habitats, though it shows a preference for forested areas close to rivers or swamps, typically with dense leaf litter and rocky areas (Moura et al 2005). In Brazil they are found most commonly in humid forest, but also occur in drier and scrubrier restinga habitat. In Paraguay they are typically associated with humid and semi-humid evergreen forests, such as the Atlantic Forest and the seasonally-inundated forests of the Pantanal. The water balance of *Philander* suggests that it is an obligate inhabitant of mesic environments (Fonseca & Cerqueira 1991).

**ALI:** Omnivorous but primarily carnivorous, taking mainly invertebrates and small vertebrates supplemented with fruit. Nowak (1991) lists small mammals, birds and their eggs, reptiles, amphibians, insects, freshwater crustacea, snails, earthworms, fruit and carrion as dietary items. Cáceres (2004) examined 14 fecal samples from Atlantic Forest in the Serra do Mar, southern Brazil, finding invertebrates in 100% of samples, vertebrates in 57% and fruit in 29%. In order of prevalence this consisted of: Coleoptera 57%, Opiliones 50%, Aves 36%, Diplopoda 36%, Blattaria 36%, Hymenoptera (ants) 29%, Pulmonata 21%, Orthoptera 21%, Decapoda 21%, Mammalia 21%, Reptilia 14% and fruits of *Monstera adansonii*, *Ficus luschnatiana* and unidentified Solanaceae all 7% each. Germination rates of 97% and 100% were recorded for *Monstera* and *Ficus* seeds respectively that had passed through the gut of this species, indicating its role as an occasional seed disperser for certain tree species. Carvalho et al (1999) recorded the following animal items in 4 fecal at Poço das Antas, Rio de Janeiro, Brazil (results as expressed as percentage of samples in which the item was present): Coleoptera 100%, Hymenoptera 50%, Arachnida 50%, Diptera 25% and Rodentia 25%. Plant material consisted of: *Piper* sp 66.7%, *Piper mollicomum* 33% and unidentified 3%. Cerqueira et al (1990) found bacon to be the most effective bait for trapping this species. Barros et al (2008) used Tomahawk traps baited with a "mixture of banana, oat, peanut butter and minced bacon, placed on top of a manioc slice" whilst Cáceres (2004) trapped the species using banana and cod liver oil. Hershkovitz (1997) fed a captive individual with beef, chicken legs, insects, peanut butter and banana. It dispatched live mice instantly by crunching the head and neck in its jaws and consuming everything "flesh, entrails, skin or bones". Prepared food was consumed at night even when provided during the day. Following feeding the animal groomed its forequarters, sides and underparts without paying particular attention to the pouch and none to the young.

**REP:** Breeding apparently occurs throughout the year but is apparently affected by resource availability, leading to breeding seasonality in some areas. Breeding has been recorded from August to February in Misiones, but Barros et al (2008) found no evidence of seasonality of breeding in the species at Poço das Antas Biological Reserve, Rio de Janeiro, with receptive females being found throughout the year except June and September. Cerqueira et al (1993) found breeding to be seasonal in restinga in southeastern Brazil with no reproductive females encountered from March to June, whilst Gentile et al (2000) found a similar situation in Atlantic Forest with no reproductive females encountered from May to June. Barros et al (2008) noted that the fragmented forest in which they worked experienced edge effects which can affect the resource availability in a way that more continuous blocks of forest would not, leading to a possible change in the breeding patterns and the ability to breed during months in which it may not be possible in a more continuous block. Males are sexually active throughout the year but the testes vary seasonally in size, though not in mass or spermatogenesis. Barros et al (2008) found no relationship between rains and the presence of



receptive females. They recorded a mean litter size of 5, with a range of 1 to 8 (n=21) and young were found throughout the year except June, October and November. Hershkovitz (1997) mentioned a female ("Barbara") with six pouches captured in Minas Gerais during October. In northeastern Argentina the observed range of litter size is from 4 to 6. A litter from Paraguay photographed by José Luis Cartes contained 5 young. The gestation period is from 13 to 30 days (Cimardi 1996). Females may abort a brood by stopping lactation if there is insufficient food available to her. Ovarian cycling is suspended during lactation but not during gestation, the act of suckling being key to the suspension of the cycle. In Brazil a litter with 4 males and 1 female young was found. Juveniles are weaned at 68-75 days when they weigh 50-75g (100-200g for captive individuals). The nest phase lasts as little as 8 to 15 days before dispersal of the young, with members of the litter becoming more anti-social towards each other following weaning. Survival chances of a litter is greatly affected by the age of the mother. Females <11 months old and >17 months old have the highest mortality rate of offspring (Gentile et al 1995). Males reach sexual maturity rapidly at 7 months, and females are sexually mature by 6 or 7 months, though the first oestrus is not until 15 months. The reproductive life of the average female is short. (Redford & Eisenberg 1992, Castro-Arellano et al. 2000). This species is considered an "r-strategist", in other words its reproductive behaviour favours a rapid rate of population increase. Such strategies are typical of species inhabiting short-lived environments or those that undergo large fluctuations in population size (Hershkovitz 1997).

**BEH: Activity Levels** Adults are generally solitary, nocturnal and predominately terrestrial. Vieira (1997) described the species as a terrestrial scamperer. However, it is an excellent climber and though it frequently uses the subcanopy, it does not apparently reach the canopy (Cunha et al 2002). The eyes shine orange under torchlight (Hershkovitz 1997). *Locomotion* The species is largely terrestrial when foraging though somewhat semi-arboreal in overall behaviour (Massoia et al 2002, Nowak 1991). Delciellos & Vieira (2006) studied arboreal locomotion of this species on horizontal branches in PN Serra dos Orgãos, Rio de Janeiro State, Brazil. A maximum velocity of 5.24 (+/-0.14) x body length/second was recorded on support branches of 5.08cm diameter, and a minimum velocity of 4.37 (+/-0.19) x body length/second was recorded on support branches of 2.54cm diameter. Minimum number of strides per second was 3.96 (+/-0.12) on support branches of 2.54cm and maximum number of stride lengths per second was 4.63 (+/-0.09) on support branches of 5.08cm diameter. Range of stride length was from 1.10 to 1.13 x body length. Maximum velocity is reached by increasing stride frequency (Delciellos & Vieira 2007). Delciellos & Vieira (2009) investigated climbing performance of this species on nylon ropes of three diameters 0.6cm, 0.9 and 1.25cm. Respective velocities (stride length x stride frequency) of 0.53 (+/-0.20), 0.81 (+/-0.30) and 1.23 (+/-0.66) were recorded for the three rope diameters. Number of strides per second respectively were 1.15 (+/-0.25), 1.65 (+/-0.44) and 1.88 (+/-0.61) for the three rope diameters. Stride length when related to body length was 0.45 (+/-0.11), 0.48 (+/-0.09) and 0.62 (+/-0.14) respectively. On release from a trap 93% of animals in Brazil used terrestrial escape routes (Castro-Arellano et al. 2000). The reduced forelimbs and larger hindlimbs are an adaptation for jumping, necessary in a semi-arboreal animal which must avoid obstacles on the forest floor and have the necessary agility to move through tree branches (Vieira 1997). *Home Range* Gentile et al (1997) estimated home range to vary between 0.12-1ha with a mean of 0.4ha in restinga habitat at Barra de Maricá, Rio de Janeiro. Range size did not vary between the wet and dry season. Male range size remained more or less constant (mean 0.28ha +/-0.13 during breeding season, 0.37ha +/-0.28 during the non-breeding season), but that of females increased significantly during the reproductive season (mean 0.57ha +/-0.27 during breeding season, 0.17ha +/-0.08 during the non-breeding season). Immature animals did not differ from adults in the size of their home ranges. Ranges were found to overlap more as population density increased, though mean range size was unchanged and territories were found to overlap irrespective of the sexes of the occupants. There is little or no contact or antagonism between adults provided that sufficient resources exist (Redford & Eisenberg 1992) and no dominance hierarchy amongst adults. Pires et al (2002) detected a rate of movement between forest fragments of 7.5% at Poço das Antas, Rio de Janeiro and noted no statistical difference in the movements between the sexes. *Roosts* Nests of this species were always between rocks close to running water in PN Serra dos Orgãos, Rio de Janeiro (Moura et al 2005). Southeastern Four-eyed Opossums sleep curled into a ball, and though the true

eyes are not visible, the "false eyes" are and give the appearance of an animal that is alert and awake (Castro-Arellano et al. 2000). Miles et al (1981) describes nests of the species in tree hollows and tree forks 8-10m, as well as nests in cavities behind buttressed tree roots. *Defensive Behaviour* Moura et al (2005) noted that released individuals ran towards rocky areas near streams. Disturbed *Philander* may climb trees to avoid danger, but when cornered this species threatens with the mouth open whilst making hissing sounds (Emmons 1999, Massoia et al 2000) and is prepared to defend itself aggressively (Nowak 1991). Herskovitz (1997) notes that cornered animals may adopt a bipodal or tripod stance and lurch forward at the aggressor with open mouth. *Parasites* Herskovitz (1997) lists the following parasites for this species: Nematoda *Rhopalia horridus* and *Viannaia conspicua*; Coleoptera *Amblyopinus henseli*; Siphonaptera *Adortaopsylla antiquorum*, *Ctenocephalides felis*, *Rhopalopsyllus lutzii*, *Tritopsylla intermedia* and *Xenopsylla cheopsis*.

**VOC:** Hissing noises accompany threat behaviour and they may utter a "long, chattering cry" when disturbed (Massoia et al 2000, Nowak 1991). Clicks, chirps and hisses are used in communication (Redford & Eisenberg 1992).

**HUM:** Occasional damage to fruit crops and cornfields has led to them receiving a bad reputation in parts of their range where they are more abundant (Cimardi 1996). In Paraguay this species is rarely encountered and interviews with locals performed by Lowen et al (1996) failed to find any reference to the species. Its human impact in Paraguay is therefore minimal. A closely-related species acts as a reservoir for *Trypanosoma cruzi* and is eaten in certain parts of its range eg Guyana, though the flesh is said to be foul-smelling. It does not figure as a regular dietary item for the indigenous tribes in Paraguay, but with infection rates varying between 5% and 40% in French Guiana it is a potential source of infection.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/search/details.php/40516/all](http://www.iucnredlist.org/search/details.php/40516/all) for the latest assessment of the species. It is likely under-recorded in Paraguay but has no doubt disappeared from large areas of its former range as a result of conversion of forest to agriculture. It is not listed for the Mbaracayú Biosphere Reserve (Esquivel 2001) and Lowen et al (1996) did not record it during extensive surveys of the Atlantic Forests of eastern Paraguay in 1992 and 1995, nor did they interview locals who were familiar with the species. Pires et al (2005) reported increased capture rates of this species in Atlantic forest fragments after fire when compared to capture rates before fires at Poço das Antas, Rio de Janeiro.

**Online Account:** [www.faunaparaguay.com/phifrehb.html](http://www.faunaparaguay.com/phifrehb.html).

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**Southeastern Four-eyed Opossum** *Philander frenatus*  
Juvenile. Location unknown. Photo courtesy of José Luis Cartes.

# 16

## Genus *Metachirus*, Burmeister 1854

This is a monotypic genus. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* E. Geoffroy St.Hilaire 1803:142. Not *Didelphis* Linnaeus (1758).

*Philander* Gray 1843:100. In part. Not *Philander* Brisson (1762), *Philander* Beckmann (1772) or *Philander* Tiedemann (1808).

*Metachirus* Burmeister 1854:135. Type species *Didelphis myosurus* (= *Didelphis myosurus* Temminck 1824 = *Didelphis nudicaudata* E. Geoffroy St.Hilaire (1803). Described as a subgenus of *Didelphis* Linnaeus (1758).

*Cuica* Liais 1872:330. In part.

*Lutreolina* Bertoni 1939:6. Not *Lutreolina* O.Thomas 1910.

*Philander* Pine 1973:391. Not *Philander* Brisson (1762), *Philander* Beckmann (1772) or *Philander* Tiedemann (1808).

**General characteristics:** This is the largest of the pouchless opossums. Dorsal pelage brownish with conspicuous pale spots above each eye and behind the ears. Ventrally paler. Sparsely-haired tail longer than the head and body lacks pigment on the terminal third. Diploid chromosome number 14.

**Cranial characteristics:** Skull slender. Older individuals with elevated supraorbital ridges extending posteriorly to the parietals but not meeting along the midline. Palate with large and conspicuous maxillopalatine fenestrae. Maxillary and palatine fenestrae are absent. Bullae small, widely-separated and incompletely ossified.

**Dental characteristics:** Upper canines well-developed, though they are less than twice the height of P3. Lower canines shorter than p2.

**Paraguayan Species:**

*Metachirus nudicaudatus* - Brown Four-eyed Opossum

# 17

## Brown Four-eyed Opossum

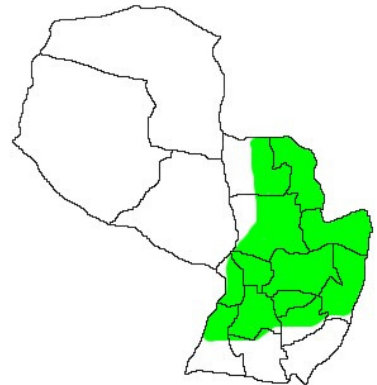
### *Metachirus nudicaudatus*

- Didelphis nudicaudata* Geoffroy St-Hilaire 1803:142. Type locality "Cayenne" French Guyana.  
*Didelphis myosuuros* Temminck 1824:38. Type locality "Brésil", restricted to Ipanema, São Paulo by Pohle (1927).  
*Didelphis nudicauda* Lesson 1827:212. Incorrect spelling.  
*Philander nudicaudus* Gray 1843:100. Name combination and incorrect spelling.  
*Didelphys* [*Metachirus*] *myosuurus* Burmeister 1854:135. Name combination and incorrect spelling.  
*Cuica myosuuros* Liais 1872:330. Name combination.  
[*Didelphys* (*Metachirus*)] *nudicaudata* Trouessart 1898:1236. Name combination.  
*Metachirus tschudii* JA Allen 1900:195. Type locality "Guayabamba" Amazonas, Peru.  
*Metachirus boliviannus* JA Allen 1901:412. Name combination.  
*Metachirus nudicaudata* Bertoni 1914:69. Incorrect gender.  
[*Didelphis* (*Metachirus*)] *tschudii* Matschie 1916:268. Name combination.  
[*Didelphis* (*Metachirus*)] *boliviannus* Matschie 1916:268. Name combination.  
[*Didelphis* (*Metachirus*)] *colombianus* Matschie 1916:268. Name combination.  
[*Didelphis* (*Metachirus*)] *phaeurus* Matschie 1916:268. Name combination.  
*Lutreolina nudicaudata* Bertoni 1939:6. Name combination.  
[*Philander*] *nudicaudatus* Pine 1973:391. Name combination.

### *Metachirus nudicaudatus*

#### (E. Geoffrey St-Hilaire 1803)

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae (Myers et al 2006). A single species is recognised in this genus, defined by Burmeister in 1854. The specific name *nudicaudatus* is taken from the Latin meaning "naked tail". Gardner (2007) recognised five subspecies, that present in Paraguay being *M.n.modestus* O.Thomas (1923). However the species is in need of revision and one or more of the subspecies may in fact be separate species (Gardner 2007). There has been considerable debate as to which generic name should take precedence for this species. Pine (1973) argued that the colour description provided by Tiedemann (1808) in his description of *Philander* referred to the pouchless Brown Four-eyed Opossum and that *Metachirops* Matschie 1916 is the correct designation for





the "Grey Four-eyed Opossums". This was based on the mistaken belief that *Philander* Brisson, (1762) was non-Linnean and therefore unavailable. Hershkovitz (1976) argued that the current use of *Philander* and *Metachirus* is correct and has been followed by most authors ever since. Synonyms adapted from Gardner (2007).

**ENG:** Brown Four-eyed Opossum (Nowak 1991, Redford & Eisenberg 1992); Rat-tailed Opossum (Cimardi 1996).

**ESP:** Comadreja de anteojos (Massoia et al 2001); Cuica común (Emmons 1999, Redford & Eisenberg 1992); Zarigüeya de cuatro ojos marrón (Emmons 1999); Comadreja de cuatro ojos marrón (Massoia et al 2001); Guayquica amarilla (Massoia et al 2001).

**GUA:** Yupatí (Massoia et al 2001).

**DES:** Though this species bears a close physical resemblance to the *Philander frenata* the two genera are not closely related. Slender with a long, conical snout and short, dense, silky pelage. Head boldly-marked, dark blackish-brown with a small creamy-white patch above each eye and a larger creamy-white patch above each ear. Ears dark brown. Dorsally they are brownish with a cinnamon tinge and sometimes with a darker wash to the rump. Some individuals are more grey-brown with a cinnamon-orange tinge to the sides. Ventrally they are whitish or pale cream, extending up to the cheeks and being sharply demarcated from the dorsal colouration laterally. Tail long and mostly naked, being furred only for the basal 5-25mm and greyish in colouration with only sparse hairs along its length. The large feet are pinkish. Scrotum pink in males. The marsupium is lacking in females, though indistinct lateral folds in the abdomen may be present. Females possess a mean of 9 mammae, arranged in two rows of four with a median teat between them. **CR** - Skull is narrow and slender. Bony palate with two fenestrae. **DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. Upper P1 about half the size of P2. **CN:** 2n=14. FN=24.

**TRA:** No information.

**MMT:** A large and robust, cat-like Didelphid, with tail slightly longer than the head and body (c118% HB length). Males are slightly larger than females. **HB:** Male 23.39cm (17-30cm), Female 22.29cm (15-26.5cm); **TA:** Male 30.77cm (22.7-37.3cm), Female 29.8cm (17.8-36.3cm); **FT:** Male 4.37cm (3.5-5.2cm), Female 4.14cm (3.4-4.7cm); **EA:** Male 3.54cm (2.8-4cm), Female 3.57cm (3.1-4.3cm); **WT:** Male 281.5g (102-480g), 235.9g (91-345g). (Eisenberg & Redford 1999). Unsexed sample **TL:** 57cm (46.9-63.8cm); **HB:** 26.17cm (21-33cm); **TA:** 30.84cm (24.2-39.5cm); **FT:** 4.41cm (3.9-5.2cm); **EA:** 2.96cm (2.2-3.9cm); **WT:** 225.56g (91-630g). (Massoia et al 2001, Emmons 1999, Redford & Eisenberg 1992). The following mean post-cranial measurements were noted by Carvalho et al (2000) for Brazilian specimens (n=3): *Ulna* 35.4mm; *Forearm* 40.8mm; *Humerus* 35.2mm; *Tibia* 49mm; *Foreleg* 50.3mm; *Femur* 39.3mm.

**SSP:** The only other species to share the "eyes" of *Metachirus* is *frenata Philander* which unsurprisingly is most easily distinguished by its greyish pelage. When viewed frontally note that the white spots above the eyes are smaller and more widely-spaced in this species. The second pair of "eyes" are much more extensive and located behind the ears, those of *Philander* being reduced and located in front of the ears. Note that the ears of this species are entirely dark, they being pale pinkish in *Philander*. The tail of *Philander* is proportionately shorter and furred at the base for the first 6 to 8 cm, as well as being bicoloured with a clearly demarcated tip - that of this species is naked to the base and either uniformly coloured or becoming gradually paler along its length. Structurally the snout is more pointed and the legs are longer in this species. Note also that female *Metachirus* do not possess a pouch, whilst those of *Philander* do.

