



# THE OPOSSUMS

## FAMILY DIDELPHIDAE

### A BASIC INTRODUCTION TO PARAGUAYAN "MARSUPIALS"

Though the words Metatherian or Didelphimorph leave non-specialists with blank looks on their faces, the traditional (though less technical) term "marsupial" is much more widely understood. To clarify, Didelphimorphia is one of three orders of American metatherians (grouped together as the Magnorder Ameridelphia), with metatherian being essentially a synonym of the word marsupial.

To the uninitiated marsupial conjures 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 in 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-alike" *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 17 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 kunsi* the smallest member of the family and so tiny that its presence in Paraguay was overlooked until very recently! Adaptable omnivores, opossums have evolved to fill every niche imaginable and are present in all the major ecosystems in modern day Paraguay. The predatory Thick-tailed Opossum *Lutreolina crassicaudata* favours grassy areas; the piscivorous Water Opossum *Chironectes minimus* is a creature of forest streams; the insectivorous Brown Four-eyed Opossum *Metachirus nudicaudatus* inhabits the forest floor; whilst the frugivorous 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* etc); and 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 Didelphimorphia 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.

### EVOLUTION OF SOUTH AMERICAN "MARSUPIALS"

(adapted from Tyndale-Briscoe 2005): South America's isolation from North America at the end of the Cretaceous 65 million years ago left the continent's mammals to evolve independently for the next 35 million years. With placental mammals assuming the herbivorous role, the marsupials filled the ecological niche of small insectivore and shared the niche of large carnivore with birds. An almost complete fossil history allows us to trace the lineages of the present day marsupials through the whole span of the Tertiary.

In one extraordinarily rich fossil site at Tiupampa, Bolivia considered to be very early Tertiary, 11 species of marsupials and seven species of placental are known from teeth, skulls and even whole skeletons, demonstrating that the lineages that would predominate for the next 65 million years were already established in early history. In the Palaeocene and Eocene epochs, which encompass the first 25

million years of the Tertiary, 24 genera of marsupials representing six distinct families are known. The one herbivorous group, the polydolopodids, did not survive past the Eocene but the carnivorous species persisted.

Total South American isolation occurred in the Oligocene (30 million years ago) when the continent was invaded by the earliest rodents and primates. They may have displaced some of the smaller arboreal marsupials or even prevented marsupials from evolving into the small to medium herbivore niches that they came to dominate thereafter. At round this time in Australia, a country with a dominant marsupial fauna, a great expansion of marsupials into arboreal and browsing niches took place.

In the Miocene (23-25 million years ago) the caenolestids (which survive today) and the large carnivorous borhyaenids, became abundant. The borhyaenids flourished until the Pleistocene epoch (3 million years ago). Borhyaenids were the large mammalian carnivores of the continent for more than 20 million years. Their short limbs made them stocky creatures like badgers, not lithe pursuit hunters like wolves. A bizarre case of convergent evolution was the sabre-tooth borhyaenids that flourished in the Pliocene (5 million years ago), at the same time as placental sabre-tooth tigers, *Barbourofelis* and *Smilodon*, were living in North America. *Thylacosmilus atrox* was a large carnivore with a pair of huge upper canines with very thin enamel and open roots, so that they could grow continuously through life. Its teeth and skull were similar to those of the northern sabre-tooth tigers but its short, strong forelimbs were suggestive of an ambush hunter that stabbed its prey to death, helped by its enormous (67°) gape. Both the variety of prey species and the marsupials that hunted them disappeared just before or soon after the continent became joined to North America about 3 million years ago.

