



# *Marmosa constantiae* (Didelphimorphia: Didelphidae)

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**Abstract:** *Marmosa constantiae* O. Thomas, 1904, is a medium-sized didelphid commonly called the white-bellied woolly mouse opossum. It is a large, stocky mouse opossum with a relatively short snout and thick, woolly pelage, 1 of 6 members of the *Marmosa* subgenus *Micoureus*. The species is poorly known but relatively widespread in central South America, from Bolivia south to extreme northern Argentina and east to Paraguay and west-central Brazil. It is a nocturnal and arboreal inhabitant of humid and subhumid forests. Though known from relatively few specimens, the species has proved to be more widespread than previously thought and is not of special conservation concern. It is currently listed as “Least Concern” by the International Union for Conservation of Nature and Natural Resources.

**Key words:** Argentina, Bolivia, Brazil, Marmosinae, Marmosini, *Micoureus*, Paraguay, white-bellied woolly mouse opossum

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## *Marmosa constantiae* O. Thomas, 1904

White-bellied Woolly Mouse Opossum

*Marmosa constantiae* O. Thomas, 1904:243. Type locality “Chapada, Matto Grosso,” Brazil.

[*Didelphys* (*Marmosa*)] *constantiae*: Trouessart, 1905:856. Name combination.

[*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.

*Marmosa constanciae* Mares et al., 1981:161. Incorrect subsequent spelling of *Marmosa constantiae* Thomas, 1904.

*M*[*icoureus*]. *constantiae*: Gardner and Creighton, 1989:4. Name combination.

*Marmosa* (*Micoureus*) *cinerea budini*: Anderson, Riddle, Yates and Cook, 1993:14. Name combination.

*Micoureus constantiae budini*: Anderson, 1997:9. Name combination.



**Fig. 1.**—Adult *Marmosa constantiae* from Reserva Natural Laguna Blanca, Departamento San Pedro, Paraguay. Used with permission of photographer Karina Atkinson, Para La Tierra.

*Micoureus constantiae constantiae*: Anderson, 1997:9. Name combination.

*M*[*armosa*]. *constantatiae constantiae* de la Sancha et al., 2012:232. Incorrect subsequent spelling of *Marmosa constantiae* Thomas, 1904.

CONTEXT AND CONTENT. Order Didelphimorphia, family Didelphidae, subfamily Didelphinae, tribe Marmosini. The subspecies *Marmosa c. budini* O. Thomas, 1920 was differentiated by size and form. *M. c. budini* is said to be smaller than the nominate, with smaller teeth, shorter molar toothrows, less pronounced supraorbital processes, and a proportionately longer tail (Tate 1933), but the description was based on an individual that was “adult, but not old” (O. Thomas 1920:196). *M. c. budini* was tentatively recognized by Anderson (1997), but the species is now usually treated as monotypic (Gardner and Creighton 2008) pending a revision of the group. *M. constantiae* is sister to *M. regina* (Gutiérrez et al. 2010; de la Sancha et al. 2012). Synonymy is modified from Gardner and Creighton (2008).

NOMENCLATURE NOTES. Until recently *Marmosa constantiae* was placed in the genus *Micoureus* Lesson, 1842, but multiple phylogenetic studies have found *Micoureus* to be embedded within *Marmosa* (Gruber et al. 2007). Gutiérrez et al. (2010) and Faria et al. (2013) found the subgenus *Micoureus* to be monophyletic, but cautioned that the subgenus likely contains unrecognized species, and is in need of revision. Voss and Jansa (2009) returned *Micoureus* to *Marmosa* and treated it as a subgenus, emphasizing that this is an interim solution, proposed to preserve the utility of the name *Micoureus* while conforming to the requirement that genera be monophyletic. The robustness of the *Micoureus* clade was confirmed by Voss et al. (2014) in a new arrangement for *Marmosa* that split the genus into 5 subgenera, and retained *Micoureus* as a subgenus with all its contents.