**DIS:** Widely distributed from Nicaragua south to Paraguay and northern Argentina. It is found only in eastern Paraguay and is absent from the Chaco. Brown (2004) listed the following specimens from Paraguay Departamento San Pedro; Aca Poi (Wharton, 1950, USNM); Tacuati, Aca Poi, S bank Rio Ypané (Wharton, 1950, USNM); Departamento Caaguazú; Caaguazú. Summerfield Colony no. 1 1 (Wharton, 1953, USNM); Departamento Paraguari; Parque Nacional Ybycuí (Myers, 1978, UMMZ); Departamento Canendiyú; Curuguaty (Myers, 1978, UMMZ).

**HAB:** Generally in forested habitats, including secondary growth, edge habitats and low stature forest. In Minas Gerais, Brazil they were found in all forest types (Redford & Eisenberg 1992). Nowak

(1991) states that the species occurs in dense forests and thickets in open, brushy country, but Emmons (1999) notes that they prefer mature forest with an open undergrowth. Moura et al (2005) found that 70% of specimens tracked avoided areas with dense canopy cover. Most specimens in Venezuela were trapped on the ground near streams (Nowak 1991). Stevens & Husband (1998) did not find the species within 80m of forest edge in the Brazilian Atlantic Forest, but Pires et al (2005) found no preference for forest interior over forest edge in a highly fragmented landscape in Rio de Janeiro State, Brazil. Pires et al (2002) stated that the species frequently moves between forest fragments with 10% of 22 recaptures showing evidence of interfragmentary movements and all movements being performed by males.

**ALI:** Omnivorous, consuming fruits, small vertebrates, birds eggs and invertebrates (Redford & Eisenberg 1992). This species is principally terrestrial and this is reflected in the diet. Cáceres (2004) studied fecal samples of 44 trapped individuals in southern Brazil and found the species to be principally insectivorous. Invertebrate remains were present in 100% of samples, composed of the following frequencies: Coleoptera 68%, Opiliones 64%, Diplopoda 50%, Hymenoptera (Formicidae) 39%, Orthoptera 23%, Blattaria 23%, Decapoda 14%, Lepidoptera larvae 7% and Pulmonata 5%. Vertebrate remains occurred in just 9% of samples, principally birds 5%, mammals 2% and reptiles 2%. Fruit remains were found in 7% of samples: *Anthurium* sp. 2%, *Philodendron* sp. 2% (both Araceae) and *Nidularium* sp. 2% (Bromeliaceae). In Rio de Janeiro State, Brazil Carvalho et al (1999) found Hymenoptera, Arachnida and termites in 75% of all fecal samples, Coleoptera in 50% of samples and Hemiptera and Diplopoda in 25% (n=4). Seeds were also present, notably those of *Cecropia* sp. The presence of seeds represents frugivory rather than granivory and Cáceres (2004) considered the species an occasional seed disperser of certain plant species. Of the fruit seeds found in fecal samples by Cáceres (2004) the following percentage germination rate was recorded *Anthurium* sp. 88%, *Philodendron* sp. 22% and *Nidularium* sp. 77%. Cáceres (2004) and Morães Junior (2004) trapped animals in wire traps in southern Brazil using banana and cod liver oil as bait.

**REP:** Limited data available, but apparently polyestrous. Breeding occurs in November in Central America. Litter size ranged from 1 to 9 with a mean of 5. Juveniles are carried on the mothers back until able to stand alone (Redford & Eisenberg 1992, Nowak 1991).

**BEH:** *Activity Levels* Typically solitary, terrestrial and nocturnal in behaviour. Agile on the ground, they have powerful hindquarters that enable them to run rapidly. Cunha & Vieira (2002) used a spool and line technique to follow 19 individuals of this species in PN Serra dos Orgãos, Brazil and found that only one individual moved above and only once to a height of just 1m in over 3200m of paths followed. Emmons (1999) describes the species as furtive and shy and extremely difficult to observe because of their propensity to flee at the slightest disturbance. However she notes that the species seems to be more active and easier to see after rain. *Locomotion* Delciellos & Vieira (2006) studied arboreal locomotion of this species on horizontal branches in PN Serra dos Orgãos, Rio de Janeiro State, Brazil. A maximum velocity of 2.88 (+/-0.22) x body length/second was recorded on support branches of 5.08cm diameter, and a minimum velocity of 2.21 (+/-0.15) x body length/second was recorded on support branches of 2.54cm diameter. Minimum number of strides per second was 2.96 (+/-0.16) on support branches of 2.54cm and maximum number of stride lengths per second was 3.65 (+/-0.15) on support branches of 5.08cm diameter. Range of stride length was from 0.75 to 0.85 x body length. Delciellos & Vieira (2009) investigated climbing performance of this species on nylon ropes of three diameters 0.6cm, 0.9 and 1.25cm. Respective velocities (stride length x stride frequency) of 0.14 (+/-0.06), 0.30 (+/-0.20) and 0.39 (+/-0.39) were recorded for the three rope diameters. Number of strides per second respectively were 0.85 (+/-0.33), 0.97 (+/-0.47) and 1.09 (+/-0.64) for the three rope diameters. Stride length when related to body length was 0.18 (+/-0.09), 0.29 (+/-0.09) and 0.32 (+/-0.11) respectively. *Home Range* A female radio-tracked in Rio de Janeiro, Brazil for three nights during November 2001 covered a home range of 8.4ha, moving a mean of 549.9m (+/-49.5m) per night. It was exclusively nocturnal in behaviour, presenting activity peaks between 20.00h and 23.00h and with activity tailing off after 02.00h. (Morães Junior 2004). Vieira & Cunha (2008) found home range size and intensity of use to be correlated to body mass. *Roosts* Loretto et al (2005) noted that the thirteen nests found during their trapping study were located on the ground in areas of

undisturbed forest with deep litter layer and tall trees. Nests were spherical and built on the forest floor or between tree roots using leaves interwoven with roots. Entrance to nests were concealed but measured 10 x 10cm. Nest sites appear to be changed at least every two months. Maximum lifespan is estimated at 3 to 4 years (Nowak 1991). *Defensive Behaviour* When disturbed runs rapidly and silently away across the forest floor (Emmons 1999). Loretto et al (2005) noted that all animals disturbed at the nest chose to run away, except for a female bearing young who gnashed the teeth, made clicking noises and hissed. The individual raised itself up and down against the roof of the nest creating a pulsating movement of an area of leaves much larger than the animal itself. They hypothesised that this defensive behaviour was exhibited only by females bearing young because of the risks associated with losing young when running rapidly through the forest. Morães Junior (2004) also stated that an animal disturbed at the nest grunted and gnashed its teeth but did not mention the reproductive condition of the animal. Considered the most aggressive opossum species by Enders (1935), who noted that an individual shipped live with a *Philander* of similar size totally dominated the other animal so that it showed signs of "being bitten severely about the head and neck" and was "totally cowed", whilst the *Metachirus* was unmarked. However Kirsh (1977) stated quite the opposite and described the species as almost quiet when handled. *Enemies* Husson (1978) reports the species as being preyed upon by Striped Owl *Asio clamator* in Surinam.

**VOC:** Typically silent but threatened individuals grunt and gnash the teeth (Emmons 1999, Morães Junior 2004).

**HUM:** Occasional damage to fruit crops and cornfields has led to them receiving a bad reputation in parts of their range where they are more abundant (Nowak 1991). In Paraguay this species is rarely encountered and interviews with locals performed by Lowen et al (1996) failed to find any reference to the species. Its human impact in Paraguay is therefore minimal.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/search/details.php/40509/all](http://www.iucnredlist.org/search/details.php/40509/all) for the latest assessment of the species). This species occurs in naturally low populations and is easily overlooked as a result of its furtive habits. It is likely under-recorded in Paraguay but has no doubt disappeared from large areas of its former range as a result of conversion of forest to agriculture. Population density near Manaus, Brazil was estimated at 25.6/km<sup>2</sup>.

**Online Account:** [www.faunaparaguay.com/metnudhb.html](http://www.faunaparaguay.com/metnudhb.html).

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# 18

## Genus *Cryptonanus*, Voss, Lunde & Jansa 2005

Five species, one in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Grymaeomys* Winge 1893:27. In part. Not *Grymaeomys* Burmeister (1854).

*Marmosa* Tate 1931:10. In part. Not *Marmosa* Gray (1821).

*Marmosa* Moojen 1943:2. In part. Not *Marmosa* Gray (1821).

*Marmosa* (*Thylamys*) Cabrera 1958:26. In part.

*Gracilinanus* Gardner & Creighton 1989:5. In part.

*Gracilinanus* Díaz, Flores & Barquez 2002:825. Not *Gracilinanus* Gardner & Creighton (1989).

*Cryptonanus* Voss, Lund & Jansa 2005:5. Type species *Cryptonanus chacoensis* (Tate 1931; originally *Marmosa agilis chacoensis*) by original description.

**General characteristics:** Outwardly extremely similar to *Gracilinanus*, in fact the Paraguayan representative of the genus is a cryptic species that was only recently distinguished from *Gracilinanus agilis*. These are extremely small opossums with a total length <260mm. The main distinguishing features refer to cranial characters and dentition. Diploid chromosome number 14.

**Cranial characteristics:** Maxillary fenestrae absent or extremely small. Projection of premaxillaries anterior to the incisors is lacking.

**Dental characteristics:** P2 smaller than P3.

**Paraguayan Species:**

*Cryptonanus chacoensis* - Chacoan Mouse Opossum



# 19

## Chacoan Mouse Opossum *Cryptonanus chacoensis*

*Marmosa agilis chacoensis* Tate 1931:10. Type locality "Sapucay" =Sapucaí, Paraguari, Paraguay.  
*Marmosa* [(*Thylamys*)] *agilis agilis* Cabrera 1958:27. In part. Not *Grymaeomys agilis*, Burmeister (1854).  
*Gracilinanus agilis* Gardner & Creighton 1989:5. In part. Not *Grymaeomys agilis*, Burmeister (1854).  
*Cryptonanus chacoensis* Voss, Lunde & Jansa 2005:1. First use of current name.

### ***Cryptonanus chacoensis* (Tate, 1931)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; *Family Didelphidae*; Subfamily Didelphinae, Tribe Monodelphini (Myers et al 2006, Gardner 2007). The genus *Cryptonanus* was defined by Voss, Jansa & Lunde, 2005. There are five known species according to the latest revision (Gardner 2007) one of which is present in Paraguay. This is a recently recognised species in a recently described genus that has for many decades been consistently confused with *agilis* *Gracilinanus* in the published literature. See the similar species section for distinguishing features. The generic name *Cryptonanus* is taken from the Greek meaning "hidden dwarf", in reference to the fact that this cryptic genus had been overlooked for so long. The species name *chacoensis* refers to the Chaco biome which makes up part of this species range. The species is monotypic. Tate (1933) reported both *Marmosa agilis agilis* and *Marmosa agilis*



(=*Cryptonanus chacoensis*) from Sapucaí, Departamento Paraguari, Paraguay but made no effort to explain how two distinct subspecies could occur in the same locality. Recognising the anomaly Cabrera (1958) synonymised the two under *M.a.agilis* but apparently did not study the type material in doing so. In fact the characters stated for Tate's "subspecific" differentiation closely correspond to the characters that distinguish *Gracilinanus agilis* from *Cryptonanus chacoensis* and his split was good, though it belonged at the generic and specific level rather than the subspecific level (Voss, Lunde & Jansa 2005). Synonyms adapted from Gardner (2007).

**ENG:** Chaco Mouse Opossum (Gardner 2007).

**ESP:** No known names.

**GUA:** No known names.

**DES:** A tiny slender mouse opossum with short, smooth pelage and very short, inconspicuous guard hairs. Dorsally the pelage is uniformly brownish-grey, lacking patternation. Ventral pelage buffy-white, self-coloured to the base (ie not grey-based) and with at least the median line whitish. Head scarcely paler than dorsum, rarely with slight suggestion of a median line and with narrow black periocular

patches. Males possess a gular gland. Ears moderately large and rounded, light fuscous-brown in colour. Vibrissae short. Plantar epithelium of tarsus naked. Central plantar surface of manus only sparsely tuberculated. Manus digits 3 and 4 of subequal length and longer than digits 2 and 5. Claws shorter than fleshy digital pads. Lateral carpal tubercles are present in adult males. Pedal digit 4 longer than adjacent digits 3 and 5. Tail greyish-brown, lightly bicoloured (darker above and paler below) and 1-1.2x head and body length. It is prehensile, lacking hair on the ventral surface at the tip. Caudal scales are arranged in annular series and bearing sparse, almost invisible hairs, three per scale. Females lack a pouch. Abdominal-inguinal mammae 4-1-4 = 9. (Tate 1933, Voss, Lunde & Jansa 2005). **CR** - Maxillary palatal vacuities, rostral process of the premaxillae and a secondary foramen ovale all absent. Palatal process of premaxilla reaches C1 on each side. Nasal wider anteriorly than posteriorly with tips extending to I1. Maxillary turbinals large and branched. Supraorbital margins large and unbeaded. Interorbital and postorbital constrictions present in juveniles and young adults. No sagittal crest. Parietal and alisphenoid contact. Petrosal exposed laterally in fenestra between parietal and squamosal. Maxillopalatine fenestrae large and palatine fenestrae present. Posterolateral palatal foramina does not extend lingual to M4 protocones. Posterior palate with conspicuous lateral corners. Maxillary and alisphenoid do not contact on orbital floor. Transverse canal foramen present. Paroccipital process of exoccipital small. Dorsal margin of foramen magnum formed by supraoccipital and exoccipitals. Angular process acute and strongly inflected. The following measurements are taken from Voss, Lunde & Jansa (2005) for specimens from Paraguay (n=3 males, n=3 females): *Condylbasal Length*: male 24.7mm, female 23.97mm (23.5-24.7mm); *Width of Nasals*: male 3.17mm(3-3.3mm), female 2.7mm (2.3-2.9mm); *Least Interorbital Width*: male 4.6mm, female 4.2mm (4-4.3mm); *Zygomatic Width*: male 14.13mm(13.9-14.4mm), female 13.4mm (13.2-13.6mm); *Palate Length*: male 13.7mm, female 12.9mm (12.6-13.3mm); *Palate Width*: male 7.73mm(7.7-7.8mm), female 7.67mm (7.6-7.8mm). **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. Crowns of I2-I5 rhomboidal, increasing in width from front to back. C1 with accessory cusps, posterior being more distinct than anterior. P1 present but small. P2 < P3, the latter lacking a cutting edge. Upper molars dilambdodont and highly carnassialized, increasing in width from front to back. M1 with ectoflexus shallow, but becoming deeper towards M3. Lower incisors with lingual cusp. Lower c1 usually with small posterior accessory cusp, but rapidly lost even with minor wear. p2>p3. Lower m3 with hypoconulid labially salient and twinned with large entoconid (much taller than hypoconulid). Molars small. Incomplete anterior cingulum on M3. The following measurements are taken from Voss, Lunde & Jansa (2005) for specimens from Paraguay (n=3 males, n=3 females): *Length of Maxillary Row of Molars*: male 9.83mm(9.7-10mm), female 9.57mm (9.3-9.8mm); *Length of Molars*: male 5.3mm(5.2-5.4-10mm), female 5.23mm (5.2-5.3mm); *M1-M3 Length*: male 4.63mm(4.6-4.7mm), female 4.6mm.

**TRA**: No information.

**MMT**: The smallest of the Paraguayan Mouse Opossums. The following measurements are taken from Voss, Lunde & Jansa (2005) for specimens from Paraguay (n=3 males, n=2 females): **TL**: male 11.93cm (11.5-12.6cm), female 11cm (10.9-11.1cm); **HB**: male 9.5cm (8.9-10cm), female 8.6cm (8.4-8.8cm); **FT**: male 1.57cm (1.5-1.6cm), female 1.5cm; **EA**: male 1.77cm (1.7-1.8cm), female 1.65cm (1.6-1.7cm); **WT**: male 16g, female 15g (14-16g).

**SSP**: Long confused with *Gracilinanus agilis*, this species is separated with care when using external characters only. Measurements and examination of skull characteristics may be necessary in some cases. Typically the tail of *Cryptonanus* is shorter when compared to head and body length (usually <1.2x) than that of *Gracilinanus* (1.2-1.5x) though there may be some overlap at the extremes and this character should not be used alone for specific designation. Tail length is typically in the range 95-117mm for adult *Cryptonanus* and 110-165mm for *Gracilinanus*. More reliable is the ratio of premolar heights, with P2<P3 in *Cryptonanus* and the two of approximately equal height in *Gracilinanus* - though be aware of the affects of teeth wear in older specimens. On the canine C1 accessory cusps are present basally in *Cryptonanus* that are absent in *Gracilinanus*. Dorsally this species is brownish-grey in colour, *Gracilinanus* is on average somewhat browner, though this character can be difficult to judge. Ventral pelage is usually somewhat greyish basally in *Gracilinanus* and buffy basally in this species. Upon direct comparison *Gracilinanus* has larger ears, longer vibrissae and broader ocular rings than *Cryptonanus*, but

these characters are difficult to measure when presented with a single specimen. Cranially maxillary palatal vacuities, rostral process of the premaxillae and a secondary foramen ovale are all present in *Graciliananus* but absent in *Cryptonanus*. The species can be easily separated from the two species of Paraguayan *Thylamys* by the fact that members of that genus have distinctly tricoloured pelage, whereas *Cryptonanus* is uniformly-coloured dorsally. *Thylamys* also habitually exhibit some degree of incrassation (fat deposits) in the tail and have highly granular surfaces to the feet, neither character being exhibited by *Cryptonanus*. Furthermore the species occurring in eastern Paraguay, *Thylamys macrurus*, is considerably larger than *Cryptonanus*. *Micoureus paraguayanus* is much larger with thick woolly pelage and broadly pale-tipped, bicoloured tail. (Voss, Lunde & Jansa 2005).

**DIS:** Occurs from northwest Argentina (Provincias Chaco and Jujuy) and Paraguay, south and east to Provincia Buenos Aires, Argentina, Rio Grande do Sul in Brazil and probably northern and western Uruguay, though the species has yet to be recorded in that country (Gardner 2007). Anderson (1997) reported the species from extreme southern Bolivia at Tarija but Voss, Lunde & Jansa (2005) stated that at least one of the four specimens mentioned was actually an unidentified species of *Marmosops*, whilst the other three specimens were unavailable for examination. The species is apparently very widespread in Paraguay and likely occurs throughout the country in suitable habitat. Voss, Lunde & Jansa (2005) list the following specimens from Paraguay: Estancia Doña Julia, Departamento Alto Paraguay (TK 61053, 61072, 61074, 61103); Estancia Dos Marias, Departamento Caazapá (GD 521); 13.3 km north of Curuguaty by road, Departamento Canendiyú (UMMZ 137143); Palmar de las Islas, Departamento Alto Paraguay (TK 65331); Concepción, Departamento Concepción (BMNH 11.11.19.23), Río Aquidaban at Paso Horqueta, Departamento Concepción (UMMZ 134552); 1.6 km south of Tobatí by road, Departamento Cordillera (UMMZ 126105); Sapucaí, Departamento Paraguari (BMNH 4.1.5.48, 5.8.1.8); Estancia La Victoria, Departamento Presidente Hayes (TK 60201).

**HAB:** There is some suggestion that this species prefers open, grassy and often wet habitats. Paraguayan distributional records reflect areas of palm savanna (humid Chaco and Pantanal), marsh and seasonally-inundated grassland. Voss, Lunde & Jansa (2005) describe capture sites in Paraguay as in a hollow log (Sapucaí), on a wood pile (Sapucaí), on wet ground in a marsh (Tobatí), on the ground in high grass at the edge of a marsh (Paso Horqueta) and on the ground at the base of fruiting bromeliad stalks (Curuguaty). This data suggests that they are able to tolerate the close proximity of humans more so than other small marsupials.