In the Pliocene epoch North and South America rejoined for the first time in more than 60 million years. Once the land connection was established a flood of species moved south and a lesser number of species moved north: a phenomenon known as the great American faunal interchange. It is not clear to what extent the invasion affected the indigenous marsupials but all the large carnivorous marsupials became extinct at or before this time. The shrews and moles (Order Insectivora) were one of the few groups that failed to penetrate the southern continent, perhaps because the small insectivore niche was already fully occupied by small to medium marsupials. Small placental carnivores, ancestors of the Procyonidae, deeply penetrated into South America however, and possibly contributed to the decline and extinction of the borhyaenids. Around the same time, the didelphids, began to flourish and present day genera began to appear. Smaller species, such as *Monodelphis* first appeared in the Miocene, *Lutreolina*, *Thylamys* and *Philander* somewhat later in the Pliocene and other species, including *Didelphis* appear in the Pleistocene, just 2 million years ago. A parallel evolution occurred in Australia, where the early carnivores were large thylacinids that were replaced in the last five million years by the smaller dasyurids.

Another family of marsupials appeared in the Pliocene: *Argyrolagus* were small, hopping forms, with very short forelegs and elongated hind. They were similar to modern day hopping mice but became extinct in the Pleistocene about 2 million years ago.

The fossil history suggests that the present day marsupial families are not closely related, this being corroborated by recent molecular evidence. On these criteria the Microbiotheriidae, represented today by *Dromiciops*, and the Didelphidae separated more than 60 million years ago, during the Palaeocene. Likewise, the differences between the Caenolestidae and Didelphidae put their separation at about 50 million years ago.

For more information on early evolution of Marsupials in South America see Goin (2003).

## **MAGNORDER AMERIDELPHIA - NEW WORLD METATHERIANS**

### **ORDER DIDELPHIMORPHIA - DIDELPHIDS**

#### **FAMILY DIDELPHIDAE - OPOSSUMS**

**General characteristics:** Seventeen species in one family. 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. 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. Each foot possesses five digits, the forefeet small, the hind feet slightly longer with a large opposable thumb lacking a nail.

**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, periotic and ectotympanic. A fenestrated bony palate is diagnostic of the family.

**Dental characteristics:** Dental formula I5/4 C1/1 P3/3 M4/4 = 50. The dentition is heterodont with as many as 50 teeth typical, all teeth behind the canines being pointed. 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. Ageing of specimens is most effective when dental classes are based on the unvarying linear sequence of upper molar eruption, as individual variation in eruption sequence of other teeth is not uncommon, even among members of the same litter (Van Nievelt & Smith 2006).

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

**Genetic characteristics:**  $2n=22$  in *Didelphis*, *Lutreolina*, *Chironectes* and *Philander*;  $2n=18$  in *Monodelphis*;  $2n=14$  in *Cryptonanus*, *Gracilinanus*, *Metachirus*, *Marmosa* and *Thylamys*.

**Ecology:** Though rarely observed, Didelphids are often amongst the most numerous of South American mammals in any given community. 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.

Didelphids are typically omnivorous, eating a mixture of plant and animal matter, though the relative proportions of each in the diet varies considerably between species. Vieira & Astúa de Morães (2003) classified the Ameridelphia into 5 diet classes, with class 1 representing the most frugivorous and class 5 representing the most carnivorous with the following results: Class 1 *Caluromys*; 2 *Marmosa*, *Gracilinanus*, *Cryptonanus*; 3 *Didelphis*; 4 *Philander*, *Metachirus*, *Monodelphis*, *Thylamys*; 5 *Lutreolina*, *Chironectes*. Several species with apparently similar ecology are able to co-exist in forested habitats by varying the proportions of foodstuffs in their diet and by occupying different levels of the forest canopy; some species being exclusively terrestrial, other exclusively arboreal and others occupying different microhabitats between the two. The role of some Didelphids in seed dispersal of forest plants has recently become apparent. See Cáceres (2006) for an excellent review of processes involved.

**Reproductive Biology:** The reproductive behaviour of this group 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. Nogueira (2003) and Nogueira & Castro (2003) describe the male genital morphology of opossums and Montero Filho & Cáceres (2003) provide a rundown of female reproductive biology.

**Physiology:** See Quadros (2003) for a microscopic analysis of guard hairs of Brazilian Didelphimorphia and its utility for species identification. José (2003) gives a description of paracloacal glands. Hokoç et al (2006) review the characteristics and vision of Brazilian species.