The generic name *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 name *Micoureus* probably originated with the Guaraní–Tupi indigenous name for an opossum, Mykuré. The species is named after Mrs. Percy Sladen (possibly Constance) who funded the collecting expedition named in her husband’s honor and during which the type was collected (Braun and Mares 1995).

*Didelphys cinerea* is listed as a synonym of *Micoureus paraguayanus* (currently *Marmosa paraguayana*) by Gardner and Creighton (2008) but the distribution given suggests a composite of species and all localities listed lie outside of the range of *M. paraguayana*. Thomas (1888) lists various specimens from Bolivia, but the only specific locality mentioned is Santa Cruz de la Sierra which lies only within the range of *M. constantiae*. *D. cinerea* was listed as a synonym of *M. constantiae* by Anderson et al. (1993), but reference to gray-based ventral pelage in the description by Thomas (1888) is not consistent with that species. We omit *D. cinerea* from the synonymy here on the basis that it cannot be confidently assigned to this species.

Published English common names include pale-bellied woolly mouse opossum (Wilson and Cole 2000; Smith 2011), white-bellied woolly mouse opossum (Gardner 2005; Gardner and Creighton 2008), and bay-colored mouse opossum (Mares et al. 1989; Canevari and Vaccaro 2007). The following Spanish language names have appeared in the literature: *Marmosa grande*

bayo (Mares et al. 1989), Comadreja grande, Comadreja baya, Comadreja pálida (Massoia et al. 2000; Canevari and Vaccaro 2007), *Marmosa grande* baya (Canevari and Vaccaro 2007), *Marmosa pálida* (Anderson et al. 1993), and *Marmosa lanuda* de vientre claro (Emmons 1999).

## DIAGNOSIS

*Marmosa constantiae* is a fairly typical member of the *Marmosa* subgenus *Micoureus*, with dense, woolly dorsal pelage that is brownish-gray and shorter ventral pelage that is pale buffy-yellow in color. Within subgenus *Micoureus*, the pale distal one-third of the tail coupled with entirely self-based ventral pelage are diagnostic for *M. constantiae*. Tate (1933) reported a mammary formula of 7-1-7 which contrasts with 4-1-4 and 5-1-5 reported for other members of the subgenus.

*Marmosa paraguayana* (Tate’s woolly mouse opossum) is the only other species in the subgenus in which the distal one-third of the tail is consistently and conspicuously paler. *M. constantiae* can be distinguished from *M. paraguayana* by a slight reddish-brown tone to the dorsal coloration (most notable laterally) and strongly buffy-yellow ventral coloration. The ventral pelage is basally self-colored in *constantiae* and gray-based in *paraguayana* as in all other members of the subgenus *Micoureus*. On direct comparison, *M. paraguayana* has rather woollier pelage than *M. constantiae* and the fur does not extend so notably over the base of the tail in the latter (2–2.5 cm) as it does in the former (3–5 cm). Morphological differences between Paraguayan specimens of *M. constantiae* and *M. paraguayana* were elucidated by Smith and Owen (2015). These 2 species are marginally sympatric in northern Paraguay and although *paraguayana* has an association with Atlantic Forest and *constantiae* with subhumid forest in Chaco and Cerrado areas, the 2 species do occur together in at least 1 locality in the country and may overlap more widely than is currently known (Smith and Owen 2015).

In northern Bolivia, *M. constantiae* is at least geographically sympatric with *Marmosa regina* (bare-tailed woolly mouse opossum). It can be reliably distinguished from that species by the extensively pale distal one-third of the tail, distinctly cinnamon dorsal coloration, and self-colored ventral pelage (as opposed to gray-based). Cranially *M. regina* has a narrower skull and lacks the expanded nasals and palatine fenestrae found in *M. constantiae* (Gardner and Creighton 2008).