**ALI:** Presumably largely insectivorous, no published data exists that can be unequivocally attributed to this species.

**REP:** No data unequivocally referring to this species is available. Massoia & Fornes (1972) stated that *Marmosa agilis chacoensis* in Rio Grande do Sul, Brazil gave birth to litters of up to 12 young, but given that the number of teats is nine the possibility of misidentification means that the data must be treated with caution.

**BEH:** *Activity Levels* All Paraguayan specimens have been taken on the ground despite simultaneous trapping efforts in trees, suggesting an at least partially terrestrial existence, whilst the prehensile tail and digit arrangement indicate that they are adapted for climbing. *Enemies* González et al (1999) report remains of this species in Barn Owl *Tyto alba* pellets in Rio Grande do Sul, Brazil, though it was reported as *Gracilinanus agilis*.

**VOC:** No information.

**HUM:** None.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN, (see [www.iucnredlist.org/details/21867](http://www.iucnredlist.org/details/21867) for the latest assessment of the species) on account of its wide distribution, large population, occurrence in protected areas, and tolerance of habitat modification. Unlike other small marsupials this species has been frequently trapped in areas close to human habitation, suggesting that they are less susceptible to habitat modification than other species. They are apparently adaptable and occur in a variety of open habitats. At this stage it is difficult to draw any firm conclusions about population trends in Paraguay owing to the confusion in the literature between this species and *Gracilinanus agilis*, but it would seem to be under less threat than most other Didelphids. The species is

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One of the more commonly captured small marsupials in Paraguay and may even be benefitting from deforestation of the Atlantic Forest and expanding its range.

**Online Account:** [www.faunaparaguay.com/crychahb.html](http://www.faunaparaguay.com/crychahb.html).

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# 20

## Genus *Gracilinanus*, Gardner & Creighton 1989

Six species, one in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* JA Wagner 1842:359. Not *Didelphis* Linnaeus (1758).

*Grymaeomys* Burmeister 1854:27. In part. Proposed as a subgenus of *Didelphis* Linnaeus (1758).

*Marmosa* O.Thomas 1898:455. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1909:379. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1910:502. Not *Marmosa* Gray (1821).

*Marmosa* Cabrera 1919:34. In part. Not *Marmosa* Gray (1821).

*Marmosa* Tate 1931:10. Not *Marmosa* Gray (1821).

*Marmosa* Miranda-Ribeiro 1936:373. Not *Marmosa* Gray (1821).

*Thylamys* Miranda-Ribeiro 1936:387. Not *Thylamys* Gray (1843).

*Marmosa* Moojen 1943:2. In part. Not *Marmosa* Gray (1821).

*Thylamys* Cabrera 1958:26. In part. Not *Thylamys* Gray (1843).

*Tylamys* Ávila-Pires 1968:167. Incorrect spelling. Not *Thylamys* Gray (1843).

*Gracilinanus* Gardner & Creighton 1989:4. Type species *Didelphis microtarsus* JA Wagner (1842) by original designation.

**General characteristics:** Very small arboreal opossums with the ratio of tail to head and body length >1.3 but usually <1.5. Tail scales square or rounded up to 40 per centimetre, and arranged in rows, not in a spiral. Large ears. Tail weakly bicoloured in the Paraguayan species. Claws of the hands do not extend beyond the digital pads. Soles of the hand and feet are smooth and lack a granular appearance. Diploid chromosome number 14.

**Cranial characteristics:** Postorbital processes absent, supraorbital margin of the frontals often beaded in older specimens. Lamboidal crest weakly-developed or absent in older individuals. Hard palate highly fenestrated generally with three pairs of fenestrae - maxillary, maillopalatine and palatine. Posterolateral palatal foramina are moderately-sized, approximately one third to half the width of M4 in length. Nasals expanded laterally at the maxillofrontal suture. Auditory bullae are large compared to related genera, but smaller proportionately than in *Thylamys*. Alisphenoid portion of the auditory bullae possesses a slender anteromedial process. Petrosal usually exposed between the squamosal and parietal.

**Dental characteristics:** Upper incisors increase in size from I2 through I5. Lower canines short. P2 equal in size to P3

**Paraguayan Species:**

*Gracilinanus agilis* - Agile Mouse Opossum

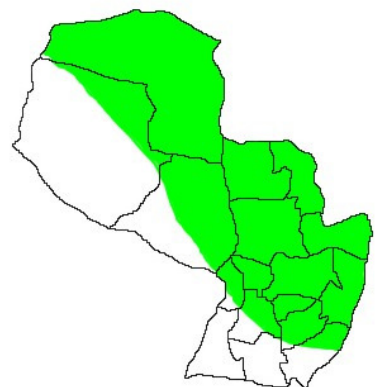
# 21

## Agile Mouse Opossum *Gracilinanus agilis*

- Didelphys* [(*Grymaeomys*)] *agilis* Burmeister 1854:139. Type locality "Lagoa Santa", Minas Gerais, Brazil.  
*Marmosa beatrix* O.Thomas 1910:502: Type locality "Ipu", Ceará, Brazil.  
[*Didelphys* (*Grymaeomys*)] *agilis* Matschie 1916:270. Name combination.  
[*Didelphys* (*Grymaeomys*)] *beatrix* Matschie 1916:270. Name combination.  
[*Marmosa* (*Marmosa*)] *beatrix* Cabrera 1919:36. Name combination.  
*Marmosa agilis buenavistae* Tate 1931:10. Type locality "Buenavista, Departamento Santa Cruz, Bolivia".  
*Marmosa agilis peruana* Tate 1931:10. Type locality "Tingo Maria, Rio Huallaga" Huánaco, Peru.  
*Marmosa agilis peruania* Tate 1933: pl.11. Incorrect spelling.  
*Marmosa blaseri* A.Mirando.Ribeiro 1936:373. Type locality "S. Bento, Goias" Brazil.  
*Thylamys rondoni* A.Mirando.Ribeiro 1936:387. Type locality "Salto do Sepotuba e São João da Serra do Norte",  
Matto Grosso, Brazil.  
*Marmosa* [(*Thylamys*)] *agilis* Cabrera 1958:27. Name combination.  
*Marmosa* [(*Thylamys*)] *beatrix* Cabrera 1958:27. Name combination.  
*Marmosa* [(*Thylamys*)] *buenavistae* Cabrera 1958:27. Name combination.  
*Marmosa* [(*Thylamys*)] *peruana* Cabrera 1958:28. Name combination.  
[*Thylamys*] *agilis* Reig, Kirsch & Marshall 1987:7. Name combination.  
*Gracilinanus agilis* Gardner & Creighton 1989:5. First use of current name.

### ***Gracilinanus agilis* (Burmeister 1854)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Monodelphini (Myers et al 2006, Gardner 2007). The genus *Gracilinanus* was defined by Gardner & Creighton 1989. There are six known species according to the latest revision (Gardner 2007) one of which is present in Paraguay. The generic name *Gracilinanus* is taken from Latin (*gracilis*) and Greek (*nanos*) meaning "slender dwarf", in reference to the slight build of this species. The species name *agilis* is Latin meaning "agile" referring to the nimble climbing technique of this species. The species is monotypic, but Gardner (2007) considers it to be composite and in need of revision. Furthermore its relationship to the Brazilian coastal Atlantic Forest species *Gracilinanus microtarsus* needs to be examined, with some authorities suggesting that the two may be at least in part conspecific. The description of the cryptic and hitherto unnoticed



genus *Cryptonanus* by Voss, Lunde & Jansa (2005) confused the situation yet further. This species is widely sympatric with *Cryptonanus chacoensis chacoensis* with which it has been consistently confused in

the literature in the past. A deliberately cautious approach to the species description has been adopted here to avoid muddying the waters yet further, and every effort has been made to quote references that refer unequivocally to *Gracilinanus agilis* and not *Cryptonanus*. Synonyms adapted from Gardner (2007).

**ENG:** Agile Mouse Opossum, Agile Opossum (Gardner 2007), Agile Gracile Mouse Opossum (Esquivel 2001, Cannevaro & Vaccaro 2007).

**ESP:** Marmosa ágil (Chebez 1996), Marmosa grácil ágil (Emmons 1999), Comadreja rojiza (Massoia et al 2000), Comadreja enana (Massoia et al 2000), Comadreja ágil (Massoia et al 2000).

**GUA:** Anguyá-guaikí (Massoia et al 2000).

**DES:** A small, slender mouse opossum with short, smooth pelage and very short, inconspicuous guard hairs. Dorsally the pelage is uniformly brownish to greyish-brown, lacking patternation. Ventral pelage buffy-white, with an indistinct greyish base to the hairs usually present and typically a line of self-coloured hairs along the midline of the body, stretching anteriorly to the throat and chin and posteriorly to the genital area. Head scarcely paler than dorsum with narrow black periocular patches, only slightly more conspicuous than those of *Cryptonanus*. Males possess a gular gland. Ears moderately large and rounded, light grey-brown in colour. Vibrissae short. Feet pale pinkish. Claws on the manus do not extend beyond the digital pads. Palmar surfaces lack the a granular appearance, sparse granules are present on the palmar surface. Tail brownish, lightly bicoloured (darker above and paler below) and 1.2-1.4x head and body length. It is prehensile, lacking hair on the ventral surface at the tip. Caudal scales are arranged in annular series and bearing sparse, almost invisible hairs. Females lack a pouch. Mammary are hidden when the female is not lactating. Abdominal-inguinal mammary 6-1-6 = 13, the most anterior reaching the thoracic region. (Tate 1933, Hershkovitz 1992). **CR** - Skull short and broad with pointed muzzle. Nasals moderately expanded basally. Palate long and strongly fenestrated. Zygomatic expanded. Bullae large and rounded with distinct processes. Temporal ridges well-spaced. Supra-orbital ridges sharp-edged and with incipient processes. Maxillary palatal vacuities, rostral process of the premaxillae and a secondary foramen ovale all present, representing the primary distinguishing features from *Cryptonanus*. (Tate 1933, Voss, Lunde & Jansa 2005). **DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. Incisors increase slightly in size from I2 to I5. P2 and P3 of approximately equal height, though be aware of the affects of teeth wear in older specimens. Canines short and close together. C1 accessory cusps are absent. Tooth rows convergent. M3 anterior cingulum complete. (Tate 1933, Gardner & Creighton 1989, Voss, Lunde & Jansa 2005).

**TRA:** No information.

**MMT:** A small Mouse Opossum. The species shows a clinal decrease in body size from north to south, with the smallest individuals occurring in Paraguay and northern Argentina. Bonvicino et al (2005) provided the following range measurements for 19 unsexed individuals from the cerrado of PN Chapada dos Veadeiros, Goiás, Brazil: **HB:** 9.2-12.9cm; **TA:** 12.6-16.4cm; **FT:** 1.2-2.2cm; **EA:** 2.2-2.4cm; **WT:** 20-45g.

**SSP:** When using only external characters this species should be separated from *Cryptonanus chacoensis* with utmost care when using external characters only. Measurements and examination of skull characteristics may be necessary in some cases. Typically the tail of *Cryptonanus* is shorter when compared to head and body length (usually <1.2x) than that of *Gracilinanus* (1.2-1.5x) though there may be some overlap at the extremes and this character should not be used alone for specific designation. Tail length is typically in the range 95-117mm for adult *Cryptonanus* and 110-165mm for *Gracilinanus*. More reliable is the ratio of premolar heights, with P2<P3 in *Cryptonanus* and the two of approximately equal height in *Gracilinanus* - though be aware of the affects of teeth wear in older specimens. On the canine C1 accessory cusps are present basally in *Cryptonanus* that are absent in *Gracilinanus*. Ventral pelage is usually somewhat greyish basally in *Gracilinanus* and buffy basally in this *Cryptonanus*. Upon direct comparison *Gracilinanus* has larger ears, longer vibrissae and broader ocular rings than *Cryptonanus*, but these characters are difficult to measure when presented with a single specimen. Cranially maxillary palatal vacuities, rostral process of the premaxillae and a secondary foramen ovale are all present in *Gracilinanus* but absent in *Cryptonanus*. The species can be easily separated from the two species of Paraguayan *Thylamys* by the fact that members of that genus have distinctly tricoloured pelage, whereas *Gracilinanus* is uniformly-coloured dorsally. *Thylamys* also



habitually exhibit some degree of incrustation (fat deposits) in the tail and have highly granular surfaces to the feet, neither character being exhibited by this species. Furthermore the species occurring in eastern Paraguay, *Thylamys macrurus*, is considerably larger than *Gracilinanus*. *Micoureus paraguayanus* is much larger with thick woolly pelage and broadly pale-tipped, bicoloured tail. (Voss, Lunde & Jansa 2005).

**DIS:** Widely distributed from northern and eastern Peru, through northern and eastern Bolivia and Paraguay to Brazil. In Brazil the distribution carves a wide arc south of the Amazon Basin and it has been recorded in the states of Maranhão, Ceará, Tocantins, Distrito Federal, Minas Gerais, Goiás, Mato Grosso and Mato Grosso do Sul (Gardner 2007, Cáceres et al 2008). The species is apparently replaced by *Gracilinanus microtarsus* in the coastal Atlantic Forest from Minas Gerais (where it they overlap slightly) to Rio Grande do Sul (Brown 2004). The text description of the range provided by Gardner (2007) does not correspond to the range map provided, mentioning Uruguay and adjacent Argentina but not mapping any points south of Asunción, Paraguay. Massoia et al (2000) map the species south to Provincia Buenos Aires, but their *Gracilinanus agilis* includes the recently recognised *Cryptonanus chacoensis* which apparently occurs much further south. It would seem that the species range in Argentina is confined to Provincia Misiones. In Paraguay the species is apparently widely-distributed in forested areas, though its precise distribution is confused by its wide sympatry with the cryptic *Cryptonanus chacoensis*. Five specimens collected at Sapucaí, Departamento Paraguari are in the British Museum (BMNH 3.2.3.39, 3.4.7.22, 3.4.7.23, 4.1.5.46 and 4.1.5.47).

**HAB:** Occurs in forested areas, both dry and humid. The species has been captured in humid Atlantic Forest at PN San Rafael (ECOSARA Biodiversity Database). In northern Paraguay it is found in cerrado and occurs in chaco woodland in the Chaco. Of 19 individuals in the cerrado of PN Chapada dos Veadeiros, Goiás, Brazil, 11 were collected in cerrado sensu stricto and 7 in cerradón, but none were trapped in gallery forest (Bonvicino et al 2005).

**ALI:** Insectivorous, frugivorous and carnivorous. They relish sweet, juicy foods and the weak dentition means they prefer soft, pulpy items. Whilst they are incapable of breaking bark to feed on exudate, they will take advantage of the work of other animals and feed on leaking sap etc. Individuals have been caught in traps baited with banana pulp and peanut butter. (Hershkovitz 1992).

**REP:** Breeding seasonal according to the availability of resources, with one or two breeding seasons per year. Females were not carrying pouched young during August in PN Chapada dos Veadeiros, Goiás, Brazil (Bonvicino et al 2005) and juveniles have been found in Bolivia during April and December (Tate 1933). Litters consist of up to 12 young (Eisenberg & Redford 1999).

**BEH:** *Activity Levels* Nocturnal, solitary and arboreal being most frequently trapped in the understorey amongst viney tangles and thin branches at a height of 1.5-2m. *Locomotion* The species moves along thin branches and vines with short, rapid steps interchanged with overhand climbing when moving up and down. The hands and prehensile tail are used for grappling. The claws of the forefeet are weak, but those of the hind feet are stronger and are used to sustain the animal when climbing downwards head first. Individuals have been seen to use the tail to swing slightly when climbing down from precarious vines. (Hershkovitz 1992). The species occasionally descends to the floor where it is slow-moving and easily captured by hand (P.Smith pers.obs.). *Roosts* Nests are built from grasses and vegetable fibres in low bushes or tree holes at a height of about 1.5m. (Canevari & Vaccaro 2007). *Defensive Behaviour* Hershkovitz (1992) described two individuals of this species which reacted to capture by raising up on their hind legs with forearms outstretched and palms facing forwards, mouth open wide exposing the dentition and making hissing sounds. When prodded with a stick the animals grasped it with the forefeet and bit it weakly. *Enemies* Hershkovitz (1992) lists snakes, owls and lizards, as well as "any large predator large enough to gulp down a mouse-size morsel". A low rate of trap mortality has been observed due to the ability of this species to enter into a torpid state when cold. (Hershkovitz 1992).

**VOC:** Animals in defensive posture make hissing sounds (Hershkovitz 1992).

**HUM:** None.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN, (see [www.iucnredlist.org/details/9417](http://www.iucnredlist.org/details/9417) for the latest assessment of the species) on account of its wide distribution, large population and occurrence in protected areas. Though rarely observed, trapping studies show that this

species is fairly common in forested areas. The main threat to the species is likely to be through conversion of forest habitat to agriculture and ranchland. However Henriques et al (2006) studied the small mammal populations in areas of cerrado in various stages of regrowth after fire and found the species to be much more numerous in areas that had not been burned for more than 12 years, suggesting that regular burning may negatively affect populations.

**Online Account:** [www.faanaparaguay.com/graaighb.html](http://www.faanaparaguay.com/graaighb.html).

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**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult lateral. Estancia Nueva Gambach, PN San Rafael, December 2008. Photo Flavia Netto, courtesy of ECOSARA Biodiversity Database.



**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult head. Estancia Nueva Gambach, PN San Rafael, December 2008. Photo Flavia Netto, courtesy of ECOSARA Biodiversity Database.

**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult frontal. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.



**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult ventral. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.





**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult dorsal. Estancia Nueva Gambach, PN San Rafael, December 2008. Photo Flavia Netto, courtesy of ECOSARA Biodiversity Database.

**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult frontal. Estancia Nueva Gambach, PN San Rafael, December 2008. Photo Flavia Netto, courtesy of ECOSARA Biodiversity Database.



**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult showing mandibular dentition. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.

**Agile Mouse Opossum**

*Gracilinanus agilis*. Adult hind foot. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.



# 22

## Genus *Micoureus*, Lesson 1842

Six species, one in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* Temminck 1824:46. In part. Not *Didelphis* Linnaeus (1758).

*Micoureus* Lesson 1842:186. Type species *Didelphis cinerea* Temminck (1824) by subsequent designation.

*Philander* Gray 1843:101. In part. Not *Philander* Brisson (1762), *Philander* Beckmann (1772) or *Philander* Tiedemann (1808).

[*Didelphys* (*Marmosa*)] Trouessart 1905:855. In part. Incorrect spelling. Not *Marmosa* Gray (1821).

*Caluromys* Matschie 1916:269. Not *Caluromys* JA Allen (1900).

*Micoures* Reig, Kirsch & Marshall 1985:337. Incorrect spelling.

*Micoures* Massoia 1988:6. Incorrect spelling.

**General characteristics:** Largest of the Monodelphini (though medium-sized when compared to other Didelphids) with tail >1.3x head and body length. Dorsal pelage is long, thick and woolly, ventral pelage is smoother and softer. Mammae are abdominal or inguinal and vary in number from 9 to 15. Tail scales are coarse and rhomboid, arranged in a spiral with 14 to 16 rows per centimetre. Fur extends approximately 5cm onto the base of the tail. Interscalar hairs of tail are slender, of approximately equal length and thickness and occur in triplets under the posterior margin of each scale. Distal third of the tail is white in the Paraguayan species, though this is not typical of the genus. Feet are broad with the claws of the forefeet extending slightly beyond the digital pads. Thenar and first interdigital pads are fused on the hindfoot but lie together on the forefoot. Fourth interdigital pad lies against the hypothenar pad of the forefoot but the two are either fused or in direct contact on the hindfoot. Central part of the soles of all feet are smooth. Digit IV on the hindfoot is longest with a length ratio of 0.45 when compared to the hindfoot length. Second and third interdigital pads on all feet are triangular and approximately as wide as they are long. Ventral surfaces of the digits have transverse bars. Fossil species of this genus are known from the late Pleistocene.