Didelphids are well known for their role in the transmission of the life cycle of the pathogenic protozoa *Trypanosoma cruzi* ZI, causal agent of Chaga's disease. Gaunt & Miles (2000) proposed that *Trypanosoma cruzi* ZI evolved in an arboreal, palm tree habitat with the triatomine tribe Rhodniini (Reduviidae), in association with the opossums of the genus *Didelphis*. Schofield (2000) however noted that there was growing evidence that the triatomine vectors evolved less than 5 million years ago, much more recently than the protozoa (65 million years ago approximately) and attempted to reconcile the apparent paradox by suggesting that Didelphids may have been original vectors of the parasite as well as original reservoir hosts.

**Taxonomy:** Metatherians (more commonly known as marsupials) were until recently classified in the single order Marsupialia, which included both Australasian and Neotropical species. More recently molecular work has revealed that in fact the group is made up of seven separate orders, three of which are Neotropical (Didelphimorphia, Paucituberculata and Microbiotheria) and one of which occurs in Paraguay.

Higher level taxonomy of Neotropical Didelphimorphia is much disputed. According to Reig, Kirsch & Marshall (1985) the single family Didelphidae could be separated into two subfamilies - Caluromyinae and Didelphinae. The former represented in Paraguay only by a single species in the genus *Caluromys*, the latter split into three tribes Metachirini (containing only *Metachirus*), Monodelphini (containing the genera *Monodelphis*, *Cryptonanus*, *Gracilinanus*, *Marmosa* and *Thylamys*) and Didelphini (containing the genera *Chironectes*, *Didelphis*, *Lutreolina* and *Philander*). This classification was followed by Gardner (2007). Hershkovitz (1992) raised Caluromyidae (including *Caluromys*) and Marmosidae (including *Monodelphis*, *Cryptonanus*, *Gracilinanus*, *Metachirus*, *Marmosa* and *Thylamys*) to family level, though this arrangement failed to gain much support and worked on the assumption that all small "mouse opossums" were closely related. More recently DNA-DNA hybridisation studies have recognised Caluromyidae as a separate family and split Didelphidae into three subfamilies: Didelphinae (containing the genera *Chironectes*, *Didelphis*, *Lutreolina*, *Metachirus* and *Philander*), Marmosinae ("pouchless mouse opossums" containing the genera *Marmosa* and *Monodelphis*) and Thylamyinae ("pouched mouse opossums" containing the genera *Cryptonanus*, *Gracilinanus* and *Thylamys*) (Kirsch & Palma 1995).

The arrangement here follows the results of molecular work by Voss & Jansa (2009), Jansa et al (2006) and Jansa & Voss (2000).

## **MAGNORDER AMERIDELPHIA - NEW WORLD METATHERIANS**

### **ORDER DIDELPHIMORPHIA - DIDELPHIDS**

#### **FAMILY DIDELPHIDAE - OPOSSUMS**

##### SUBFAMILY CALUROMYINAE - WOOLLY OPOSSUMS 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 stylar cusps.

**Taxonomy:** Five species in three genera in South America. A single species in the genus *Caluromys* occurs in Paraguay. This subfamily is sometimes raised to family level.

##### **Genus *Caluromys*** JA Allen, 1900: Woolly Opossums

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

##### **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.

*Sarigna* 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.

**Cranial characteristics:** (Fig 1) 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

SUBFAMILY DIDELPHINAE Gray, 1821 - TRUE OPOSSUMS

**Tribe Didelphini Gray, 1821**

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

**Genus Didelphis** Linnaeus, 1758: *True Opossums*

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.

**Dental characteristics:** Dental wear can be used for aging in this genus, see species accounts and (Fig 2).

**Evolution:** Formerly considered to be the most primitive of Didelphid lineages, Patton & Costa (2003) demonstrated that the genus is in fact young and speciated relatively recently.

**Paraguayan Species:**

*Didelphis albiventris* - White-eared Opossum

*Didelphis aurita* - Southern Black-eared Opossum

**Genus Chironectes** Illiger, 1811: Water Opossum

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

**Synonyms:**

*Latra* 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 & Hageman 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:** A monotypic genus, see the species account.

