PALE-BELLIED WOOLLY MOUSE OPOSSUM

Marmosa constantiae O.Thomas, 1904

FIGURE 1 - (FPMAM423PH) Adult, Reserva Natural Laguna Blanca, Departamento San Pedro (Karina Atkinson/Para La Tierra August 2010).

TAXONOMY: Class Mammalia; Subclass Theria; Infraclass Metatheria; Magnorder Ameridelphia; Order Didelphimorphia; Family Didelphidae; Subfamily Marmosinae, Tribe Marmosini (Gardner 2007). The genus *Marmosa* was described by Gray (1821).

Until recently this species was placed in the genus *Micoureus* Lesson, 1842, but multiple phylogenetic studies have found *Micoureus* to be embedded within *Marmosa* (Gruber et al 2007). Voss & Jansa (2009) opted to return *Micoureus* to *Marmosa* and treat it as a subgenus, noting that this arrangement may change again in the future. Gutiérrez et al (2010) found the subgenus to be monophyletic, but warned that the taxonomy of the group has not been revised for many years and that it likely contains currently unrecognised species that theoretically could change the result.

Currently there are six recognised species in the subgenus *Micoureus* (Gardner 2007) two of which are present in Paraguay. The genus *Marmosa* is derived from the name given to the "murine opossums" of Brazil according to Seba and later adapted to the French as *Marmose* by Buffon (Palmer 1904). The subgenus *Micoureus* is probably taken from the Guaraní/Tupi indigenous name for an opossum Mykuré. The species name *constantiae* is in honour of Mrs Constant, the wife of C.Constant (1820-1905) a famed French taxidermist and collector. (Anderson 1997, Jobling 1991).

The species is treated as monotypic by Gardner (2007), though Anderson (1997) recognised two subspecies differentiated largely by size. *M.c.budini* is said to be smaller than the nominate, with smaller teeth and a proportionately longer tail (Tate 1933). Cranially the skull of *M.c.budini* is said to be smaller, with shorter molar tooth rows and less produced supraorbital processes. In his revision of the group Tate (1933) noted that this taxon may ultimately be merged with the nominate. Given how poorly known the species is, plus the complexities of Didelphid morphometry over different age classes, we agree with Gardner (2007) that it is preferable to consider the species monotypic pending revision. Synonyms adapted from Gardner (2007):

Marmosa constantiae O.Thomas 1904:243. Type locality "Chapada", Mato Grosso, Brazil.
Didelphys (*Marmosa*)] *constantiae* Trouessart 1905:856. Name correction.
[*Didelphis* (*Caluromys*)] *constantiae* Matschie 1916:270. Name combination.
[*Marmosa* (*Marmosa*)] *constantiae* Cabrera 1919:36. Name combination.
Marmosa budini O.Thomas 1920:195. Type locality "Altura de Yuto, Rio San Francisco", Jujuy, Argentina.
Marmosa constantiae budini Tate 1933:76. Name combination.
M[*icoureus*] *constantiae* Gardner & Creighton 1989:4. Name combination.
Marmosa (Micoureus) cinerea budini Anderson, Riddle, Yates & Cook 1993:14. Name combination.
Micoureus constantiae budini Anderson 1997:9. Name combination.
Micoureus constantiae constantiae Anderson 1997:9. Name combination.

ENGLISH COMMON NAMES: Pale-bellied Woolly Mouse Opossum (Wilson & Cole 2000), White-bellied Woolly Mouse Opossum (Gardner 2007), Bay-coloured Mouse Opossum (Mares et al 1989, Canevari & Vaccaro 2007).

SPANISH COMMON NAMES: Marmosa grande bayo (Mares et al 1989), Comadrejita grande, Comaderjita baya, Comadrejita pálida (Massoia et al 2000, Canevari & Vaccaro 2007), Marmosa grande baya (Canevari & Vaccaro 2007), Marmosa lanuda de vientre claro largo (Emmons 1999).

GUARANÍ COMMON NAMES: No information.

DESCRIPTION: A large stocky mouse opossum with relatively short snout and thick, woolly pelage - though somewhat shorter than *M.paraguayana*. Head vaguely triangular in profile. Dorsally grey, though appearing lightly grizzled due to darker hair bases and paler tips. In certain lights the dorsal pelage can appear tinged brownish or reddish, especially on the flanks. Ventrally strongly straw-yellowish with the mid-ventral hairs self-coloured to the base. Ventro-lateral hairs may have slight greyish bases, but these can frequently obscured and they never appear as obviously grey-based as the ventral hairs of *M.paraguayana*. Young animals may be tinged pinkish buff and extremely young animals may be more salmon-buff. The head is typically quite strongly yellow, especially on the cheeks and muzzle, and grey only on the forehead. Eye-rings are black, typically narrowed behind and below the eye. 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 and furred for 2-2.5cm at the base. Tail with sparse hair, characteristically bicoloured with a blackish-brown base and pinkish white terminal third - though the amount of pale colouration is subject to individual variation. The vibrisse are short and the ears of moderate size, somewhat blackish-purple in colour. Tail scales are rhomboid and arranged in a spiral. Females lack a marsupium but have 15 inguinal mammae arranged in a circular pattern (7-1-7). Though Emmons (1999) states that the male has a pink