**Cranial characteristics:** Skull large with broad zygomatic arches. Postorbital processes are well-developed and beaded. Nasals abruptly expanded at the maxillofrontal suture. Lacks sagittal crest, temporal ridges being subparallel or convergent posteriorly. Prominent lamboidal crest. Auditory bullae large and set wide apart - the ratio of the distance between the bullae to the width of one bulla >1.5. Alisphenoid component of the bulla is hemispherical and lacking an anteromedial process. Ectotympanic expands laterally forming the ventral wall of the bulla. Maxillary fenestrae absent or extremely small. Maxillopalatine fenestrae and posterolateral foramina present, latter approximately equal to half the width of the last upper molar. Projection of premaxillaries anterior to the incisors is lacking.

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***Dental characteristics:*** I1 is longest and separated from I2 by a space. Incisor length increases from I2 through to I5. P2 is larger than P3 and M3 is the widest upper molar. Canines are long and curved.

***Skeletal characteristics:*** Caudal vertebrae vary in number from 32-35.

***Paraguayan Species:***

*Micoureus paraguayanus* - Long-furred Woolly Mouse Opossum



# 23

## Long-furred Woolly Mouse Opossum *Micoureus paraguayanus*

*Didelphis cinerea* Temminck 1824:46. Type locality "Brésil" restricted by Tate 1933:55 to Río Mucurí, Bahía, Brazil.

*Micoureus cinereus* Lesson 1842:186. Name combination.

*Philander cinerea* Gray 1843:101. Name combination.

*Didelphys* [(*Metachirus*)] *cinerea* Burmeister 1854:137. Name combination.

*Didelphys* [(*Micoureus*)] *cinerea* O.Thomas 1888:342. Name combination.

*Grymaeomys cinerea* Winge 1893:46. Name combination and incorrect gender.

[*Didelphys* (*Marmosa*)] *cinerea* Trouessart 1898:1238. Name correction.

*Marmosa cinerea* O.Thomas 1901:536. Name combination.

[*Didelphis* (*Caluromys*)] *cinerea* Matschie 1916:269. Name combination.

[*Marmosa* (*Marmosa*)] *cinerea cinerea* Cabrera 1919:36. Name combination.

*Marmosa* (*Micoureus*) *cinerea* Pohle 1927:241. Name combination.

*Marmosa cinerea paraguayana* Tate 1931:1. Type locality "Villa Rica", Guairá, Paraguay.

[*Micoures*] *cinereus* Reig, Kirsch & Marshall 1985:342. Name combination.

*Micoures cinerea paraguayana* Massoia 1988:6. Name combination and incorrect gender.

[*Micoureus demerarae*] *paraguayana* Gardner 1993:20. Name combination and incorrect gender.

*Micoureus cinereus paraguayanus* González, Marques & Pacheco 1997: 195. Name combination.

[*Micoureus*] *limae* Patton, Silva & Malcolm 2000:72. Name combination.

[*Micoureus*] *travassosi* Patton & Costa 2003:75. Name combination.

*Micoureus paraguayensis* Gardner 2007:77. Name combination and transcription error.

***Micoureus paraguayanus* (Tate 1931)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Monodelphini (Myers et al 2006, Gardner 2007). The genus *Micoureus* was defined by Lesson, 1842. There are six known species according to the latest revision (Gardner 2007) only one of which is present in Paraguay. The genus *Micoureus* is probably taken from the Guaraní/Tupi indigenous name for an opossum Mykuré. The species name *paraguayanus* refers to Paraguay the country of provenance of the type specimen. The species is monotypic. Formerly considered conspecific with the Woolly Mouse Opossum *M.demerararae* (O.Thomas, 1905), the Atlantic Forest form was described by Tate (1931) as *Micoureus cinerea paraguayanus*, with type locality "Villarica, Paraguay". Tate (1933) was unwittingly referring to this species in part when making his description of *Micoureus cinerea*, though for the cranial characteristics he relied on three different



specimens from Pará, Pernambuco and Rio de Janeiro. As currently understood only the Rio de Janeiro specimen would today be referable to *M.paraguayanus*, the others likely being *M.demerararae dominus* (Gardner 2007). More recently the names *Micoureus limae* (Patton, Silva & Malcolm 2000) and *Micoureus travassosi* (Patton & Costa 2003) have been used for the species. Synonyms adapted from Gardner (2007)

**ENG:** Long-furred Woolly Mouse Opossum (Brito & Fonseca 2007, Canevari & Vaccaro 2007), Tate's Woolly Mouse Opossum (Gardner 2007), Woolly Mouse Opossum (Barros et al 2008).

**ESP:** Marmosa grande gris (Redford & Eisenberg 1992, Massoia et al 2000), Comadreja cenicienta (Massoia et al 2000), Comadreja gris (Canevari & Vaccaro 2007), Marmosa lanuda de pelo largo (Emmons 1999).

**GUA:** Anguyá-mykuré (Massoia et al 2000), Guaikí (Massoia et al 2000).

**DES:** A large stocky mouse opossum with relatively short snout and long, thick, woolly pelage. Head somewhat triangular in profile. Dorsal pelage uniform greyish, sometimes with a slight brownish tinge. Ventrally creamy-yellow or buffy-white, the colour extending onto the chin, laterally towards the cheeks and on the face up between the eyes. Eyes large and dark, accentuated by black patches around the eyes which extend slightly in a point towards the snout. Ears large, slightly pointed but with rounded tips and brownish-pink in colour. Nose pinkish. Feet are broad and pinkish, the claws of the forefeet extending slightly beyond the digital pads. Thenar and first interdigital pads are fused on the hindfoot but lie together on the forefoot. Fourth interdigital pad lies against the hypothenar pad of the forefoot but the two are either fused or in direct contact on the hindfoot. Central part of the soles of all feet are smooth. Digit IV on the hindfoot is longest with a length ratio of 0.45 when compared to the hindfoot length. Second and third interdigital pads on all feet are triangular and approximately as wide as they are long. Ventral surfaces of the digits have transverse bars. Tail long (c1.3x head and body length) and furred for 3-5cm at the base. Tail with sparse hair, characteristically bicoloured with a blackish-brown base and pinkish white terminal third. Tail scales are rhomboid and arranged in a spiral. Females lack a marsupium but have 11 inguinal and abdominal mammae arranged in a circular pattern (5-1-5). Male with bluish scrotum. (Tate 1933, Emmons 1999, Massoia et al 2000, Canevari & Vaccaro 2007, Gardner 2007). **CR** - Zygomatic arches evenly arched and broadly expanded, but converging anteriorly so that the greatest width of zygomatic arch is near the junction of the squamosals. Supraorbital processes slightly pointed and located anteriorly when compared to other members of the genus. Nasals broad basally. Temporal ridges not closely approximated and postorbital constriction is not marked. Bullae large and well-rounded. Palate short and broad. (Tate 1933). **DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. I1 is longest and separated from I2 by a space. Incisor length increases from I2 through to I5. P2 is larger than P3 and M3 is the widest upper molar. Canines are long and curved. **CN:** 2n=22.

**TRA:** No information.

**MMT:** Easily the largest of the Paraguayan Mouse Opossums. **TL:** 38.88cm (27-46cm); **HB:** 16.86cm (12-20cm); **TA:** 21.94cm (15-26cm); **FT:** 2.51cm (2.25-2.95cm); **EA:** 2.75cm (2.5-3cm); **WT:** male 109.9g (56-194g) female 99.1g (53-230g). (Redford & Eisenberg 1992). The following mean post-cranial measurements were noted by Carvalho et al (2000) for Brazilian specimens (n=5): *Ulna* 29mm; *Forearm* 31.4mm; *Humerus* 25.8mm; *Tibia* 30.2mm; *Foreleg* 37.1mm; *Femur* 31mm.

**SSP:** Identifiable by size alone, this is much the largest of the Paraguayan mouse opossums. Note also the dense, woolly, greyish pelage and the bicoloured tail with dark base and whitish tip, which immediately identifies the species in Paraguay. Both *Gracilinanus agilis* and *Cryptonanus chacoensis* are considerably smaller (with body length approximately the length of an index finger as opposed to an entire hand in this species). *Thylamys macrurus* is the only species that approaches this in size but it lacks the bicoloured tail (though it is white-tipped) and has notably contrasting pelage with the flanks paler than the dorsum. Furthermore female *Thylamys* have the teats arranged in bilaterally symmetrical rows and not in a circular pattern as in other mouse opossums. Finally note that this species is confined to Atlantic Forest habitat and would not be expected in the Chaco or dry areas.

**DIS:** This species is restricted to eastern Paraguay, Provincia Misiones in Argentina (Iguazú, Gral. Belgrano, Candelaria, Cainguás, Oberá, San Ignacio and Apóstoles - Chebez 1996) and eastern Brazil from southern Bahía to Rio Grande do Sul. In Paraguay specimens are known from Departamentos Paraguari (Sapucaí), San Pedro (Nueva Germania), Guairá (Villarica), Itapúa (PN San Rafael) and Alto Paraná (Itabó Itaipú Reserve and Tati Yupí). It was not listed by Esquivel (2001) for the Mbaracayú Biosphere Reserve, Departamento Canindeyú, but it is likely present there.

**HAB:** This species is considered endemic to the Atlantic Forest (Barros et al 2008) with a preference for areas of dense forest rich in vines and palm trees, though it also occurs in open, high forest (Emmons 1999). In Brazil it is able to tolerate a certain degree of habitat disturbance and fragmentation and occurs in both secondary and primary forest, having even been recorded in exotic *Eucalyptus* plantations with a native subcanopy (Stallings 1989). Pires et al (2002) found that only 1.2% of 442 recaptures showed evidence of movement between forest fragments in Rio de Janeiro State, Brazil.

**ALI:** Carvalho et al (1999) found that in Rio de Janeiro State, Brazil the most frequent items in fecal samples (n=105) were insects from the orders Coleoptera (in 63.3% of fecal samples), Hymenoptera (56%), Arachnida (25.7%), Orthoptera (19.3%), Hemiptera (15.6%), Lepidoptera pupae and larvae (14.7%), Diptera pupae and larvae (9.2%) and Blattaria (1.8%). Smaller amounts of Neuroptera and termites (0.9% each) were also recorded. Surprisingly freshwater Crustacea (Copepoda and Isopoda) were noted in 0.9% of the fecal samples. 64% of fecal samples contained seeds mainly from secondary vegetation, those that were identified including *Piper* (23.5%), *Cecropia* (10.9%) and Solanaceae (1.6%). Casella & Cáceres (2006) investigated stomach contents of the species in Paraná State, Brazil (n=3) and considered the species to be an opportunistic generalist feeder with the emphasis on insectivory supplemented by frugivory and carnivory in smaller quantities. They found Blattaria, Hymenoptera and bird remains in two out of the three specimens, and Orthoptera in one specimen. Seeds of *Cecropia* sp. and an unidentified species of Solanaceae were found in single different specimens. During a fecal analysis study (n=30) on Santa Catarina Island, Brazil, Cáceres et al (2002) found Coleoptera (53% of samples) and Hymenoptera (43%) to be the main items in the diet. Decapoda were present in 33% of sample and Opiliones in 23%. Other animal items present in the diet were: Birds (7%), Blattaria (7%), Lepidoptera (7%), Diplopoda (7%) and Orthoptera (3%). Seeds of *Cecropia* (33%), *Piper* sp (27%) and *Ottonia martiana* (23%) were prominent in the diet, and in lesser quantities *Ficus* sp. (7%) and *Maclura tinctoria* (7%). Larger quantities of seeds (e.g. *Cecropia*, *Piper*, *Ficus* and *Ottonia*) appeared in feces during the warmer and rainy months (March to May) and became absent or less prominent during the colder months (June to August). They also noticed a correlation in that fruit was more prominent in the diet when the species was trapped in the trees and less prominent when trapped on the ground, suggesting that an absence or reduction in arboreal fruit is related to descent to the ground to feed. The presence of intact seeds in the diet likely represents frugivory rather than granivory and the species is presumably an important seed disperser in forest fragments. Cáceres et al (2002) captured individuals in traps baited with banana and peanut butter.

**REP:** Barros et al (2008) documented the reproductive pattern of the species in Rio de Janeiro State, Brazil. The species was found to be strongly seasonal in its reproduction, corresponding with the time of year when resources are most plentiful. Females were found to be reproductively active only during the wet season (October-May) and juveniles were found only from January to May. At least two litters were produced annually, one in October/November and another in January/February. Litter size varied from 6 to 11. Pires & Fernández (1999) found territorial behaviour in this species to be consistent with a promiscuous mating system. The age of first breeding for both sexes is 6 months (Rocha 2000).

**BEH:** *Activity Levels* Arboreal and nocturnal, occupying the canopy and subcanopy of forest and only rarely descending to the ground. *Locomotion* Delciellos & Vieira (2006) studied arboreal locomotion of this species on horizontal branches in PN Serra dos Orgãos, Rio de Janeiro State, Brazil. A maximum velocity of 6.40 (+/-0.12) x body length/second was recorded on support branches of 10.12cm diameter, and a minimum velocity of 5.20 (+/-0.11) x body length/second was recorded on support branches of 2.54cm diameter. Minimum number of strides per second was 4.60 (+/-0.09) on support branches of 2.54cm and maximum number of stride lengths per second was 5.67 (+/-0.17) on support branches of 10.12cm diameter. Range of stride length was from 1.10 to 1.13 x body length. Maximum velocity is reached by increasing stride frequency (Delciellos & Vieira 2007). Delciellos & Vieira (2009) investigated climbing performance of this species on nylon ropes of three diameters 0.6cm, 0.9 and 1.25cm. Respective velocities (stride length x stride frequency) of 1.68 (+/-0.92), 2.01 (+/-0.95) and 2.48 (+/-0.85) were recorded for the three rope diameters. Number of strides per second respectively were 2.69 (+/-0.89), 3.26 (+/-1.80) and 2.99 (+/-0.74) for the three rope diameters. Stride length when related to body length was 0.60 (+/-0.18), 0.64 (+/-0.15) and 0.82 (+/-0.12) respectively. *Home Range* Pires & Fernández (1999) studied home range of the species in forest fragments in Rio de Janeiro state, Brazil using a capture recapture technique. They found no significant difference in size between male and female home range, but male ranges increased in size during the breeding season. Over the course of the year mean home range size in males (n=10) was 0.82ha (range 0.1-2.45ha), increasing from a mean of 0.25ha (range 0.1-0.4ha) in the non-breeding season to 1.62ha (range 0.65-2.45ha) in the breeding season. Male ranges overlapped greatly during the breeding season, but during the non-breeding season they did not overlap with those of other males, though they did overlap with females. Female range size (n=16) remained constant throughout the year with a mean of 0.45ha (range 0.1-1.1ha) and there was little or no overlap in territorial boundaries. Range size of females was smaller where population density was greater. Dispersal between forest fragments was recorded in males only and only during the breeding season, the species forming a metapopulation of resident populations connected by a small number of individuals that move between populations (Brito & Fernández 2000, 2002). Moraes & Chiarello (2005) working in the same area used radiotracking to estimate home ranges and found larger home ranges for the species than the estimates obtained using capture recapture analysis. They estimated male home range to be 5.4-24ha and female home range at 0.3-10.7ha. Tagged individuals moved a mean of 423m per night (range 34-1140m), with males (mean 583m +/-53m; range 317-1097m) moving significantly further than females (mean 335m +/-47m; range 34-1014m). Areas of intense activity were associated with the nesting site and typically males had several areas of intense activity within their ranges whilst females had only one. *Roosts* Roosting behaviour of the species in Rio de Janeiro State, Brazil was studied by Moraes & Chiarello (2005). Roosts were occupied during the daylight hours and the same roost site may be used more than once. A distinct preference for roosting in the spiny palm species *Astrocaryum aculeatissimum* was noted with 70.7% of the 58 roost sites found being in the junction between the petiole and trunk at a height of 4.55m (+/-1.36). Such sites were found to naturally gather masses of dry leaves which acted as a ready-made nest. Other roosts were in a tangle of lianas (n=7) and tree holes (n=2) at a mean height of 10.67m (+/-2.75m). The height difference was significant and it was hypothesised that the spiny trunk of the palm provided protection against predators and made it a favoured roost site. *Defensive Behaviour* Threatened animals gesture with the mouth open bearing the teeth, but the bite is weak. *Enemies* The species was predated by Barn Owl *Tyto alba* in Misiones Argentina (Massoia 1988). *Longevity* The longest lifespan recorded for a wild individual is 24 months (Rocha 2000).

**VOC:** No information.

**HUM:** None.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/details/136844](http://www.iucnredlist.org/details/136844) for the latest assessment of the species) on account of its wide distribution and presence in a number of protected areas. The species is able to tolerate some degree of habitat modification but its reliance on the endangered Atlantic Forest habitat means that it has undoubtedly declined substantially in recent years. Moderate habitat fragmentation probably has little effect on this species given its small size and they have been shown to cross 800m of open habitat between forest patches (Pires et al 2005). It has been suggested that the species may even prefer secondary forest (Pires et al 2005), though it is generally considered to be more numerous in pristine forest (Emmons 1999). Pires et al (2005) found that the species was captured less often near forest edge after fire than before fire, meaning that the combined effects of fire and fragmentation would likely act to reduce populations. Furthermore it has been suggested that only males disperse (Pires & Fernández 1999) and males alone cannot colonise empty patches of forest that are not already inhabited by females. However Moraes & Chiarello (2005) called this assumption into question following their radiotracking survey which apparently indicated that movements assumed to be dispersal may actually be part of normal but rare foraging patterns taking the animals into open habitats. Population sizes are typically small with estimates of less than 20 individuals in two Brazilian forest fragments of 7 and 8.8ha respectively (Quental et al 2001). Using a computer analysis of minimum viable population size, Brito & da Fonseca (2006) estimated that populations of 100 and 2000 individuals were necessary to achieve demographic and genetic stability respectively, within a time frame of 100 years and that isolation of populations represented the greatest threat to their survival. Minimum area of suitable habitat was estimated as 65ha to preserve demographic stability and 1300ha to preserve genetic stability. Given the fact that resources are not evenly distributed within any one area of forest the conservation of larger areas is required to effectively conserve the species. Brito & Grelle (2004) had earlier estimated that a minimum reserve size of 3600ha was necessary to maintain a viable population in Rio de Janeiro State, Brazil. Brito & da Fonseca (2007) ran a computer simulation to model the effects of population fragmentation and found that a single population was more stable than several smaller populations of equal size regardless of the rate of dispersal. Furthermore they concluded that populations of <50 individuals were highly susceptible to extinction over a 100 year time frame. Working under the assumption of male-biased dispersal, Brito & da Fonseca (2006) recommended promoting conditions for dispersal jointly with translocation of females as the best means of conserving the species. Given the increasingly fragmented nature of the Atlantic Forest in Paraguay, the species might best be considered near threatened nationally.

**Online Account:** [www.faunaparaguay.com/micparhb.html](http://www.faunaparaguay.com/micparhb.html).

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**Long-furred Woolly Mouse Opossum**

*Micoureus paraguayanus*. Adult. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.

**Long-furred Woolly Mouse Opossum**

*Micoureus paraguayanus*. Adult threat posture. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.