**Paraguayan Species:**

*Chironectes minimus* - Water Opossum

**Genus *Lutreolina*** O. Thomas, 1910: Thick-tailed Opossum

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:** A monotypic genus, see the species account.

**Paraguayan Species:**

*Lutreolina crassicaudata* - Thick-tailed Opossum

**Genus *Philander*** Brisson, 1762: Grey Four-eyed Opossums

Six species, one 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. 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.

**Taxonomy:** Species limits in this genus are far from defined and though several geographically isolated species formerly included within the widespread *Philander opossum* have been recognised in recent years, the specific identity of Paraguayan specimens remains unclear. Patton & Costa (2003) noted a major phylogeographic gap between typical *P. frenatus* of coastal Brazil and the *Philander* present in "eastern Paraguay", the latter being more closely aligned phylogenetically to southern Amazonian populations of *P. opossum canus*, itself a taxon of disputed specific identity.

**Paraguayan Species:**

*Philander frenatus* - Southeastern Four-eyed Opossum

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

**General characteristics:** Single large opossum with total length >500mm. Pouch absent.

**Genus *Metachirus*** Burmeister, 1854: Brown Four-eyed Opossum

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:** 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.

**Cranial characteristics:** A monotypic genus, see the species account.

**Dental characteristics:** A monotypic genus, see the species account.

**Taxonomy:** Patton & Costa (2003) found considerable molecular divergence in specimens from across the wide range of this currently monotypic genus, consistent with the existence of more than one species. Work remains to be done to define these species limits.

**Paraguayan Species:**

*Metachirus nudicaudatus* - Brown Four-eyed Opossum

SUBFAMILY THYLAMYINAE Hershkovitz, 1992

**General characteristics:** Five species in three genera and two tribes. Pouch present and large number of teats.

### **Tribe Marmosopsini**

**Genus *Gracilinanus*** Gardner & Creighton, 1989: Mouse Opossums  
Six species, two 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 *Didelphys 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.

**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, maxillopalatine 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 Gracile Opossum

*Gracilinanus microtarsus* - Reddish Gracile Opossum

**Genus *Cryptonanus*** Voss, Lund & Jansa 2005: Cryptic Mouse Opossums

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

*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.

**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* - Chaco Mouse Opossum

**Tribe Thylamyini Hershkovitz, 1992**

**Genus Thylamys** Gray, 1843: Fat-tailed Opossums

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* Liáis 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).

*Thulamys* 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 number 15 to 19 (7-1-7 or rarely 9-1-9). Feet are small and white with short digits and well-developed unguis reaching the claw tips. Claws on the

forefoot digits II-IV extend well beyond the digital pads. Central soles of the feet are covered with small granular tubercles. Thenar and hypothenar pads are not fused with interdigitals. 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. Distribution of vibrissae (per side of body): 2 superciliary, 5 to 8 genal, 3 submental, 2 interramal, 1 antebrachial, 1 anconeal, and 3 to 4 carpal. Fossil species of this genus are known from the late Pleistocene.

**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 only slightly expanded 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. Molars wide and compressed lengthways. Paracone of M2 slightly displaced towards lingual border. Lower canines with well-developed cusp.

**Taxonomy:** The historical taxonomy of this genus is summarised by Solari (2003).

**Paraguayan Species:**

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

*Thylamys pusillus* - Chaco Fat-tailed Opossum

SUBFAMILY MARMOSINAE Reig, Kirsch & Marshall, 1985

**General characteristics:** Five species in two genera and two tribes. Pouch absent and large number of teats.

**Tribe Marmosini Reig, Kirsch & Marshall, 1985**

**Marmosa** Gray, 1842: Mouse Opossums

Fifteen species, two in Paraguay both in the subgenus *Micoureus*.