## GENERAL CHARACTERS

*Marmosa constantiae* is a large stocky mouse opossum, with a relatively short snout and thick, woolly dorsal pelage (Fig. 1). Dorsally gray, lightly grizzled due to darker hair bases and paler tips, and with a slight brownish tinge most notable on the flanks. Ventrally buffy-yellow with hairs self-colored to the base, and inconspicuous grayish bases confined to the ventrolateral

pelage. In some specimens, the head may be quite strongly buffy-yellow, especially on the cheeks and snout. Black eyerings are prominent and narrow behind and below the eye. The nose is pink, the vibrissae short, and the blackish-purple ears are of moderate size. The tail is long and furred basally for 20–25 mm, being characteristically bicolored with the basal two-thirds a purplish-black and the terminal one-third a pinkish-white (the amount of pale coloration being subject to variation). Thenar and 1st interdigital pads are fused on the hindfoot but lie together on the forefoot. The 4th interdigital pad lies against the hypothenar pad of the forefoot but the 2 are either fused or in direct contact on the hindfoot. Digit IV on the hindfoot is longest with a length ratio of 0.45 when compared to the hindfoot length. Second and 3rd interdigital pads on all feet are triangular and approximately as wide as they are long. No sexual size dimorphism was detected among Paraguayan specimens (Smith and Owen 2015). Description adapted from Tate (1933), Emmons (1999), and Smith (2011). Ranges of external measurements were: length of head and body, 113–180 mm; length of tail, 145–233 mm; length of ear, 20.3–32 mm; length of hind foot, 21–30 mm; mass 35–144 g (Anderson 1997; Eisenberg and Redford 1999; Flores and Díaz 2002; Cáceres et al. 2007; de la Sancha et al. 2012; Smith et al. 2012; Smith and Owen 2015).

The skull is robust with wide zygomatic arches (Fig. 2). Round accessory orifices almost always present behind the large posterior palatal foramina. Nasals are broad at the maxillofrontal suture, and broadly rounded posteriorly. In older specimens, the interorbital region is rather broad, and separated by large and pointed supraorbital processes from a postorbital constriction. Palate short and broad, usually with rounded fenestrae behind the posterior palatal foramina (closed in type). Bullae variable, small and often slightly pointed (Tate 1933; Díaz and Barquez 2002). Ranges of cranial measurements were: condylobasal length, 34.4–42.7 mm; breadth of nasals, 3.0–6.2 mm; least interorbital breadth, 5.8–7.8 mm; breadth of zygomatic arch, 19.7–26.2 mm; length of palate, 19.1–23.9 mm; breadth of palate, 12.1–14.4 mm; length of maxillary tooth row, 14.3–17.1 mm; length of molar row, 7.7–8.9 mm; M1–M3, 6.4–7.7 mm (de la Sancha et al. 2012; Smith et al. 2012; Smith and Owen 2015). Flores (2003) provides a detailed comparative account of cranial morphology for Argentine specimens.

## DISTRIBUTION

*Marmosa constantiae* is restricted to central South America (Brown 2004), where it is relatively widespread from northern Bolivia south to extreme northern Argentina, and east to Paraguay and west-central Brazil (Fig. 3). In Bolivia, it has been recorded in departamentos Pando, Beni, La Paz, Cochabamba, Santa Cruz, Chuquisaca, and Tarija (Anderson 1997). *M. constantiae* is little known in Brazil where it has been reported only in Mato Grosso, Mato Grosso do Sul, and Rondônia states



Fig. 2.—Dorsal, ventral, and lateral views of skull and lateral view of mandible of an adult male *Marmosa constantiae* (CZPLT-M [Collection of Zoology, Para La Tierra—Mammals] 437) from Reserva Natural Laguna Blanca, Departamento San Pedro, Paraguay. Greatest length of skull (anterior-most point of nasals to posterior-most point of occipital condyles) is 43.1 mm.