**Long-furred Woolly Mouse Opossum**

*Micoureus paraguayanus*. Adult ventral. Estancia Nueva Gambach, PN San Rafael, June 2008. Photo Sylvia Qu, courtesy of ECOSARA Biodiversity Database.

# 24

## Genus *Thylamys*, Gray 1843

Nine species, two in Paraguay. Synonyms adapted from Gardner (2007).

**Synonyms:**

*Didelphis* Desmarest 1804:19. In part. Not *Didelphis* Linnaeus (1758).

*Didelphys* Olfers 1818:205. Incorrect spelling. Not *Didelphis* Linnaeus (1758).

*Sarigua* Muirhead 1819:429. In part.

*Didelphis* Desmarest 1827:398. In part. Not *Didelphis* Linnaeus (1758).

*Didelphys* Waterhouse 1841:106. Incorrect spelling. Not *Didelphis* Linnaeus (1758).

*Micoureus* Lesson 1842:186. In part.

*Didelphys* JA Wagner 1842:360. Incorrect spelling. Not *Didelphis* Linnaeus (1758).

*Thylamys* Gray 1843:101. Type species *Didelphis elegans* Waterhouse (1839) by monotypy.

*Didelphis* Reinhardt 1851:v. In part. Not *Didelphis* Linnaeus (1758).

*Grymaeomys* Burmeister 1854:130. In part.

*Microdelphys* Burmeister 1856:86. In part. Proposed as a subgenus of *Didelphis* Linnaeus (1758).

*Cuica* Liais 1872:330. In part.

*Didelphys* (*Micoureus*) O.Thomas 1888:340. In part. Incorrect spelling. Not *Didelphis* Linnaeus (1758). Not *Micoureus* Lesson (1842).

*Philander* Cope 1889:130. In part. Not *Philander* Brisson (1762).

*Didelphys* RA Philippi 1894:36. Incorrect spelling. Not *Didelphis* Linnaeus (1758).

*Micoureus* Goeldi 1894:462. Not *Micoureus* Lesson (1842).

*Marmosa* O.Thomas 1894:188. In part. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1896:313 In part. Not *Marmosa* Gray (1821).

[*Didelphys*] (*Peramys*) Trouessart 1898:1244. In part. Incorrect spelling. Not *Didelphis* Linnaeus (1758). Not *Peramys* Lesson (1842).

*Marmosa* O.Thomas 1902:158. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1912:409. Not *Marmosa* Gray (1821).

*Didelphis* (*Dromicops*) Matschie 1916:271. Not *Didelphis* Linnaeus (1758). Not *Dromicops* O.Thomas (1894).

*Marmosa* O.Thomas 1921a:186. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1921b:519. Not *Marmosa* Gray (1821).

*Marmosa* O.Thomas 1926:327. Not *Marmosa* Gray (1821).

*Marmosa* Tate 1931:14. Not *Marmosa* Gray (1821).

*Marmosa* Marelli 1932:68. Not *Marmosa* Gray (1821).

*Thylamis* A.Miranda-Ribeiro 1936:328. Incorrect spelling.

*Marmosa* Handley 1957:402. Not *Marmosa* Gray (1821).

*Didelphys* (*Peramys*) Cabrera 1958:29. Incorrect spelling. Not *Peramys* Lesson (1842).

*Dromictops* Cabrera 1958:30. Incorrect spelling. Not *Dromicops* O.Thomas (1894).

*Marmosa* Petter 1968:313. Not *Marmosa* Gray (1821).

*Thylamys* Reig, Kirsch & Marshall 1985:336. Incorrect spelling.

*Macrodelphys* BE Brown 2004:145. Incorrect spelling.

**General characteristics:** Small opossums with the ratio of tail to head and body length in the region of 1 to 1.25. Bilaterally symmetrical rows of teats (as opposed to teats arranged in a circular pattern as in other genera) include inguinal, abdominal and pectoral teats and may number up to 19. Feet are small and white with short digits. Claws on the forefoot digits II-IV extend well beyond the digital pads. Central soles of the feet are covered with small granular tubercles. The tail is bicoloured in many species and at certain times of year some species store fat in the basal section of their tails. Tail scales are tiny (35 or more rows per cm), rounded or square in shape and arranged in rings. Fossil species of this genus are known from the late Pleistocene. Diploid chromosome number 14.

**Cranial characteristics:** Postorbital processes usually absent, but may appear as ridges or postorbital projections in adults of some species (eg. *T.pusillus*). Nasals are elongated, slender and do not expand at the maxillofrontal suture. Auditory bullae are large, rounded and not widely separated - ratio of distance between bullae to width of a single bulla is 1.5 or less. An anteromedial alisphenoid process is present. Palate may have 2 or 3 paired fenestrae. Posterolateral palatal foramina are extremely long and the width of each is equal to or greater than the width of the last molar.

**Dental characteristics:** P3 exceeds P2 in height and anteroposterior length.

**Paraguayan Species:**

*Thylamys macrurus* - Long-tailed Fat-tailed Opossum

*Thylamys pusillus* - Chaco Fat-tailed Opossum

# 25

## Long-tailed Fat-tailed Opossum

### *Thylamys macrurus*

[*Didelphys*] *macroura* Illiger 1815:107. Nomen nudum.

[*Didelphys*] *marmota* Oken 1816:1140. Name unavailable.

[*Didelphys*] *macrura* Olfers 1818:205. Based on de Azara (1801:290). Type locality "Tapoua" =Tapuá, Departamento Presidente Hayes, Paraguay.

*Didelphis grisea* Desmarest 1827:398. Based on de Azara (1801:290). Type locality "Tapoua" =Tapuá, Departamento Presidente Hayes, Paraguay.

[*Didelphys*] ([*Grymaeomys*] [*griseus* Burmeister 1856:83. Name combination.

T[*Thylamys*]. *marmota* Allen & Chapman 1897:28. Name combination but not *Marmosa marmota* Thomas (1896).

[*Didelphys* (*Marmosa*)] *grisea* Trouessart 1898:1241. Name correction.

*Marmosa grisea* Bertoni 1914:69. Name combination.

[*Didelphis* (*Thylamys*)] *grisea* Matschie 1916:271. Name combination.

*Marmosa marmota marmota* Tate 1933:218. Name combination but not *Marmosa marmota* Thomas (1896).

*Marmosa pusilla* Hershkovitz 1959:338. In part. Not *Didelphis pusilla* Desmarest (1804).

*Marmosa* (*Thylamys*) *grisea* Kirsch & Calaby 1977:14. Name combination.

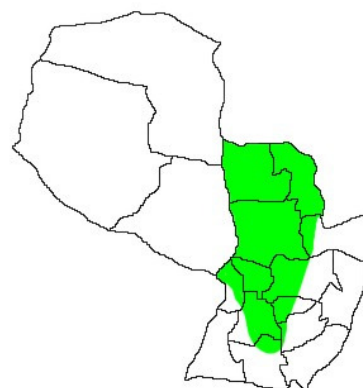
[*Thylamys*] *griseus* Reig, Kirsch & Marshall 1987:7. Name combination.

T[*Thylamys*]. *macrura* Gardner & Creighton 1989:4. First use of modern name and incorrect gender.

*Thylamys grisea* Contreras & Contreras 1992:1. Name combination and incorrect gender.

***Thylamys macrurus* (Olfers, 1818)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Monodelphini (Myers et al 2006, Gardner 2007). The genus *Thylamys* was defined by Gray, 1843 and Palma et al (2002) concluded that the genus was differentiated during the Pleistocene. The species currently recognised as *Thylamys* correspond roughly to the "*elegans*-group" as defined in the monography by Tate (1933). There are nine known species according to the latest revision (Gardner 2007) two of which are present in Paraguay. The genus *Thylamys* is from the Greek meaning "pouched mouse". The species name *macrurus* is Greek meaning "long-tailed". The species is monotypic. The species was described by Olfers (1818) as *Didelphys macrura*, based on de Azara's (1801: 290) "Micouré à longue queue" with restricted type locality as Tapuá, Departamento Presidente Hayes, Paraguay". No holotype was designated (Brown 2004). Some



authors (Redford & Eisenberg 1992) recognise the descriptor as (Desmarest 1827) whose *Didelphis grisea* was also based on de Azara's description. The earliest official description based on de Azara's "Micouré à longue queue" was by Oken (1816) but his name was non-Linnean and hence unavailable. In fact Azara's original description lacked precision, was apparently based on an immature specimen (Hershkovitz 1959) and could refer to any small, greyish mouse opossum (Gardner 2007). In recent literature the species has frequently been referred to as *Marmosa marmota marmota* (Tate 1933) and *Marmosa grisea* (Cabrera 1958). Following an analysis of nucleotide sequence data from the mitochondrial cytochrome-*b* gene, Braun et al (2005) concluded that the species was strongly differentiated from other species in the genus and Palma et al (2002) concluded in an earlier molecular analysis that it was in fact the most primitive taxon and that migration of this species across the Rio Paraguay may have given rise to the evolution of *Thylamys pusillus*. Synonyms adapted from Gardner (2007).

**ENG:** Long-tailed Fat-tailed Opossum (Canevari & Vaccaro 2007), Paraguayan Thylamys (Gardner 2007), Paraguayan Fat-tailed Mouse Opossum (IUCN 2009).

**ESP:** No known names.

**GUA:** No known names.

**DES:** A medium-sized, corpulent mouse opossum with short, dense, smooth fur. Dorsally they are darkest, being greyish-brown, fading to light grey on the flanks and with a slight reddish tone on the shoulders. Darker dorsal colouration extends down the centre of the head as a medial line, the hairs being grey-based and white with dark tips except for the area above the eye and in front of the ears where they are white-based with dark tips. Dorsal pelage is composed of long guard hairs (10-12mm) which are grey for the basal third, darker distally and occasionally white-tipped; and shorter cover hairs (9-10mm) which are four-banded, grey basally and distally, changing to dark brown and creamy with dark tips. Ventrally they are creamy-white or pure white, with guard hairs 7-8mm long and cover hairs 5-6mm long and a very narrow 3mm wide line of greyish hairs along the flanks. A highly-developed gular gland may stain the surrounding pelage yellowish. Eyes large, surrounded by narrow black patch that extends only slightly in front of the eye and onto the cheeks. Ears large, naked and reddish-brown in colour. A tuft of white fur is present behind the ears. Tail is furred for the basal 1cm, prehensile and c1.3x head and body length. It appears essentially naked without magnification. Colour brownish-grey on the dorsal side basally, greyish distally and pale greyish on the ventral side for its entire length except for a whitish tip. Tail scales are tiny rounded or square in shape and arranged in rings with three hairs pair scale. The central hair of each caudal scale triplet is longer (4-5 scales long vs. 2-3 scales long) and thicker than the lateral hairs. The prehensile tip lacks hairs and is approximately 20mm long. Though it is often stated that there is no evidence of tail incrassation in this species, Carmignotto & Monfort (2006) found evidence of slight incrassation in all the

specimens that they examined. Limbs are grey dorsally and whitish ventrally, those of the forelimbs paler dorsally. Feet are small and white with unguis tufts and short digits. The toes are long with short claws that do not extend beyond the apical pads of the forefeet, but are slightly longer on the hindfeet. Six separate pads are present on each foot, with large granules and dermatoglyphs on the palmar and plantar surfaces. Females lack a marsupium and have bilaterally symmetrical rows of teats including inguinal, abdominal and pectoral teats. The area around the teats may be stained pinkish-cinnamon in some individuals. The scrotum of males is darkly-pigmented and covered with self-pigmented hairs (Tate 1933, Canevari & Vaccaro 2007, Gardner 2007, Carmignotto & Monfort 2006). **CR** - Skull robust, with broad zygomatic arch and slender rostrum. Brain case moderately broad. Nasals long and rounded posteriorly. They show slight expansion at the maxillo-frontal suture, narrowing slightly behind it and the lateral margins are subparallel. Supraorbital crests well-developed and pronounced postorbital constriction. Anterior part of interorbital region broader in males than females, but interorbital constriction not greatly constricted in either sex. Small temporal ridges may converge on the parietal. In the male the temporal ridges form an incipient crest on the interparietal but in the female are separated by 2-3mm. Petrosals are laterally exposed in a fenestra between the squamosal and parietal bones. Zygomatic arches slightly expanded and the external surface of the jugals exhibits a conspicuous concavity along the anterior margin of the zygomata. Lambdoidal crests moderately-developed. Lacrimal foramina large and laterally-exposed in orbital margins. Palate broad and highly fenestrated with maxillopalatine, palatine, and maxillary openings. Posterolateral palatal foramina are large and reach the lingual apices of the protocones of M4. Incisive foramina extend posteriorly to the midline of the canines and are widest anteriorly, narrowing in the middle to posterior portion. Tympanic bullae well-developed but proportionately smaller than in other members of the genus. Carmignotto & Monfort (2006) give the following measurements for 8 specimens (3 male, 4 female and one of indeterminate sex) from Matto Grosso do Sul, Brazil and Paraguay without distinguishing between the sexes: *Basal Length*: 31.47mm (+/-1.41); *Greatest Cranial Length*: 32.02mm (+/-1.46); *Greatest Cranial Height*: 10.26mm (+/-0.44); *Width of Braincase*: 12.09mm (+/-0.38); *Greatest Zygomatic Width*: 17.63mm (+/-1.17); *Length of Nasals*: 13.6mm (+/-1.06); *Width of Nasals*: 2.96mm (+/-0.32); *Palate Length*: 16.61mm (+/-0.68); *Palate Width*: 10.05mm (+/-0.58); *Interorbital Constriction*: 5.14mm (+/-0.56); *Postorbital Constriction*: 5.33mm (+/-0.22); *Width of Rostrum*: 5.24mm (+/-0.47); *Width Across Bullae*: 11.47mm (+/-0.56); *Width Between Bullae*: 5.20mm (+/-0.36); *Bullae Width*: 3.11mm (+/-0.08); *Minimum Pterygoid Bridge Width*: 2.71mm (+/-0.14); *Mandibular Length*: 23.22mm (+/-1.56). Tate (1933) and Contreras & Contreras (1992) published the following skull measurements: *Basal Length*: male 31.8mm, female 31.3mm; *Greatest Cranial Length*: male 34.9mm, female 33.5mm; *Greatest Zygomatic Width*: male 18.6-19.8mm, female 19mm; *Mandible Length*: male 26-27.2mm, female 25.9mm; *Length of Nasals*: male 15.1-16.3mm, female 14mm; *Palate Length*: male 18.6mm, female 17.5mm; *Bullae Width*: male 3.5mm, female 3.5mm. **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. Incisors increase in size from I2 to I5. Canines well-developed with posterior accessory cusps. P3 exceeds P2 in height and anteroposterior length. Molar rows convergent. Molars are compressed antero-posteriorly, especially M4. Styler cusp C is well developed on the upper molars, and is similar in size to styler cusps B and D in M1, and smaller than styler cusps B and D in M2 and M3. The ectoflexus is serrated giving the styler shelf a serrated profile in lingual view. Carmignotto & Monfort (2006) give the following measurements for 8 specimens (3 male, 4 female and one of indeterminate sex) from Matto Grosso do Sul, Brazil and Paraguay without distinguishing between the sexes: *Length of Upper Toothrow*: 12.38mm (+/-0.42); *Length of Upper M1-M4*: 6.14mm (+/-0.21); *Length of Mandibular Row of Molars*: 6.93mm (+/-0.17); *Upper Canine Length*: 2.43mm (+/-0.37); *Upper Canine Width*: 1.48mm (+/-0.11); *Upper P3 Length*: 1.76mm (+/-0.33). Tate (1933) and Contreras & Contreras (1992) give the following for Paraguayan specimens: *Length of Mandibular Row of Molars* male 7-7.4mm, female 7.3mm. **CN**: 2n=14; FN=20. X chromosomes are small acrocentrics (Palma 1995).

**TRA**: No information.

**MMT**: The larger of the two Paraguayan *Thylamys* and second only to *Micoureus paraguayanus* in size amongst the Paraguayan Mouse Opossums. There is evidence of some sexual size dimorphism with males being larger than females in most measurements (Cáceres et al 2007). The following



measurements are taken from Cáceres et al (2007) for specimens in southeastern Brazil: **HB**: male 12.24cm (+/-1.11, n=31) female 11.13cm (+/-5.3, n=12); **TA**: male 13.84cm (+/-0.79, n=31) female 13.39cm (+/-0.55, n=12) approximately 1.2x head and body length; **FT**: male 1.69cm (+/-0.14, n=30) female 1.58cm (+/-0.1, n=12); **EA**: male 2.14cm (+/-0.28, n=30) female 1.92cm (+/-0.24, n=12); **WT**: male 52.4g (+/-12.2, n=37) female 41g (+/-10, n=17). Carmignotto & Monfort (2006) give the following measurements for 8 specimens (3 male, 4 female and one of indeterminate sex) from Matto Grosso do Sul, Brazil and Paraguay without distinguishing between the sexes: **HB**: 11.2cm (+/-1.02); **TA**: 14.45cm (+/-0.67) approximately 1.3x head and body length; **FT**: 1.75cm (+/-0.09); **EA**: 2.35cm (+/-0.23); **WT**: 38.83g (+/-9.92). Contreras & Contreras (1992) cite the following measurements for two male specimens from Paraguay, the first of unknown provenance and the second from Cordillera de los Altos, Departamento Paraguari: **TL**: 28cm, 29.2cm; **HB**: 14.5cm, 13.1cm; **TA**: 13.5cm, 16.1cm; **FT** (including claw): 1.9cm, 2.02cm; **EA**: 2.3cm, 2.85cm; and the following for a single female specimen from Sapucaí, Departamento Paraguari: **TL**: 30.8cm; **HB**: 14.7cm; **TA**: 16.1cm; **FT** (including claw): 1.8cm; **EA**: 2.5cm.

**SSP**: Members of the genus *Thylamys* can be distinguished from other mouse opossums by their noticeably bicoloured pelage, being darker dorsally and paler laterally, and by the densely-granulated soles of the feet. Furthermore female *Thylamys* have the teats arranged in bilaterally symmetrical rows and not in a circular pattern as in other mouse opossums. The only other member of the genus present in Paraguay is *Thylamys pusillus*, which is principally distinguished on size, being typically <35g in weight and with a tail typically much less than 135mm in length (compared to >40g and >135mm in this species). Note that this species frequently shows a whitish tip to the tail which is absent in *T.pusillus*. The two species of *Thylamys* are apparently allopatric, this species being so far only conclusively recorded in eastern Paraguay, whilst *T.pusillus* appears to be confined to the Chaco. Cranially the posterolateral foramen does not exceed M4 in this species, though it does in *T.pusillus*.

**DIS**: The geographical range of this species is poorly known and it may prove to be more widespread than is currently thought. In Brazil it occurs from near Campo Grande, Mato Grosso do Sul in the north and east, south to north-eastern Paraguay. Anderson (1997) provides details of a single specimen from Santa Cruz, Bolivia, the first record for that country. It may be present in the southern Pantanal of Brazil where suitable habitat is apparently present. (Cáceres et al 2007). In Paraguay specimens are known from Asunción, Departamento Central, Departamento Concepción, Pedro Juan Caballero, Departamento Amambay, Coronel Oviedo, Departamento Caaguazú and Sapucaí and Cordillera de los Altos, Departamento Paraguari, and there is a literature citation from San Ignacio, Departamento Misiones (Contreras & Contreras 1992). The original description of the species was based on de Azara's vague description of his "Micouré à longue queue" which failed to conclusively identify this species. The type locality given was Tapuá, Departamento Presidente Hayes (Gardner 2007), but Tate (1933) quotes Schuller (undated) in stating that the location of Tapuá is "a few miles northeast of Asunción" at 25° 10' 25" latitude and 0° 9' 11" taking Asunción as a meridian of 0°, which presumably places it on the east bank of the Rio Paraguay in Departamento Central. Given the uncertainty over the identity of de Azara's specimen, the precise locality of Tupuá and the lack of further specimens from the Chaco we prefer to consider its presence on the western bank of the Rio Paraguay as hypothetical pending new information.