scrotum, a male from Departamento San Pedro had a bluish scrotum. (Tate 1933, Emmons 1999, Massoia et al 2000, Canevari & Vaccaro 2007, Gardner 2007).

CRANIAL CHARACTERISTICS: The cranium is robust with wide zygomatic arches. Round accessory orifices almost always present behind the large posterior palatal foramina. Nasals broad at the maxillo-frontal suture, and behind broadly rounded. Supraorbital processes in old animals very large and pointed, and narrowing abruptly behind to a postorbital constriction. In the type and other old specimens a rather pronounced postorbital constriction is seen, and moderate approximation of temporal ridges. Interorbital region anterior to the processes, rather broad. Palate short and broad, usually with rounded fenestrae behind the posterior palatal foramina (closed in type). Bullae variable, rather small and often slightly pointed. (Tate 1933).

De la Sancha et al (2012) provided the following measurements for their unsexed sample from Paraguay (n=3): *Condylobasal Length* 38.14mm (37-40.01mm); *Least Interorbital Width* 6.92mm (6.16-7.61mm); *Zygomatic Width* 21.79mm (20.7-23.5mm); *Nasal Width* 5.08mm (4.78-5.38mm); *Palate Length* 20.83mm (20.5-21.02mm); *Palate Width* 13.24mm (12.2-13.94mm).

Tate (1933) gave the following measurements for dorsal cranial sutures for specimen AMNH 10059: *Nasal Suture* 20.6mm; *Frontal Suture* 12.4mm; *Parietal Suture* 8.5mm; *Distance from Lambdoid Crest to Front of Supraoccipital* 5.3mm.

Flores & Diaz (2002) provide the following cranial measurements for two Argentinian specimens IADIZA 6117 (Salta) and MACN 32.29 (Tucumán) respectively: *Condyloincsive Length* 373mm, 368mm; *Width of Braincase* 146mm, 136mm; *Postorbital Constriction* 75mm, 68mm; *Zygomatic Width* 21mm, NA; *Length of Mandible* 28.4mm, 27mm.

DENTAL CHARACTERISTICS: I5/4 C1/1 P 3/3 M 4/4 = 50. A slight diastema between I1 and j2 in the upper jaw. I5 always slightly larger, sometimes separated from I4 by a very slight space. Incisors of mandible semirecumbent, closely appressed. All with slightly spatulate crowns.(Tate 1933) Differentiated from other members of the genus by having the last upper molar compressed. P2 and P3 of similar size and larger than P1. Canines well-developed. (Díaz & Barquez 2002).

De la Sancha et al (2012) provided the following measurements for their unsexed sample from Paraguay (n=3): *Length of Maxillary Tooth Row:* 16.28mm (15.5-16.86mm); *Length of Molars:* 8.31mm (7.7-8.85mm); *M1-M3 Length:* 7.13mm (6.6-7.66mm); *M4 Width:* 2.835mm (2.83-2.84mm). Flores & Diaz (2002) provide the following dental measurements for two Argentinian specimens IADIZA 6117 (Salta) and MACN 32.29 (Tucumán) respectively: *Length of Upper Tooth Row:* 20.4mm, 19.2mm; *Length of Lower Tooth Row:* 9mm, 9.1mm.

GENETIC CHARACTERISTICS: No information.

TRACKS AND SIGNS: No information.

EXTERNAL MEASUREMENTS: *Marmosa* are clearly larger than other Paraguayan Mouse Opossums, though this species averages slightly smaller than the congeneric *M.paraguayana*. Males generally larger than females, though old females may be as large as normal males (Tate 1933). Eisenberg & Redford (1999) give the following measurements for 11 unsexed specimens: **TL:** 36.75cm (33-40cm); **HB:** 16.17cm (14-18cm); **TA:** 20.57cm (19-22cm); **FT:** 2.35cm (2.1-2.7cm); **EA:** 2.58cm (2.3-3.1cm); **WT:** 90g (n=1). Anderson (1997) provided the following ranges for 8 Bolivian specimens: **TL:** 31-42.4cm; **TA:** 18-22.7cm; **FT:** 2.2-2.7cm; **EA:** 2.3-3cm; **WT:** 73-148g. Flores & Diaz (2002) provide the following measurements for a specimen from Provincia Salta, Argentina (IADIZA 6117): **TL:** 33cm; **TA:** 18.5cm; **FT:** 2.4cm; **EA:** 2.7cm; **WT:** 432g (??).