Subgenus **Micoureus** Lesson, 1842: Woolly Mouse Opossums

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

**Synonyms:**

**Marmosa** Gray 1821: 308. Type species *Didelphis murina*.

*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:** Medium-sized Didelphids with tail >1.3x head and body length. Dorsal pelage is long, thick and woolly, ventral pelage is smoother and softer. Mammary 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.

**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:**

*Marmosa paraguayana* - Long-furred Woolly Mouse Opossum

*Marmosa contantiae* - White-bellied Woolly Mouse Opossum

**Tribe Monodelphini Hershkovitz, 1992**

**Genus Monodelphis** Burnett, 1830: Short-tailed Opossums

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 brevicaudata* 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 brevicaudata* Erxleben (1777).

*Grymaeomys* Burmeister 1854:138. In part.

*Hemiurus* 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. 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 kunsii* - 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.

**Online Resources**

**Website of Professor Nilton Cáceres** - Has published widely on Brazilian Didelphidae with pdfs to download. <http://jararaca.ufsm.br/websites/niltoncaceres/7c040a4556412562fc09ee82ebb6a592.htm>

**Website of Professor Rui Cerqueira** - Has published widely on Brazilian Didelphidae with pdfs to download. <http://www.biologia.ufrj.br/labs/labvert/ruir.htm>

**HYPOTHETICAL SPECIES**

The following three species may be considered of possible or probable occurrence in Paraguay but documentation of their presence is currently lacking. All species are included in the key (p000) to enable their accurate identification in the field and are covered in abbreviated form here.

**GREY FOUR-EYED OPOSSUM *Philander opossum***

All Paraguayan *Philander* were initially attributed to this species, but following the recognition of *Philander frenatus* as a distinct species, the Paraguayan and Misiones, Argentina populations were redesignated. However a thorough review of Paraguayan specimens has never been performed (PhD student Noé de la Sancha is currently in the process of doing so) and the specific identity of Paraguayan *Philander* remains unclear.

The specific identity of *Philander* specimens from the Chaco and Paraguayan Pantanal as *frenatus* is questionable given the preferred Atlantic Forest habitat of that species. These populations may be referable to *Philander opossum canus* which closely approaches the northern Paraguayan Chaco on the opposite bank of the Rio Negro in Bolivia. Furthermore Patton & Costa (2003) found the *Philander* of Mato Grosso do Sul, Mato Grosso and “adjacent Paraguay” to be phylogeographically closer to *P. opossum canus* than to *P. frenatus*. They did not sample populations either from Paraná, Brazil or Misiones, Argentina populations.

Another possible scenario is the presence of both species in Paraguay, with *P. frenatus* confined to the southern and eastern Atlantic Forests and overlapping into adjacent Paraná and Misiones Argentina, whilst populations of Amazonian *P. o. canus* (or some other taxon) extends southwards from Amazonia into the Paraguayan Chaco and likely the cerrado belt of northern Oriental Paraguay - approximately corresponding to the areas adjacent to Mato Grosso do Sul and Mato Grosso as presumably sampled by Patton & Costa (2003). Several superspecies groups show similar distribution patterns at the meeting of these two extensive and biogeographically very different ecosystems.

**YELLOW-SIDED SHORT-TAILED OPOSSUM *Monodelphis dimidiata***

The species is widespread in Argentina where it is considered typical of the Pampas Region. Its distribution extends



from 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 western Provincia Misiones (Departamentos Capital and Apóstoles), Argentina. Its occurrence in the southern grasslands of Paraguay is considered possible and should be searched for in Departamentos Misiones and Neembucú.

**TAWNY-HEADED SHORT-TAILED OPOSSUM** *Monodelphis scalops*

Though reported for Paraguay by Contreras and Silveira Avalos (1995), the specimen was identified erroneously and this species is still awaiting documentation for Paraguay. The species has been recorded in Brazil and Misiones Province (Departamentos Iguazú, Guaraní and Oberá) Argentina and is likely present in the Atlantic Forest of eastern Paraguay, though it is nowhere common and is easily overlooked. Its presence in Paraguay is considered possible and might best be searched for in the Itaipú reserves of Departamento Alto Paraná.