**HAB**: Though traditionally considered a species of semideciduous forest (Cannevari & Vaccaro 2007), Cáceres et al (2007) called that into question and demonstrated that the species occurs in open shrubby savanna and cerrado, including cerradón in southwestern Brazil. In fact they considered that functional adaptations were typical of an open-country species and hypothesised that once its distribution is better known it may prove to be present in humid chaco, transitional dry forests and arboreal savannas. They suggested that the presence of the species in forest could be explained by a scansorial mode of life. Carmignotto & Monfort (2006) state that the species is exclusively found in cerrado in Brazil with specimens collected in dense cerrado *sensu stricto*.

**ALI**: Considered primarily an insectivore with omnivorous tendencies (Cannevari & Vaccaro 2007), though no detailed information has ever been published on the diet of the species. Cáceres et al (2007) captured individuals in Rio Grande do Sul, Brazil in traps baited with a mixture of bacon, pumpkin, and cod liver oil.



**REP:** Cáceres et al (2007) caught only one juvenile in the dry season (July) in Mato Grosso do Sul, Brazil compared to 32 in the wet season (October to March), despite the same trapping effort. More males were caught (35/57 total captures) during the dry season (April to September) and more females (27/40 total captures) during the wet season (October to March). The authors speculated that the differences in trapping success between the sexes (with more males than females captured) coupled with the sexual size dimorphism was possibly indicative of a non-monogamous social system owing to the fact that males are more mobile when in search of mates. The higher trapping rate of males in the dry season and bias of juveniles captured in the wet season was associated with a highly seasonal breeding system beginning in the dry season when males search for mates and culminating in the wet season with the birth and growth of young. Females would thus be expected to be more active in the wet season whilst occupied with lactation and care of young and this was also supported by the greater trapping success of females during that season.

**BEH:** Considered crepuscular in behaviour (Cannevari & Vaccaro 2007). Cáceres et al (2007) caught this species on the ground and in the understorey using pitfall and baited live traps. Previous authors had considered the species arboreal, but they seem more adapted to a scansorial way of life and 32 of 39 (82%) released individuals opted for a terrestrial escape compared to just 7 (18%) which climbed the nearest tree. However the species does have some adaptations to suggest that they are more arboreal than other members of the genus, including longer, more pointed toes and claws. *Parasites* Cáceres et al (2007) found the following parasites on six individuals from Mato Grosso do Sul, Brazil: Tick *Argas miniatus* (17 individuals present on 100% of specimens), Trombiculinae (3 individuals; 17% prevalence) and lice *Gyropus lenti lenti* (1 individuals; 17% prevalence).

**VOC:** No information.

**HUM:** None.

**CON:** Globally considered to be of Low Risk Near Threatened by the IUCN, (see [www.iucnredlist.org/details/21867](http://www.iucnredlist.org/details/21867) for the latest assessment of the species) on account of an inferred population decline due to habitat destruction and conversion to agriculture. The limited information available on the biology of this species makes its threat status difficult to assess, though Cáceres et al (2007) found it to be the commonest small marsupial in their study area in Mato Grosso do Sul, Brazil. Few specimens are known from Paraguay, but sampling effort has been sporadic and of low intensity, and the species may theoretically be more widespread than is currently known. However habitat destruction is occurring rapidly in eastern Paraguay and like many mammal species with specialist habitat requirements it is undoubtedly declining. The species occurs in some protected areas in Paraguay but apparently does not in Brazil.

**Online Account:** [www.faunaparaguay.com/thymachb.html](http://www.faunaparaguay.com/thymachb.html).

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## Chaco Fat-tailed Opossum *Thylamys pusillus*

- Didelphis pusilla* Desmarest 1804:19. Based on de Azara (1801). Type locality "Saint Ignace-Gouazou" =San Ignacio Guazu, Departamento Misiones, Paraguay.  
[*Didelphys*] *nana* Illiger 1815:107. Nomen nudum.  
*Didelphys nana* Oken 1816:1140. Name unavailable.  
[*D*] *idelphys. nana* Olfers 1818:206. Based on Desmarest (1804).  
*Sarigna pusilla* Muirhead 1819:29. Name combination.  
*Didelphys* [(*Grymaeomys*)] *pusilla* Burmeister 1854:140. Name combination.  
*Philander pusillus* Cope 1889:130. Name combination.  
*Micoureus pusillus* Ihering 1894:11. Name combination.  
*Micoureus griseus* O.Thomas 1894:184. Not *Didelphis grisea* Desmarest (1827) and later redescribed as *Marmosa citella* O.Thomas (1912).  
M[*armosa*]. *pusilla* O.Thomas 1896:314. Name combination.  
*Marmosa marmota* O.Thomas 1896:313-314. Based on *Didelphys marmota* Oken (1816) but indication to O.Thomas (1894).  
[*Didelphys* (*Marmosa*)] *pusilla* Trouessart 1898:1240. Name combination.  
*Marmosa citella* O.Thomas 1912:409. Type locality "Goya, Corrientes, Argentina" =*Micoureus griseus*.  
[*Didelphis* (*Thylamys*)] *citella* Matschie 1916:271. Name combination.  
[*Marmosa* (*Marmosa*)] *pusilla* Cabrera 1919:38. Name combination.  
[*Marmosa* (*Thylamys*)] *citella* Cabrera 1919:40. Name combination.  
[*Marmosa* (*Thylamys*)] *marmota* Cabrera 1919:40. Name combination.  
*Marmosa verax* O.Thomas 1921:520. Type locality "Mission west of Concepción, Paraguay"  
*Marmosa marmota verax* Tate 1933:220. Name combination.  
*Marmosa janetta pulchella* Cabrera 1934:126. Type locality "Robles, Santiago del Estero, Argentina"  
[*Marmosa* (*Thylamys*)] *pusilla* Cabrera 1958:32. Name combination.  
M[*armosa*]. *pusilla verax* Wetzell & Lovett 1974:206. Name combination.  
[*Thylamys*] *pusillus* Reig, Kirsch & Marshall 1987:7. First use of modern name.  
*Thylamys pusilla* Brown 2004:193. Incorrect gender.

***Thylamys pusillus* (Desmarest, 1804)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae, Tribe Monodelphini (Myers et al 2006, Gardner 2007). The genus *Thylamys* was defined by Gray, 1843 and Palma et al (2002) concluded that the genus was differentiated during the Pleistocene. The species currently recognised as *Thylamys* correspond roughly to the "*elegans*-group" as defined in the monography by Tate (1933). There are nine known species according to the latest revision (Gardner 2007) two of which are present in Paraguay. The genus *Thylamys* is from the Greek meaning "pouched mouse". The species name *pusillus* is Latin meaning "very small or tiny". The species is monotypic, though Gardner (2007) notes that the taxon requires revision. No holotype was designated (Brown 2004). The species was described by Desmarest (1804) as *Didelphis pusilla*, based on de Azara's (1801: 290) account of two males which he called "Le



Micouré nain" and with type locality "Saint Ignace-Gouazou". Tate (1933) restricted this to San Ignacio Guazú, Departamento Misiones, Paraguay. De Azara's original description was vague and fails to conclusively identify this species based on our current knowledge of Didelphids. Additionally the type locality given is in eastern Paraguay where this species apparently does not occur, or at least where it has never been conclusively recorded. It seems that de Azara's description may have been referring to another species, but due to its vagaries it was later applied by Desmarest and others to what we now know to be *Thylamys pusillus*. Much of the confusion in the literature of the late 19th and early 20th Century can be attributed to O.Thomas (1888) who misapplied the name *pusillus* to the unrelated *Gracilinanus microtarsus* (Wagner 1842). Tate (1933) used the name *Marmosa marmota verax* in the same sense that *Thylamys pusillus* is used here and his *Marmosa pusilla* appears to be based at least in part on this species. Cabrera (1958) included *Marmosa marmota* as a synonym of *Marmosa grisea* (Bertoni 1914) = *Thylamys macrurus*. To further complicate matters O.Thomas (1896) used *Marmosa marmota* for material from Corrientes, Argentina which included an immature individual which he had previously described as "*Micoureus griseus* Desmarest 1827". He later received more material from the same location that he initially attributed to *Marmosa marmota*, but then later used as the basis of his *Marmosa citella* which is now considered a junior synonym of *Marmosa marmota*, which in turn is a junior synonym of *Thylamys pusillus*. Hershkovitz (1959) considered the species to be conspecific with *Thylamys macrurus* under the name *Marmosa pusilla*. Palma et al (2002) concluded from their molecular analysis that this species was derived from the more primitive *Thylamys macrurus* following a migration of that species across the Rio Paraguay. Synonyms adapted from Gardner (2007).

**ENG:** Chaco Fat-tailed Opossum, Chacoan *Thylamys* (Gardner 2007), Common Fat-tailed Mouse Opossum (IUCN 2009), Small Fat-tailed Mouse Opossum (IUCN 2009), Common Mouse Opossum (Canevari & Vaccaro 2007), Small Fat-tailed Opossum (Canevari & Vaccaro 2007).

**ESP:** *Marmosa común* (Massoia et al 2000, Redford & Eisenberg 1992), *Comadreja enana* (Chebez 1996, Massoia et al 2000), *Comadreja enana* (IUCN 2009), *Comadreja común* (Canevari & Vaccaro 2007), *Comadreja enana común* (Canevari & Vaccaro 2007).

**GUA:** Anguyá guakí (Massoia et al 2000, Canevari & Vaccaro 2007).

**DES:** A small mouse opossum with short, dense, smooth fur. This species is almost identical in external appearance to *Thylamys macrurus* and is best separated by body and tail measurements. Dorsally they are darkest, being greyish-brown, fading to light grey on the flanks. Darker dorsal colouration extends down the centre of the head as a medial line. Ventrally they are creamy-white or pure white. Eyes large, surrounded by a poorly-defined narrow black patch that extends only slightly in front of the eye and onto the cheeks. Ears large, naked and reddish-brown in colour. Tail prehensile and c1.14x head and body length. It appears essentially naked without magnification. Colour brownish-grey on the dorsal side basally, greyish distally and pale greyish on the ventral side for its entire length

and lacks a whitish tip. Tail scales are tiny rounded or square in shape and arranged in rings with three hairs pair scale. The prehensile tip lacks hairs. Fat is stored in the tail and some degree of incassination is usually visible throughout the year. Limbs are grey dorsally and whitish ventrally, those of the forelimbs paler dorsally. Feet are small and white with ungual tufts and short digits. The toes are long with short claws that do not extend beyond the apical pads of the forefeet, but are slightly longer on the hindfeet. Six separate pads are present on each foot, with large granules and dermatoglyphs on the palmar and plantar surfaces. Females lack a marsupium and have bilaterally symmetrical rows of 15 teats, most inguinal in position with two pectoral pairs. (Canevari & Vaccaro 2007, Carmignotto & Monfort 2006). **CR** - Skull robust, with broad zygomatic arch and slender rostrum. Brain case moderately broad. Nasals long and rounded posteriorly. They show slight expansion at the maxillo-frontal suture, narrowing slightly behind it and the lateral margins are subparallel. Supraorbital crests well-developed and pronounced postorbital constriction. Palate long. Posterolateral palatal foramina are large and exceed the lingual apices of the protocones of M4. Tympanic bullae well-developed. Carmignotto & Monfort (2006) give the following measurements for 7 specimens (6 males, 1 female) from Paraguay without distinguishing between the sexes: *Basal Length*: 26.31mm (+/-0.83); *Greatest Cranial Length*: 26.83mm (+/-0.94); *Greatest Cranial Height*: 9.20mm (+/-0.28); *Width of Braincase*: 10.45mm (+/-0.26); *Greatest Zygomatic Width*: 15.06mm (+/-0.46); *Length of Nasals*: 11.01mm (+/-0.4); *Width of Nasals*: 2.47mm (+/-0.21); *Palate Length*: 13.76mm (+/-0.79); *Palate Width*: 8.24mm (+/-0.32); *Interorbital Constriction*: 4.00mm (+/-0.29); *Postorbital Constriction*: 4.59mm (+/-0.24); *Width of Rostrum*: 4.38mm (+/-0.42); *Width Across Bullae*: 9.95mm (+/-0.34); *Width Between Bullae*: 4.16mm (+/-0.26); *Bullae Width*: 2.60mm (+/-0.08); *Minimum Pterygoid Bridge Width*: 2.32mm (+/-0.17); *Mandibular Length*: 19.49mm (+/-0.80). **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. Molar rows convergent and compressed antero-posteriorly. Canines well-developed but short. Carmignotto & Monfort (2006) give the following measurements for 7 specimens (6 males, 1 female) from Paraguay without distinguishing between the sexes: *Length of Upper Toothrow*: 10.13mm (+/-0.29); *Length of Upper M1-M4*: 5.09mm (+/-0.08); *Length of Mandibular Row of Molars*: 5.65mm (+/-0.11); *Upper Canine Length*: 1.97mm (+/-0.30); *Upper Canine Width*: 1.14mm (+/-0.18); *Upper P3 Length*: 1.26mm (+/-0.05). **CN**: 2n=14; FN=20. X chromosomes are small submetacentrics and Y chromosome absent in somatic cells (Palma 1995).

**TRA**: No information.

**MMT**: The smaller of the two Paraguayan *Thylamys*. Carmignotto & Monfort (2006) give the following measurements for 7 specimens (6 males, 1 female) from Paraguay without distinguishing between the sexes: **HB**: 10.23cm (+/-0.93); **TA**: 11.65cm (+/-0.96) approximately 1.14x head and body length; **FT**: 1.38cm (+/-0.08); **EA**: 2.14cm (+/-0.16); **WT**: 25.03g (+/-6.15).

**SSP**: Members of the genus *Thylamys* can be distinguished from other mouse opossums by their noticeably bicoloured pelage, being darker dorsally and paler laterally, and by the densely-granulated soles of the feet. Furthermore female *Thylamys* have the teats arranged in bilaterally symmetrical rows and not in a circular pattern as in other mouse opossums. The only other member of the genus present in Paraguay is *T. macrurus* which is principally distinguished by its larger size, being typically >40g in weight and with a tail typically greater than 135mm in length (compared to <35g and tail much less than 135mm in this species). The two species of *Thylamys* are apparently allopatric, this species being so far only conclusively recorded in the Chaco west of the Rio Paraguay, whilst *T. macrurus* appears to be confined to eastern Paraguay. Note that this species does not show a whitish tip to the tail which is usually present in *T. macrurus*. Cranially the posterolateral foramen exceeds M4 in this species, though it does not in *T. macrurus*.

**DIS**: The geographical range of this species is poorly known and further confused by various taxonomic changes and errors in the published literature. Carmignotto & Monfort (2006) consider the species to be adequately documented only from southern and eastern Bolivia, the Chaco of Paraguay, northwestern Argentina and Uruguay. Their examination of the specimens proved that published records of this species from northeastern and central Brazil (Gardner 1993, Eisenberg & Redford 1999) were actually referable to *Thylamys karimii*, which was formerly considered conspecific, whilst Schaller's (1983) records of "*Marmosa pusilla*" from Matto Grosso do Sul, are in fact *Gracilinanus agilis*. They consider that the species has yet to be documented for Brazil. They examined eight specimens

from Paraguay from the following locations, all in the Paraguayan Chaco: 11km N of Filadelfia, Departamento Boquerón (FMNH 164095 & FMNH 164096); 295km NW by road from Villa Hayes, Departamento Presidente Hayes (MVZ 144310); 410km NW by road from Villa Hayes, Departamento Boquerón (MVZ 144312 & MVZ 144313); 460km NW by road from Villa Hayes, Departamento Boquerón (MVZ 144311); Estancia Toledo, 35km W of Filadelfia, Departamento Boquerón (FMNH 164097); Dr. Pedro P Peña, Departamento Boquerón (USNM 390027). The type locality is San Ignacio-Guazú, Departamento Misiones, Paraguay. This locality is in eastern Paraguay apparently outside the known range of this species, and no bona fide specimens have ever been found east of the Rio Paraguay. See the taxonomic section for notes on the vagaries of de Azara's original description and the reasons for suspecting that de Azara may have been referring to a different species given our current understanding of Didelphid taxonomy. Though Gardner (2007) maps the species for Provincia Misiones, Argentina its occurrence there was considered hypothetical by Chebez (1996) who noted that the only evidence for its occurrence are remains of a species similar to *Thylamys* recovered from the pellets of a Barn Owl (Massoia et al 1989).

**HAB:** This species is confined to xeric, wooded, scrubby and frequently thorny habitats in the Paraguayan Chaco. It is semi-arboreal in behaviour (Cannevari & Vaccaro 2007).

**ALI:** Considered primarily an insectivore with omnivorous tendencies (Cannevari & Vaccaro 2007), though no detailed information has ever been published on the diet of the species. Fruit likely plays a significant part in the diet at least seasonally. The species is able to accumulate fat in the tail during times of plentiful resources, which help it to survive leaner times in its harshly seasonal environment.

**REP:** Little published information. Cannevari & Vaccaro (2007) state that females apparently reproduce twice a year giving birth to 14 or 15 young per brood.

**BEH:** Considered nocturnal and arboreal in behaviour, this species spends the day in burrows holes or abandoned nests (Cannevari & Vaccaro 2007). One burrow was located under a cactus and in Salta, Argentina the species continued to be active even when there was snow on the ground. (Eisenberg & Redford 1999). Specimens have been taken on the ground in pitfall traps as well as in trees and shrubs (Gardner 2007).

**VOC:** No information.

**HUM:** None.

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/details/40519](http://www.iucnredlist.org/details/40519) for the latest assessment of the species) because of its wide distribution, occurrence in protected areas and large population. The species is apparently common in the Paraguayan Chaco, though rarely encountered other than by trapping studies and given the isolated nature of its habitat and low human population pressure it is currently under no threat in Paraguay. It probably occurs in most if not all of the protected areas in the Dry Chaco, but to date has been documented only for PN Rio Negro, Departamento Alto Paraguay (questionably) and the now defunct PN Tinfunque, Departamento Boquerón/Presidente Hayes (Yanosky 1998). However the species has likely declined as a result of deforestation in the areas around the Mennonite colonies in the Central Chaco and will continue to do so as the agricultural frontier expands in the region.

**Online Account:** [www.fauparaguay.com/thypushb.html](http://www.fauparaguay.com/thypushb.html).

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# 27

## Genus *Monodelphis*, Burnett 1830

Twenty-nine species, three present in Paraguay.

**Synonyms:**

*Sorex* Müller 1776:36. In part. Not *Sorex* Linnaeus (1758).

*Didelphis* Erxleben 1777:80. In part. Not *Didelphis* Linnaeus (1758).

*Didelphys* Schreber 1777:549. In part. Unjustified emendation.

*Viverra* G.Shaw 1800:432. In part. Not *Viverra* Linnaeus (1758).

*Mustela* Daudin in Lacépède 1802:163. In part. Not *Mustela* Linnaeus (1758).

*Philander* Tiedemann 1808:428. In part.

*Sarigua* Muirhead 1819:429. In part.

*Monodelphis* Burnett 1830:351. Type species *Monodelphis brachyura* Burnett (1830) (= *Didelphys brachyuros* Schreber 1777 [= *Didelphis brevicandata* Erxleben 1777]) by selection.