The following measurements are for specimens (n=1 male, n=3 females) from Reserva Natural Laguna Blanca, Departamento San Pedro (Smith et al 2012): **TL:** male 38.2cm female 33.5cm (32.4-34.6cm); **HB:** male 16.2cm female 13.57cm (13.1-14.1cm); **TA:** male 22cm female 19.93cm (19.3-20.5cm); **FT** male 3cm female 2.4cm (2.3-2.5cm); **EA:** male 2.8cm female 2.5cm; **WT:** male 92g female 56.7g (51-58g).

De la Sancha et al (2012) provided the following measurements for their unsexed sample from Paraguay (n=6): **TL:** 32.02cm (22-41.2cm); **TA:** 18.18cm (13.5-23.5cm); **FT** 2.48cm (2-2.9cm); **EA:** 2.03cm (1.2-2.3cm); **WT:** 60.1g (50-90.5g).

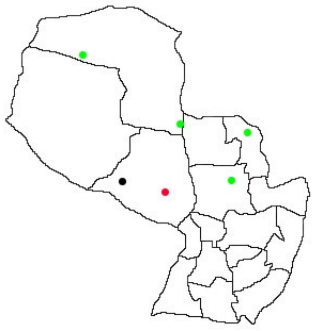
De la Sancha et al (2012) commented that the specimen MSB 67000 from the Cerrado zone of Departamento Amambay was somewhat larger than their Chaco specimens. They noted that proposed subspecies were split principally on size, but declined to comment on the implications of this for Paraguayan specimens as a result of their small sample size. Smith et al (2012) however noted that with the additional specimens from Departamento San Pedro the apparent morphometric differences between the Chaco and Cerrado populations were less clear, with a similar range of body sizes to those reported by de la Sancha et al (2012) demonstrated at this single locality.

SIMILAR SPECIES: Compared to other Paraguayan genera of mouse opossums *Marmosa* are identifiable by size alone, being much larger. Note also the dense, woolly, greyish pelage and the bicoloured tail with dark base and whitish tip, which immediately identifies the species in Paraguay. This is the only genus of Paraguayan mouse opossums in which the tail scales are rhomboid and arranged in a spiral sequence. Both *Gracilinanus* and *Cryptonanus* are considerably smaller (with body length approximately the length of an index finger as opposed to an entire hand in this genus).

Marmosa paraguayana is similar but confined to the Atlantic Forests of eastern Paraguay where this species apparently does not occur. The ranges come very close to each other in Departamento San Pedro, there are no known reports of the two species at the same locality. Though of similar general shape and sharing the woolly pelage of *M.paraguayana* (though less dense), this species can be distinguished on account of its more reddish dorsal colouration (most notable laterally), strongly yellowish ventral colouration and the fact that the fur does not extend notably over the base of the tail as it does in *paraguayana*. Crucially the ventral pelage is basally self-coloured in *constantiae* and grey-based in *paraguayana*. Note that females of this species possess 15 mammae, as opposed to just 11 in *paraguayana*.

Thylamys macrurus is the only non-*Marmosa* 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 that *Thylamys* frequent.

DISTRIBUTION: In Bolivia the species has been recorded in Departamentos Pando, Beni, La Paz, Cochambamba, Santa Cruz, Chuquisiaca and Tarija (Anderson 1997).



In Brazil the only records are from Mato Grosso and Mato Grosso do Sul states (Gardner 2007). In Argentina it has been recorded from Provincias Jujuy (Díaz & Barquez 2002), Tucumán (Flores & Dias 2002) and Salta (Mares et al 1999), though the recent report of a specimen from Formosa (De la Sancha et al 2012) suggests that the species may be more widely distributed in that country than is currently known.

Voss et al (2009) mentioned the presence of the species in Paraguay in passing, but the first specimen data was provided by De la Sancha et al (2012) from four diverse locations in the Chaco and cerrado zone: Cerro León (MNHNP 0481, 1659, 1660) and Puerto Casado (FMNH 54404) both Departamento Alto Paraguay; km155 Ruta Trans Chaco (MNHNP 121795), Departamento Boquerón 33km SE of Pedro Juan Caballero (MSB 67000) Departamento Amambay. Smith et al (2012) provided details of additional specimens from Reserva Natural Laguna Blanca, Departamento San Pedro (CZPLT 012, 013, 014, 015).