**Key to Adults of the Paraguayan Species of Opossum**

**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

**go to 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* go to 3**

**2b** Not as above

**go to 7**

**3a** Colouration uniform on dorsum without contrasting colouration on flanks, head or rump

**go to 6**

**3b** Flanks, head and/or rump contrasting with dark brown or greyish dorsum

**go to 4**

**4a** Dorsal colour extends down centre of head

**go to 5**

**4b** Dorsal colour does not extend down centre of head.

**Hypothetical in Atlantic Forest *Monodelphis scalops***

**5a** Flanks yellowish, contrasting with greyer dorsum but fading gradually to midline of paler underparts. Rump greyish. Fur long and lax. Feet whitish or buffy.

**Hypothetical in open grassy habitats *Monodelphis dimidiata***

**5b** Flanks reddish, contrasting sharply with both browner dorsum and paler underparts. Rump dark reddish. Fur short and smooth, lying flat against body. Feet reddish. Atlantic Forest and edge

***Monodelphis sorex***

**6a** Size small (hindfoot with claw <16mm). Dorsal colouration uniformly reddish or reddish-brown

***Monodelphis kungsi***

**6b** Size larger (hindfoot with claw >18mm). Dorsal colouration uniformly grey or grey-brown

***Monodelphis domestica***

**7a** Conspicuous pale spots above eye and at base of ears

**go to 8**

**7b** No conspicuous pale spots above eye and at base of ears

**go to 10**

**8a** 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***

**8b** Dorsal pelage short and 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* go to 9**

**9a** Dark grey with creamy or white venter. Throat pelage grey-based with whitish midline. Atlantic Forest  
***Philander frenatus***

**9b** Pale grey.

**Hypothetical. Populations in the Paraguayan Chaco may be referable to this species *Philander opossum***

**10a** 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***

**10b** Not as above

**go to 11**

**11a** 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***

**11b** Not as above

**go to 12**

**12a** Size large (total length >500mm). Pelage with long, prominent guard hairs and soft, dense underfur. Females with well-developed marsupium

***Didelphis 13***

**12b** Size small or medium (total length generally much less than 450mm) . General appearance mouse-like  
**go to 14**

**13a** Dorsal pelage mostly greyish. Prominent white facial markings. Ears pale. Widespread in a variety of habitats

***Didelphis albiventris***

**13b** Dorsal pelage mostly blackish. Golden-buff facial markings. Ears dark. Forested areas only

***Didelphis aurita***

**14a** Size medium (TL>350mm), white tip to tail

***Micoureus* go to 15**

**14b** Size small (TL <200mm). Pelage short. Usually no white tip to tail

**go to 16**

**15a** Fur long and woolly extending 30mm or so down base of tail. Ventral pelage buffy to cinnamon and grey-based. Southern and eastern Paraguay in Atlantic Forest.

***Micoureus paraguayanus***

**15b** Fur long but not overly dense and not notably extending onto base of tail. Ventral pelage creamy to yellow-white and white-based. In northern Chaco and cerrado region.

***Micoureus constantiae***

**16a** 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 go to 17***

**16b** 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 circular arrangement  
**go to 18**

**17a** Size large, tail >135mm. Weight >40g. Tail with whitish tip. Orient only

***Thylamys macrurus***

**17b** Size small, tail <135mm. Weight <35g. Tail lacks whitish tip. Chaco only

***Thylamys pusillus***

**18a** 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 go to 19***

**18b** 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***

**19a** Dorsal pelage pale brown to greyish-brown looking grizzled. Ventral pelage grey-based except for chin, throat, upper breast and scrotal area. Ocular patch does not extend to nose and ears. Face not markedly paler than dorsum. Tail typically <140mm. Ears usually >21mm. Mainly cerrado in distribution.

***Gracilinanus agilis***

**19b** Dorsal pelage reddish-brown to chestnut-brown looking uniform. Ventral entirely grey-based except for chin. Ocular patch extends to nose and ears. Face contrastingly paler than dorsum. Tail typically >140mm. Ears usually <21mm. In Atlantic Forest

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