? *Crossopus* Lesson 1842:91. In part. Not *Crossopus* Wagler (1832).

*Micoureus* Lesson 1842:186. In part.

*Peramys* Lesson 1842:187. Type species *Peramys brachyurus* Lesson (1842) (= *Didelphis dimidiata* JA Wagner (1847) by selection. Not *Didelphis brevicandata* Erxleben (1777).

*Grymaeomys* Burmeister 1854:138. In part.

*Hemiuirus* P.Gervais 1855:287. Preoccupied.

*Microdelphys* Burmeister 1856:83. Type species *Didelphis (Microdelphys) tristriata* Burmeister (1856) (= *Didelphys tristriata* Illiger 1815, [= *Sorex americanus* Müller 1776]) by designation. Proposed as a subgenus of *Didelphis* Linnaeus (1758).

*Microdidelphys* Trouessart 1898:1242. Incorrect spelling.

*Monodelphiops* Matschie 1916:261. Type species *Microdelphys sorex* Hensel (1872) by designation.

*Minuania* Cabrera 1919:30. Type species *Didelphis dimidiata* JA Wagner (1847) by description.

*Microdelphis* Pohle 1927:240. Incorrect spelling.

*Monodelphys* Reig 1959:57. Incorrect spelling.

*Monodelphis* Tállice, Lafitte de Mosera & Machado 1960:151. Incorrect spelling.

**General characteristics:** Three species of small, “shrew-like opossums”, with very short tails - 50-70% of the head and body length. Species are extremely similar and distinguished with care, all having short, stout legs, short ears, long-pointed snouts continuous with a steep forehead and a short prehensile-tipped tail. Toes are short, the fifth digit of the hind foot being particularly so and not opposable with the rest of the foot. Claws are long and some species show modifications of the forefeet for digging. Foot pads are poorly developed. Pelage is never long and lax, but varies from short and smooth to long and woolly and guard hairs are absent. Predominately terrestrial and crepuscular in habits, the life cycle is short and neither sex survives to reproduce a second season.

Diploid chromosome number 18. No fossil remains have been found that can be assigned to the Pleistocene or earlier.

**Cranial characteristics:** Palate lacks a second posterior pair of vacuities. Posterolateral foramina reduced. Poorly developed orbitae and lachrimal foramina opening outside the orbit. Alisphenoid with lateral bony rib. Paraoccipital processes well-developed.

**Dental characteristics:** First premolars not greatly reduced. Third premolar larger or much larger than second premolar on upper and lower jaws. Premolars typically increase in size from front to back. Canine fossae well-developed. Upper first incisor smaller than I2-I4. M4 with vestigial metacone. Lower third premolar larger than p2. m1-4 with short talonids. Poorly developed hypoconids and entoconids. m4 with well-developed cingulum labial to its talonid.

**Paraguayan Species:**

*Monodelphis domestica* - Grey Short-tailed Opossum

*Monodelphis kunyi* - Pygmy Short-tailed Opossum

*Monodelphis sorex* - Red-sided Short-tailed Opossum

Two further species of *Monodelphis* have been stated to occur in Paraguay in the published literature. *M.scalops* (Contreras & Silveira 1995) was shown to be an incorrectly identified specimen of *M.sorex* (de la Sancha et al 2007). *Monodelphis brevicaudis* mapped for the Paraguayan Chaco by Brown (2004) has variously been regarded to be a senior synonym of *M.domestica* or *M.brevicaudata*, but is now generally considered a synonym of *M.sorex* (de la Sancha et al 2007). Other species may occur in Paraguay but their presence is yet to be proven.

# 28

## Grey Short-tailed Opossum *Monodelphis domestica*

- Didelphys domestica* Wagner 1842:359 Type Locality "Cuayaba", Mato Grosso, Brazil.  
*Hemiurus hunteri* P.Gervais 1856:101. Name combination. Not *Didelphys hunteri* Waterhouse (1841).  
*Hemiurus concolor* P.Gervais 1856:pl.16. New name combination.  
[*Didelphys* (*Microdelphys*)] *domestica* Burmeister 1856:87. Name combination.  
*Didelphys* [(*Peramys*)] *domestica* O.Thomas 1888:358. Name combination.  
*Hemiurus domesticus* Winge 1893:55. Name combination.  
P[*eramys*]. *domesticus* O.Thomas 1897:220. Name combination.  
*Peramys domestica* Heck 1912:14 Name combination.  
[*Didelphis* (*Monodelphis*)] *concolor* Matschie 1916:271. Name combination.  
[*Didelphis* (*Monodelphis*)] *domestica* Matschie 1916:272. Name combination.  
*Monodelphis domestica* Pohle 1927:240. First use of current name.  
*Monodelphis domestica domestica* Cabrera 1958:8. Name combination.  
*Monodelphis brevicaudis brevicaudis* Wetzel & Lovett 1974:206. Not *Didelphys brevicaudis* Olfers (1818).  
*Monodelphis domesticus* Mello 1977:391 Name combination and incorrect gender.

### ***Monodelphis domestica* (Wagner 1842)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae (Myers et al 2006). Twenty-nine species are recognised in this genus, three are present in Paraguay. The scientific name *Monodelphis* is from the Greek meaning "single womb", *domestica* is Latin for "domestic" derived from the species habit of entering human dwellings. The species is monotypic. Wetzel & Lovett (1974) mistakenly regarded *Didelphys brevicaudis* as a senior synonym of this species. Synonyms adapted from Macrini (2004) and Gardner (2007).

**ENG:** Grey Short-tailed Opossum, Grey-faced Opossum (Macrini 2004), Short Bare-tailed Opossum (Macrini 2004)

**ESP:** Colicorto gris (Emmons 1999), Colicorto chaqueño (Massoia et al 2000), Catita (Massoia et al 2000).

**GUA:** Anguja mykure (Esquivel 2001), Mbicuré-í (Massoia et al 2000).



**DES:** Pelage short, dense and smooth, somewhat uniformly brownish-grey but paler and more creamy-white towards the cheeks and venter, often with a slight yellowish tinge. Some individuals may show indistinct olive-speckling to the dorsum and/or paler flanks. Pelage is fluorescent under ultra-violet light, that of study skins reddish-purple dorsally and reddish-orange ventrally. Naked nose pinkish, ears are large and greyish. Semi-prehensile tail short and thick-based, dark brown above and paler below and at the tip. It is furred at the basal 25% of its length and naked for the rest. Extremities pinkish. Females lack a pouch and usually possess 13 nipples, though in some the most anterior may be absent and they may have only 11 or 12. **CR** - Skull of adult males larger than that of females, but female skull bones grow faster because of a shorter growing period. Well-developed sagittal crest. *Basal Length:* 35.7mm; *Premaxillary-Condylar Length:* 38.7mm (26.7-44.7mm); *Greatest Width:* 19.8; *Greatest Zygomatic Width:* 20.8mm (14.3-25mm); *Mandible Length:* 28.8mm (19-34.4mm); *Length of Nasals:* 17.8mm; *Maximum Nasal Width:* 4.6mm; *Minimum Nasal Width:* 2.3mm; *Inter-temporal Constriction:* 6mm; *Palate Length:* 20.3mm; *Palate Width Inside M3:* 12.1mm; *Palate Width Outside M3:* 7.1mm; *Length of Palatal Vacuities:* 2.9mm; *Basisphenoid + Basioccipital Length:* 12.6mm. (Macrini 2004) **DF:** I5/4 C1/1 P 3/3 M 4/4 = 50. Molars are tribosphenic. Dental eruption pattern typical of Didelphinae but P3 may erupt either before, after or at the same time as M4. *Length M1-M3:* 6.6mm. **CN:** 2n=18. X chromosome smaller than autosomes.

**TRA:** Well-developed curved claws and small digital pads (Macrini 2004).

**MMT:** Easily the largest of the Paraguayan Short-tailed Opossums. **TL:** 21.23cm (17.8-27cm); **HB:** 14.32cm (12.3-20cm); **TA:** 6.91cm (4.6-10.6cm) approximately 50% of body length; **FT:** 1.77cm (1.4-2.2cm); **EA:** 1.98cm (1.4-2.8cm); Distance from Muzzle to Eye 1.73cm; **WT:** 71.4g (36-93g) As much as 100-150g in captivity where males may be considerably heavier than females. Females stop growing upon reaching sexual maturity though males continue to grow. Growth in length is finite but mass increases through life; **WN:** 0.10g. (Massoia et al 2000, Macrini 2004, Eisenberg & Redford 1999, Emmons 1999)

**SSP:** Much the largest of the Paraguayan Short-tailed Opossums and with the most uniformly brownish-grey colouration. *Monodelphis sorex* is distinctly reddish in colouration, particularly on the head, rump and sides, which immediately separates it. On average it is almost twice the size of *Monodelphis kunsi*, with longer fur and proportionately longer ears. Cranially it has a much larger skull with a pronounced sagittal crest, the latter character absent in *M. kunsi*.

**DIS:** Widely distributed through the caatinga belt of Brazil south of the Amazon, into eastern Bolivia, across northern Paraguay and into the Chaco of northern Argentina where it has been recorded in the Reserva Natural de Formosa, Provincia Formosa.

**HAB:** Typical of xeric habitats, being found in the cerrado and Paraguayan Chaco where it inhabits cerradón, cerrado scrub and chaco woodland. Also in more open, grassy habitats, including recently-burned areas.

**ALI:** Carnivorous. A voracious hunter of invertebrates and small vertebrates including rodents, lizards, frogs and snakes, able to take prey of similar body mass to its own. They may take fruit and carrion when available. The sense of smell is used to detect food, the nose often being inserted into the substrate whilst sniffing. Prey is captured with the forefeet after a rapid pounce and vertebrates are killed with a bite to the back of the neck. Prey is often manipulated in the forefeet prior to consumption. The tail is carefully-removed from scorpions before they are eaten. There is no direct evidence proving that wild individuals require access to drinking water. Domestic individuals fed on commercially-available fox-food pellets performed better than those on a meat diet (Macrini 2004).

**REP:** Captive breeding studies of specimens collected in the Brazilian caatinga make this one of the most well-known small opossums. It breeds throughout the year in the Chaco and Brazilian caatinga producing at least two litters and occasionally as many six annually. Breeding is seasonal in Bahía, Brazil, and coincides with the wet season. Initial interactions between male and female consist of genital sniffing and often followed by open-mouthed threat displays. Receptive females exhibit behaviours such as rump dragging, but even females exhibiting such behaviours respond aggressively to males and may continue to do so even whilst mating. Females do not have an oestral cycle and must be exposed

to male pheromones to enter oestrus 4 to 11 days later. In the laboratory c86% of matings occurred in the dark phase of the laboratory-controlled mating cycle. Ovulation occurs 18-20 hours after mating, stimulated by contact with the male and conception 2 hours later. The gestation is 14 to 15 days, new-borns being c1cm long, altricial and immediately attaching to a nipple. Litters in wild populations in the Brazilian caatinga contain 6 to 11 offspring, with an average of 8.4. In captivity litters of 3 to 14 have been reported with an average of 7. The juveniles are attached to the nipple for 2 weeks before being transferred to the nest or carried on the mother's back. Neonates that fall from the nipple are not retrieved by the mother, but older young which fall from her back are retrieved. Hair growth begins at 18-21 days and the eyes open at 28-35 days. Once hair has begun to grow the mother grooms her offspring using her tongue, teeth and forefeet. Wounds incurred prior to postnatal day 9 heal without scarring. Juveniles are capable of taking solid food at 4 to 5 weeks and captive juveniles can be successfully separated from the mother at 7 weeks. Typically weaning occurs at 8 weeks. The parent recognises her own young by their scent. A minimum of 7 to 8 weeks passes between litters. Sexual maturity is reached at 5 to 7 months, and captive individuals were able to reproduce at 15 months. Juvenile females do not reach puberty unless they are exposed to male pheromones. (Redford & Eisenberg 1999, Macrini 2004). Captive individuals breed happily in cages 43 x 22 x 13cm with a small nest box 18 x 13 x 10cm, a covering of wood-shavings on the floor and an ambient temperature of between 23.5 and 26.5°C. Captive populations may produce up to four annual litters. Switching males following mating acts to reduce female violence and males must be removed upon birth of the litter. Upon reaching sexual maturity the siblings must be separated. Onset of reproductive declines begins earlier in females (18-24 months) than males (24-30 months). (Macrini 2004).

**BEH:** *General Behaviour* Terrestrial and solitary in habits. Though frequently described as diurnal in habits (Redford & Eisenberg 1999, Massoia et al 2000), Macrini (2004) states that the greatest period of activity is for the first 1 to 3 hours after dusk and that activity continues periodically through the night. Nests are built by both sexes, but those built by females tend to be more solidly constructed. In Brazil nests were built in crevices in rocky outcrops made of leaves, bark, snake skins, grasses, plastic, paper and cloth. Material is collected using the mouth but manipulated between the forelegs, hindlegs and semi prehensile tail. In the nest the animal sleeps on its side, curling into a ball during colder weather. They leave the nest cautiously, sniffing the air and frequently pausing motionless when disturbed. Home range in the Brazilian caatinga was estimated at 1209m<sup>2</sup> (+/-1050) for males and 1789m<sup>2</sup> (+/-488) for females. Territories are marked by rubbing the chin, side of the head and then flanks against a substrate. Additionally males may rub the venter and drag the scrotum across the surface. In the wild scent-marking is used to mark "personal space" such as the area immediately around the nest entrance. Under laboratory conditions animals scent mark their cage shortly after introduction. Head marking is the most frequently used technique, whilst hip-marking is seen more often in females. Scent marking behaviour appears to be related to increased androgen levels and is first seen at 14 weeks. Following feeding the animal frequently grooms, sitting semi-erect and licking the soles of the forefeet before moving them in a circular motion over the head and snout. The chest and abdomen may then be licked and the incisors used as a sort of "comb". The hindfeet are used primarily for scratching with the animal leaning to one side and scratching the dorsum, back of the head, abdomen, shoulders and sides for a period of 2 to 10 seconds. After scratching the feet are licked. Periods of grooming may last 2 minutes or more. Nuzzling is a behaviour associated with odour uptake from dry surfaces. It involves the repeated rubbing and moistening of dry surfaces with the underside of the nose, followed by licking of the nose to promote oral uptake of odours. Captive individuals have a natural lifespan of 36 to 42 months, with one individual living 49 months. (Macrini 2004). *Aggressive Behaviour* This species is intolerant of conspecifics responding aggressively, growling and hissing and threatening with open mouth. Continued approach of an intruder incites the defensive animal to adopt a semi-erect posture, increasing to a near erect posture that precedes a strike with the forefeet and mouth if the threat persists. Aggressive encounters are rarely prolonged and though open-mouth threats are performed by both sexes, physical conflict occurs only between males. Males do not behave aggressively towards females, though females frequently do towards males. Juveniles may engage in play-fighting, though adults rarely or never do so. (Macrini 2004).

*Parasites* The following parasites have been reported across the species range. Coccidian *Eimeria* sp.; Trematode *Rhopalium dobbini*; Nematode *Viannaia monodelphisi*; Tapeworm *Linstonia schmidtii*; Protozoans *Trypanosoma* sp.; Acari *Amblyomma dissimile*.

**VOC:** Aggressive interactions are accompanied by growls and hisses. Males may try to appease aggressive females with clicking vocalisations. (Macrini 2004).

**HUM:** This species occasionally enters human dwellings (hence the epithet *domestica*) where it may be confused with a mouse or rat. The species may have benefitted from deforestation opening up new areas of potential habitat and enabling them to colonise secondary habitats (Emmons 1999).

**CON:** Globally considered to be of Low Risk Least Concern by the IUCN (see [www.iucnredlist.org/search/details.php/40514/all](http://www.iucnredlist.org/search/details.php/40514/all) for the latest assessment of the species). The species is apparently common in its Brazilian range and though little data is available for Paraguayan populations it is the most frequently encountered member of its genus and given the isolated nature of its preferred habitat it is not likely to be under any direct threat. Population densities in the caatinga of Brazil varied from 0 to 4/ha.

**Online Account:** [www.faunaparaguay.com/mondombh.html](http://www.faunaparaguay.com/mondombh.html).

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**Grey Short-tailed Opossum**

*Monodelphis domestica*. Adult. Departamento Amambay. Photo courtesy of Philip Myers.

**Grey Short-tailed Opossum**

*Monodelphis domestica*. Adult. Mbaracayú Biosphere Reserve, Departamento Canindeyú. Photo courtesy of Alberto Esquivel.



**Grey Short-tailed Opossum**

*Monodelphis domestica*. Adult. Mbaracayú Biosphere Reserve, Departamento Canindeyú. Photo courtesy of Alberto Esquivel.



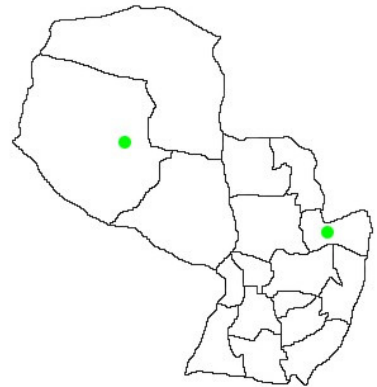
# 29

## Pygmy Short-tailed Opossum *Monodelphis kungsi*

*Monodelphis kungsi*, Pine 1975 W bank of Rio Itonamas, 4km N of Magdalena, Departamento Beni, Bolivia.

### **Monodelphis kungsi Pine 1975**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae (Myers et al 2006). Twenty-nine species are recognised in this genus, three are present in Paraguay. The scientific name *Monodelphis* is derived from the Greek meaning "single womb". The species name *kungsi* is in honour of Dr Merle L. Kuns who obtained the type specimen. The species is monotypic. However what is currently understood as "*Monodelphis kungsi*" may in fact be a cryptic species complex given the wide range and diverse habitats in which the "species" has been found, its rarity being apparently inconsistent with a habitat generalist. A similar pattern of distribution is exhibited by three similar species of *Thylamys* (*velutinus*, *macrurus* and *venustus*). There is notable variation in the specimens, but currently so few specimens are available that it is not possible to make any firm conclusions.(de



la Sancha et al 2007). Synonyms adapted from Anderson (1982) and Gardner (2007).

**ENG:** Pygmy Short-tailed Opossum

**ESP:** Colicorto pigmeo (Emmons 1999).

**GUA:** No known names.

**DES:** Small, compact and shrew-like. Pelage very short, appearing dorsally uniform warm brown with a slight reddish hue sometimes slightly stronger on the head, and especially so on the chicks and at the base of the ears. Closer inspection reveals the hairs to be greyish basally, and ochraceous medially and tipped blackish. Longer guard hairs are completely black, making up about 5% of the dorsal hairs, decreasing laterally and being absent on the venter. The ventral hairs are cream-coloured or ochraceous with variable white patches. A throat gland is present, partly hidden by fur. Pelage about 3mm long on dorsum, decreasing to 2mm on venter. Tail short, about 50% of head and body length, dark dorsally and buffy ventrally with a naked tip. Ears short and rounded. Limbs short and stout. Hind foot with a conspicuous basal web between digits 3 and 4 and a less obvious web between digits

2 and 3. Five large palmar pads and six plantar pads. Hindfeet also with a number of small blackish pads. Small pads on the forefeet are unpigmented. There are mystacial, genal, supraorbital and interramal facial vibrissae. Scrotum black. **CR** - Skull lacks a sagittal crest. Rostrum short and no postorbital thickening or processes. **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. Lacks enlarged canines. (Anderson 1982). **CN** - 2n=18, FN=30. X-chromosome submetacentric, Y-chromosome acrocentric. (Carvalho et al 2002).