(Melo and Sponchiado 2012). The Argentine distribution includes provincias Jujuy (Díaz and Barquez 2002; Gamboa Alurralde et al. 2015), Tucumán (Flores and Díaz 2002), and Salta (Mares et al. 1989; Díaz et al. 2000), with a single record of a specimen from the Chaco region in Provincia Formosa (de la Sancha et al. 2012). *M. constantiae* has only recently been reported for Paraguay (Voss et al. 2009) but is apparently fairly widespread in the Cerrado and Chaco regions with specimen records from both sides of the Paraguay River in departamentos Amambay, San Pedro, Presidente Hayes, and Alto Paraguay. It was erroneously reported from Departamento Boquerón (de la Sancha et al. 2012), although it may occur there (Smith et al. 2012; Smith and Owen 2015) and also potentially occurs in Departamento Concepción. Specimens of *M. constantiae* from Parque Nacional Defensores del Chaco in Departamento Alto



**Fig. 3.**—Geographic distribution of *Marmosa constantiae*. Map redrawn from International Union for Conservation of Nature and Natural Resources (2012), modified using data from Voss et al. (2009), de la Sancha et al. (2012), and Smith and Owen (2015).

Paraguay are morphometrically distinct from other Paraguayan *M. constantiae* specimens and may represent an unrecognized taxon (Smith and Owen 2015). No fossils are known.

### FORM AND FUNCTION

*Marmosa constantiae* shows numerous adaptations for an arboreal lifestyle. Tail scales are rhomboid and arranged in a spiral, and the tail is sparsely haired and prehensile. Feet are broad, the stout claws of the forefeet extending slightly beyond the digital pads as an adaptation for climbing. The median part of the soles of the feet is smooth, but the ventral surfaces of the digits have transverse bars as an aid for gripping. The flexor tendons of the manus of this species were described in a comparative study by Abdala et al. (2006). Males possess bony radial tubercles that are absent in females, and it is assumed that these perform a copulatory function (Lunde and Schutt 1999).

Females lack a marsupium but have 15 inguinal mammae arranged in a circular pattern (7-1-7—Gardner and Creighton 2008). The abdominal-inguinal mammary field is pigmented ochraceous in lactating females (Flores et al. 2000). The male has been stated to have a pink scrotum (Emmons 1999), but 1 male from Departamento San Pedro, Paraguay, had a bluish scrotum (Smith et al. 2012). Males lack a gular gland (Hershkovitz 1992).

Dental formula of adults is  $i\ 5/4, c\ 1/1, p\ 3/3, m\ 4/4$ , total 50. A slight diastema is present between I1 and I2 and I5 is always slightly larger, sometimes separated from I4 by a very slight space. Mandibular incisors are semirecumbent, closely appressed

and all with slightly spatulate crowns. Last upper molar compressed. P2 and P3 of similar size and larger than P1. Canines are well-developed (Tate 1933; Díaz and Barquez 2002).

### ONTOGENY AND REPRODUCTION

Of 6 female *Marmosa constantiae* taken in Bolivia, 4 had no embryos in July, August, and September, 1 was lactating in May, and 1 had 5 young in August (Anderson 1997). Tate (1933) notes breeding or nursing females in January (presumably in Bolivia) and juveniles in April. In Provincia Jujuy, Argentina, a lactating female was taken in June (Flores et al. 2000) and a juvenile was taken in August (Flores 2006).

None of the specimens captured during July, August, and February in Departamento San Pedro, Paraguay, showed signs of reproductive activity (Smith et al. 2012), but a female was captured with 7 hairless young in September 2012 at the same locality. Young were anchored to the teat with their mouth and though they were able to use their legs to move, they lacked sufficient strength to hold onto the pelage of the mother. On the day of capture, the young had the following mean measurements ( $n = 6$ ): length of head and body, 30.3 mm; length of tail, 6.3 mm; mass, 1.8 g. Three days later these had increased to ( $n = 7$ ): length of head and body, 31.3 mm; length of tail, 12.9 mm; mass, 2.1 g. Young fed from a specific teat, ignoring other available teats and were not aided by the mother when reattaching. After 6 days in captivity the female consumed all the offspring. The same female had been captured during May of the same year when it had a mass of 62 g, increasing to 70 g upon recapture a month later and 85 g after consuming its young (September).