There is some doubt as to the correct collection location of specimen MNHNP 121795 (in reality TK 121795). De la Sancha et als (2012) text states that the specimen is in Departamento Boquerón in accordance with the collector´s field data, but in their Fig 2, partially replicated in the distribution map here, it is mapped within Departamento Presidente Hayes (black point). The mapped location does not correspond to km155 of Ruta Trans-Chaco, km155 being approximately in the area of the Rio Negro (red point)., but in fact to a point roughly 155km WEST of the Ruta Trans Chaco and is presumably an error. The collector´s notes (I.Mora) do not provide GPS coordinates for the point, but they do specifically state

that the specimen was found dead on the Ruta Trans-Chaco. It would seem most likely that the locality "km155 of Ruta Trans Chaco" is correct (red point), but that the collector incorrectly noted this locality as inside Departamento Boquerón, when in fact it is in Presidente Hayes.

The Paraguayan range of the species comes very close to the known range of the Atlantic Forest endemic *Marmosa paraguayana*, though they appear to be allopatric. *M.constantiae* apparently replaces *M.paraguayana* in the north of the country, and the presence of the species in Provincia Formosa, Argentina raises the possibility of its occurrence in the western Oriental region close to the Rio Paraguay.

HABITAT: Little specific data is available for habitat preference in Paraguay, but it seems to prefer subhumid or semi-humid forest in otherwise semi-arid areas. Specimens collected at RN Laguna Blanca were in semi-humid semi-deciduous transitional forest in an area surrounded by cerrado. This forest skirts the eponymously-named lake at the site and has a fairly open undergrowth. The specimens were captured in arboreal sherman traps situated above 1m from the forest floor. (Smith et al 2012).

De la Sancha et al (2012) comment that the species is distributed in "open areas of both Chaco and Cerrado" but the statement appears to be misleading. The area around Cerro León where their Dry Chaco specimens were collected is in fact similarly transitional between subhumid and dry forest, whilst Voss states that the general area where the Cerro Corá specimen was taken "had a mostly closed, at least medium tall canopy with some large trees, along with some open agricultural areas that were starting to return to forest." Anderson (1997) notes that "No information for Bolivia is available on habitat", but Mares et al (1989) describe the habitat in Provincia Salta, Argentina as "Humid forests; transitional forests" in the Yungas region. These habitat descriptions fit much more closely with the data from Laguna Blanca.

ALIMENTATION: No specific data available, but suspected to be similar to other members of the genus.

Diet in Captivity Specimens at Laguna Blanca were captured in Sherman traps baited with oats, peanut butter and vanilla essence. (Smith et al 2012)

REPRODUCTIVE BIOLOGY: Litte information available.

Seasonality None of the specimens captured during July, August and February at Laguna Blanca showed signs of reproductive activity (Para La Tierra data). Anderson (1997) states that of six females taken in Bolivia, four had no embryos in July, August and September, one was lactating in May and one had five young in August. Tate (1933) notes breeding or nursing females in January (presumably in Bolivia?) and juveniles in April.

GENERAL BEHAVIOUR: ***Activity Levels*** Arboreal and nocturnal. A little known species which is infrequently recorded over most of its range.

Defensive Behaviour Threatened animals gesture with the mouth. Handled animals were found to be more aggressive than *Marmosa paraguayana*, thrashing about and attempting to bite the handler (Para La Tierra data). Diaz & Barquez (2002) note that animals captured in Provincia Jujuy, Argentina showed "aggressive behaviour".

Parasites Brennan (1970) reported the chigger *Eutrombicula alfreddugesi* from Bolivian specimens. Heckscher et al (1999) describe the coccidian *Eimeria micouri* from this species in Bolivia. One Paraguayan specimen from Laguna Blanca had two botfly larvae on the belly and three on its lower back (J.Sarvary pers. comm.).

VOCALISATIONS: No information.

HUMAN IMPACT: None.

CONSERVATION STATUS: Globally considered to be of Low Risk Least Concern by the IUCN, on account of its presence in a number of protected areas. See http://www.iucnredlist.org/apps/redlist/details/13297/0 for the latest assessment of the species. Though this species has only recently been confirmed in Paraguay, its national range appears to be wide and it occurs in a number of protected areas. The IUCN highlights that little is known of the species biology or ecological requirements and that climatic or land use changes could quickly result in the species becoming seriously threatened, recommending a re-evaluation of the species status once further data becomes available. It is of no small consequence that there has been a considerable acceleration of deforestation in the Chaco and Cerrado regions of Paraguay in recent years and to date no population data is available at the national level. That said, unquantified `preliminary data from the Reserva Natural Laguna Blanca

suggests that the species is relatively common there and is able to survive even in heavily degraded forest. (Para La Tierra data)

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