**TRA**: Hind foot with a conspicuous basal web between digits 3 and 4 and a less obvious web between digits 2 and 3 Five large palmar pads and six plantar pads. (Anderson 1982).

**MMT**: Much the smallest of the Paraguayan Short-tailed Opossums. **TL**: 11.87cm (10.3-14.7cm); **TA**: 4.04cm (3.6-4.5cm); **FT**: 1.17cm (1.1-1.4cm); **EA**: 1.11cm (1-1.4cm); **WT**: 11.9g (7.5-30g) One specimen in the Colección Boliviana de Fauna, La Paz weighed 30g, the maximum weight record for any of the other known specimens was just 16g. Leaving this large specimen out of the calculations gives a mean for the sample of 10.56g (de la Sancha et al 2007)

**SSP**: Much the smallest of the Paraguayan Short-tailed Opossums, distinctly shrew-like with a bicoloured pelage of warm brownish dorsum and contrasting creamy-white ventrum. *Monodelphis sorex* is much larger and distinctly reddish in colouration, particularly on the head, rump and sides. On average this species is almost half the size of *Monodelphis domestica*, with shorter fur and proportionately shorter ears - that species also being distinctly greyish in colouration. Cranially it has a much smaller skull than other species, lacking enlarged canines and characteristically without a sagittal crest, the latter character present in all other Paraguayan *Monodelphis*.

**DIS**: This is a poorly known but apparently has a wide distribution in Bolivia, northern Argentina, Brazil and Paraguay. Until recently it was known only from a handful of specimens. The type locality in Bolivia is on the west bank of the Rio Itonamas, 4km N of Magdalena, Provincia Itenez, Departamento Beni at a height of 200m, not far from the Brazilian border. The second specimen was captured close to the Argentinian border in southern Bolivia at the Rio Lipo in Departamento Tarija at 1500m. The species has since been found to be quite wide-ranging through southern, eastern and western Bolivia (Vargas et al 2003). It is known from a single specimen in Argentina, collected in the northern part of Provincia Salta in Departamento General José de San Martín in May 2005 (Jayat & Miotti 2005). In Brazil there are records from the States of Goiás, Minas Gerais and Capital Federal. Three specimens are known from Paraguay, two from Aguara Ñu in the Mbaracayú Forest Reserve in Departamento Canindeyú and one from Cruce los Pioneros, Departamento Presidente Hayes in the Central Chaco, and it may be expected to occur in the intermediate area. (de la Sancha et al 2007).

**HAB**: Despite the small number of known specimens it has been recorded in five different biomes. Brazilian specimens were taken in cerrado. In Bolivia it has been collected in cerrado-like savanna in Beni, lowland tropical evergreen forest (Bolivian Amazonian forest) in the west of the country and dry forest at medium altitude in the south of the country. In Argentina the species is known from Yungas in the Andean Foothills (Jayat & Miotti 2005). In Paraguay at Aguara Ñu the two specimens were trapped in cerrado dotted with dwarf palms, tall grass, scattered bushes and termite mounds. Despite extensive trapping in the Atlantic Forest in this area the species had never previously been recorded there. The habitat at Cruce los Pioneros is low chaco woodland, though the area is extensively anthropomorphic. Occurrence in a woodland type habitat in the Chaco would seem at odds with its apparent avoidance of forested areas in eastern Paraguay. The species has been captured in both pristine and disturbed habitats.

**ALI**: Dentition suggests this species is likely insectivorous like other members of the genus, but no specific information is available for this rarely-recorded species. It would seem to fill a similar niche to the Old World shrews of the family Soricidae. (Anderson 1982). The specimen captured in Argentina was caught in a Sherman trap baited with oats (Jayat & Miotti 2005).

**REP**: No information. A subadult female captured in Bolivia on 1 August was without embryos and was not lactating (Vargas et al 2003).

**BEH**: *General Behaviour* Specimens caught in Argentina and Paraguay were all captured in Sherman live traps located on the ground (Jayat & Miotti 2005, de la Sancha 2007) and some in Bolivia in pitfall traps (Vargas et al 2003) suggesting that they are terrestrial in behaviour.

**VOC**: No information.

**HUM:** No information. The species is unlikely to have any impact on human populations and its rarity means that it likely exists in many areas without being noticed.

**CON:** Globally considered to be Least Concern by the IUCN, having previously been considered Endangered (1996-2007) due to the very few known specimens at the time (see [www.iucnredlist.org/search/details.php/13696/all](http://www.iucnredlist.org/search/details.php/13696/all) for the latest conservation assessment of the species). The species is now known to be more widespread than previously thought, with catholic habitat tastes and apparently occurring in a number of protected areas. The species occurs in both pristine and disturbed habitats and has likely been overlooked over much of its range. Currently known from three, widely-separated specimens in Paraguay its range likely includes much of the area in between and is possibly fairly extensive, though the species occurs at naturally low densities throughout its wide geographic range. It is probably best considered Data Deficient at national level.

**Online Account:** [www.faunaparaguay.com/monkunhb.html](http://www.faunaparaguay.com/monkunhb.html).

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30  
Red-sided  
Short-tailed Opossum  
*Monodelphis sorex*

- Didelphis tricolor* Lund 1840:19 not *Didelphis tricolor* E. Geoffroy St-Hilaire 1803.  
*Didelphys* [*Microdelphys*] *sorex* Hensel 1872:122 Type locality "Rio Grande do Sul" restricted to "Taquara" by Cabrera (1958).  
*Didelphys* (*Peramys*) *henseli* O.Thomas 1888:159 Type locality "Taquara, Rio Grande do Sul".  
*Peramys sorex* O.Thomas 1888:380 Name combination.  
[*Didelphis* (*Monodelphis* )] *henseli* Matschie 1916:271 Name combination.  
[*Didelphis* (*Monodelphis* )] *lundii* Matschie 1916:271 Type locality "Lagoa Santa, Minas Gerais" based on *D.tricolor* Lund 1840.  
[*Didelphis* (*Monodelphis* )] *sorex* Matschie 1916:272 Name combination.  
*Peramys henselii* Cabrera 1919:42 Name combination.  
*P[eramys] (Peramys)* *sorex* A. Miranda-Ribeiro 1936:404 Name combination.  
*Peramys henselii* A. Miranda-Ribeiro 1936:409 Incorrect spelling.  
*P[eramys]. d.[imidiata]itatiayae* A. Miranda-Ribeiro 1936:421 Type locality "Campo Bello, Rio de Janeiro".  
*Monodelphis henseli* Cabrera & Yepes 1940:32 Name combination.  
*Monodelphis henseli* Cabrera & Yepes 1940:32 First use of current name combination.  
*Monodelphis tricolor paulensis* COC Vieira 1950:359 Type locality "Pirituba, subúrbio da cidade de Sao Paulo".  
*Monodelphis touan paulensis* Cabrera 1958:9 Name combination.  
*Monodelphis henseley* Tállice, Laffite de Mosera & Machado 1960:151 Incorrect spelling.  
*Monodelphis touan* Olrog & Lucero 1981:68 Not *Mustela touan* Bechstein 1800.  
*Monodelphis henseli* Ávila-Pires 1994:369 Name combination.  
*Microdelphis sorex* Ávila-Pires 1994:369 Name combination.  
*Monodelphis brevicaudatus* Chebez & Massoia 1996: 199 Not *Didelphis brevicaudatus* Erxleben 1777.

***Monodelphis sorex* (Hensel 1872)**

**TAX:** Class Mammalia; Subclass Theria; Infraclass Metatheria; Order Didelphimorphia; Family Didelphidae; Subfamily Didelphinae (Myers et al 2006). Eighteen species are recognised in this genus, three are present in Paraguay. The scientific name *Monodelphis* is from the Greek meaning "single womb", *sorex* is Latin meaning shrew. The species is monotypic. This species suffers from a complicated taxonomic history. The species was originally described on the basis of immature specimens and as a result many immature specimens referred to in the literature are reliably identified. However adult female and half-grown males have in the past frequently referred to as Hensel's Short-tailed Opossum *Monodelphis henseli* (Thomas 1888) and this name has continued to appear in recent works on South American mammals (eg. Redford & Eisenberg 1992, Hershkovitz 1992) perpetuating the confusion. Furthermore adult males have frequently been confused with *M.dimidiata* (Wagner 1847), and



also attributed to two defunct taxa *M.tricolor* (Lund 1840) and *M.touan* (Shaw 1800), both of which are synonyms of the Guianan Short-tailed Opossum *M.brevicaudata* (Erxleben 1777) a species confined to northern Amazonian South America. As the only "red-sided" *Monodelphis* known from Paraguay this species is likely the "Micouré cinquième, ou micouré à queue courte" of de Azara (1801). If this is the case then the oldest name attributable to the species is *Monodelphis brevicaudis*, Olfers 1818 and *M.wagneri* Matschie, 1916 is a synonym. Hershkovitz (1959) recognised *M.brevicaudis* as a valid species but assigned no specimens to the taxon and this was followed by Brown (2004) who went so far as to map the species for the Paraguayan Chaco (where *M.sorex* does not occur), though in her text she notes that the species is based on de Azara's description and two lost specimens lacking locality data and that the name may require "reassignment". De la Sancha et al (2007) state that *Monodelphis brevicaudis* has variously been regarded to be a senior synonym of *M.domestica* or *M.brevicaudata*, but is now generally considered a synonym of *M.sorex*. The Tawny-headed Short-tailed Opossum *Monodelphis scalops* was reported erroneously for Paraguay by Contreras & Silveira Avalos (1995), though their written description clearly refers to *M.sorex*, a fact confirmed upon examination of the specimen by de la Sancha et al (2007). Synonyms adapted from Gardner (2007).

**ENG:** Red-sided Short-tailed Opossum, Southern Red-sided Opossum (Gardner 2007), Hensel's Short-tailed Opossum (Redford & Eisenberg 1992), Shrewish Short-tailed Opossum (Canevari & Vaccaro 2007).

**ESP:** Colicorto rojizo (Canevari & Vaccaro 2007, Massoia et al 2000), Colicorto selvático (Canevari & Vaccaro 2007, Massoia et al 2000), Colicorto musaraña (Canevari & Vaccaro 2007, Emmons 1999), Musaraña (Massoia et al 2000).

**GUA:** Guaiquiaca-aña (Canevari & Vaccaro 2007), Anguja (Massoia et al 2000), Mbicuré-í (Massoia et al 2000, Canevari & Vaccaro 2007).

**DES:** A small to medium-sized *Monodelphis* with short, rounded ears and tail approximately 50% of head and body length. Pelage short and smooth, lying flat against the body. Forehead, crown and dorsum dark brown, somewhat greyer on the head and deep reddish-chestnut on the rump. Sides of head to just above the eye orange-rufous. Flanks and sides reddish, sometimes with slight greyish tinge but always clearly demarcated from the dorsal colouration. Venter creamy-yellow to pale reddish. Feet reddish. Tail dark brown above and pale reddish below. Great sexual dimorphism in size with males up to 50% larger than females. Females lack a pouch and possess more mammae than any other mammal - 25-27, arranged with five central nipples and the remainder arranged in lateral lines. **CR** - The following cranial measurements are those provided by Contreras & Silveira Avalos (1995) for their male Paraguayan specimen: *Greatest Length*: 35.4mm; *Minimum Postorbital Constriction*: 5.6mm; *Width of Brain Case*: 13.9; *Greatest Zygomatic Width*: 20.5mm; *Mandible Length*: 27mm; *Length of Nasals*: 15.5mm;



*Palate Length*: 17.4mm; **DF**: I5/4 C1/1 P 3/3 M 4/4 = 50. The following dental measurements are those provided by Contreras & Silveira Avalos (1995) for their male Paraguayan specimen: *Length of Upper Tooth Row* 16.9mm; *Length of Upper Molar Row* 9.9mm; *Length of Lower Tooth Row* 14.1mm; *Distance across M3* 10.1mm; *Distance M1-M4 on Upper Tooth Row* 5.7mm; *Distance M1-M4 on Lower Tooth Row* 7.2mm; **CN**: 2n=18.

**TRA**: No information.

**MMT**: A medium-sized Short-tailed Opossum. There is marked sexual dimorphism in size, with males up to twice the size and weight of females. **TL**: 14.48cm (11.9-21.5cm); **HB**: 9.38cm (7.8-13cm); **TA**: 5.1cm (3.6-8.5cm) approximately 50% of body length; **FT**: 1.52cm (1.5-1.55cm); **EA**: 0.88cm (0.53-1.1cm); **WT**: 48g; (Massoia et al 2000, Redford & Eisenberg 1992, Emmons 1999). Contreras & Silveira Avalos (1995) gave the following measurements for a single male specimen wrongly identified by them as *M. scalops*: **TL**: 21cm; **HB**: 14.5cm; **TA**: 6.5cm; **FT**: 1.7cm not including claw, 1.9cm including claw; **EA**: 1.5cm; **WT**: 68g.

**SSP**: Intermediate in size amongst the three *Monodelphis* species currently documented for Paraguay, this is the only species that occurs in the Atlantic Forest. This species can be instantly separated from the other two species on account of its distinctive pelage colouration with reddish flanks contrasting with a grey-brown dorsal surface. Other Paraguayan species are uniformly coloured. Two additional species of possible occurrence in Paraguay are confusable with this species. The Tawny-headed Short-tailed Opossum *Monodelphis scalops* is clearly distinguishable by its uniformly tawny head, which lacks the brownish-grey crown and forehead of this species, and has grey rather than reddish flanks. The species has been recorded in Brazil and Misiones Province, Argentina and is likely present in the Atlantic Forest of Paraguay, though no confirmed records exist. The Yellow-sided Short-tailed Opossum *Monodelphis dimidiata* is of similar general patternation and size to this species. However the dorsal area is distinctly grey, not grey-brown as in this species and the flanks and side of the face are pale tawny-yellow, not reddish-brown. *M. dimidiata* has long, lax fur (except in old males), compared to the short, smooth fur of this species, and the feet are whitish or buffy as opposed to reddish in *M. sorex*. Furthermore *M. dimidiata* occurs in open, grassy habitats, not humid forests. The species is widespread in Argentina in the River Plate Basin, north to Provincia Salta and east through coastal Uruguay to Rio Grande do Sul, Brazil. It is apparently also present in Provincia Misiones, Argentina and its occurrence in Paraguay is considered possible, though it would represent a northern range extension.

**DIS**: An Atlantic Forest endemic species occurring in southern Brazil, south-eastern Paraguay and Misiones Province in Argentina. In Brazil the records are clustered in Minas Gerais, Sao Paulo and Rio Grande do Sul, though the species likely occurs more or less continuously between those points where suitable habitat occurs. In Paraguay there are specimen records from PN San Rafael, Departamento Itapúa and 12km W of Ciudad del Este area, Departamento Alto Paraná.

**HAB**: Occurs in humid Atlantic forest in eastern Paraguay where it is the only *Monodelphis* so far reported.

**ALI**: Considered to be insectivorous by Canevari & Vaccaro (2007) and "principally carnivorous" by Massoia et al (2000). Casella & Cáceres (2006) published the first specifics on the diet of this species after studying stomach contents of animals (n=26) captured in western Paraná State, Brazil. They considered the species to be an opportunistic generalist feeder with a principally insectivorous diet supplemented with meat and fruit. Arthropods were the principal item in the diet with Coleoptera the single most prevalent group found in 92% of stomachs. Other animal items found in stomachs in order of prevalence were: Hymenoptera 80%, Blattaria 31%, Mammalia 31%, Orthoptera 30%, Decapoda 15%, Opiliones 15%, Acari 8%, other Crustacea 8%, Myriapoda 4%, Aves 4% and insect larvae 4%. Seeds were found in 8% of stomachs (*Cecropia* sp. and *Rubus* sp.) and unidentified plant material in 30% of stomachs. Of the 57 seeds found, 54 were intact and only 3 had been predated, suggesting that it was the fruit that had been consumed and indicating that the species may play a role in seed dispersal.

**REP**: No published information. The species has the largest number of mammae of any mammal (25-27) and in view of this Gardner (2007) suggested that the species may prove to be semelparous - a



possibility supported by the high number of young individuals when compared to adults in specimen collections.

**BEH:** *General Behaviour* The species is terrestrial and crepuscular (IUCN 2008). No published information. *Enemies* Ávila-Pires & Gouvêa (1977) mentioned a specimen of *M.dimidiata* taken from the oesophagus of a *leucurus Elanus Kite tailed-Whitebut* Gardner (2007) considers it more likely that it was this species - however White-tailed Kite is an open-country species that does not occur in Atlantic Forest and *M.dimidiata* is typical of grassland habitats (P.Smith pers.obs.). *Parasites* Notman (1923) described an ectoparasitic Staphylinid beetle *Omaloxenus bequarti* found on a *Monodelphis* collected at "Alto Itatiaya, Setto (sic) do Itatiaya, Brazil" which may have been this species. Fain (1979) reported *M.dimidiata* as the host of a Listrophid mite *Didelphoecius paranensis*, but Gardner (2007) believes that the correct identification of the host may actually be *M.sorex*.

**VOC:** No information.

**HUM:** This rare forest species has little impact on humans within its range.

**CON:** Globally considered to be Low Risk, Least Concern by the IUCN, (see [www.iucnredlist.org/details/13701](http://www.iucnredlist.org/details/13701) for the latest assessment of the species) on account of a supposedly wide distribution and its occurrence in a number of protected areas. The species has recently been downgraded from its previous designation as vulnerable. The species is not listed by CITES. This species is considered endemic to the Atlantic Forest, one of the world's most seriously threatened habitat types and is probably worthy of greater conservation concern. Canevari & Vaccaro (2007) consider the species to be vulnerable in Argentina and insufficiently known in Brazil. Population size in Paraguay is little known but, as in other areas of the range, areas of available suitable habitat have declined alarmingly over recent decades. Though surveys have been insufficient to determine population sizes, there is little doubt that the population is in decline as a result of habitat destruction. The species is present in PN San Rafael, but currently the reserve faces serious conservation issues, suffers from inadequate protection and has a questionable legal status. It is presumably present in some of the Itaipú Reserves in Departamento Alto Paraná but deforestation in this area has been massive and huge areas of prime forest were lost as a result of the Itaipú dam project. There is no doubt that the species is threatened in Paraguay, as with other species restricted to the Atlantic Forest. It is apparently absent from the Mbaracayú Forest Reserve, Departamento Canindeyú, arguably Paraguay's best protected Atlantic Forest reserve (Esquivel 2001).

**Online Account:** [www.faunaparaguay.com/monsorhb.html](http://www.faunaparaguay.com/monsorhb.html).

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# FAUNA PARAGUAY HANDBOOK OF THE MAMMALS OF PARAGUAY

## VOL 1: MARSUPIALIA

The **FAUNA Paraguay Online Handbook of Paraguayan Fauna** aims to collate together in one place all that is currently known about the animals inhabiting this richly biodiverse country located at the heart of the South American continent. With the data presented in a readable manner and fully-referenced throughout the text, these handbooks aim to be of use to the professional whilst simultaneously appealing to the interested amateur. The complete online handbook will provide detailed coverage of all the vertebrate species inhabiting this little known country and will be constantly updated as and when new data is published, ensuring that the information presented is the most up-to-date that is currently available. The aim of the handbooks is to help generate an interest in the biodiversity of Paraguay, a country all too frequently ignored by researchers and eco-travellers, to stimulate an interest in the conservation issues affecting the country, and to highlight the gaps in our knowledge as an aid to future research.

Volume 1 of the **FAUNA Paraguay Online Handbook of Paraguayan Fauna** deals with the Marsupials, a charismatic group of small to médium-sized mammals represented by 15 species in Paraguay.