### ECOLOGY

*Marmosa constantiae* is mainly arboreal, being captured most often in the understory of forests and only occasionally on the ground (Vieira 2006; Hannibal and Cáceres 2010; Smith et al. 2012; Vieira and Camargo 2012). It occurs in a variety of ecoregions including the Yungas, Chaco, Cerrado, Chiquitania, Pantanal, and Amazonia and their transitions, and it is often common (Cáceres et al. 2008; Hannibal and Neves-Godoi 2015). Habitat is typically moist, humid, subhumid, or gallery forests, especially in areas of transition from humid to dry areas, and it is able to withstand considerable habitat alteration (Cáceres et al. 2007; Cáceres et al. 2008; Voss et al. 2009; Smith et al. 2012; Smith and Owen 2015).

The Argentine distribution of *M. constantiae* shows high endemism values for the Yungas ecoregion (Sandoval et al. 2010) though this publication came prior to the subsequent report of a specimen from the Formosan Chaco (de la Sancha et al. 2012). In Paraguay, it has been found in subhumid gallery forests in the Cerrado and Chaco regions (Smith et al. 2012; Smith and Owen 2015) and in Bolivia, it was found to be the 2nd most common small mammal in the Chaco alluvial plain (Cuéllar and Noss 2003). In Brazil, *M.*

*constantiae* has been trapped in gallery forests and disturbed cerrado in the Cerrado and Pantanal ecoregions (Cáceres et al. 2007; Cáceres et al. 2008; Roman 2009; Hannibal and Cáceres 2010; Alho et al. 2011; Paglia et al. 2012). *M. constantiae* occurs close to sea level in Paraguay and in the Urucum Mountains of Brazil was captured between 400 and 1,000 m (Cáceres et al. 2011). The type specimen of *Marmosa budini* was “caught in an upland wood” at an elevation of 500 m (O. Thomas 1920:195).

*Marmosa constantiae* is described as an insectivore–omnivore (Ojeda and Mares 1989). The stomach of a specimen from Aguas Negras, Provincia Jujuy, Argentina, contained remains of hemipteran bugs and vegetable matter (Flores 2006). A captive female at Reserva Natural Laguna Blanca consumed Orthoptera (Tettigoniidae), Mantodea (Mantidae), Blattaria (Blattidae); Auchenorrhyncha (Cicadidae) and Lepidoptera that it was presented with, but rejected carrot and tomato. One large moth was pounced upon with a forepaw on each wing and the body was consumed with the wings being discarded. No discarded remains of other invertebrates were found in the enclosure.

The chigger *Eutrombicula alfreddugesi* (Acari: Trombiculidae—Brennan 1970) and the coccidian *Eimeria micouri* (Conoidasida: Eimeriidae—Heckscher et al. 1999) were reported from Bolivian specimens of *M. constantiae*. The tick *Ixodes luciae* (Acari: Ixodidae—Autino et al. 2006) and the flea *Adoratopsylla intermedia* (Siphonaptera: Ctenophthalmidae—Lareschi et al. 2010) have been reported on specimens from Provincia Salta, Argentina. A Paraguayan specimen from Reserva Natural Laguna Blanca had 2 botfly larvae (Diptera: Oestridae) on the belly and 3 on its lower back.

*Marmosa constantiae* has been described as solitary and nocturnal. Animals captured in Provincia Jujuy, Argentina, showed aggressive behavior (Díaz and Barquez 2002). Threatened animals gesture with an open mouth and may hiss, bark, and bite. *M. constantiae* at Reserva Natural Laguna Blanca, Paraguay, were captured in Sherman traps baited with oats, peanut butter, and vanilla essence (Smith et al. 2012).

## GENETICS

The diploid number (2n) for *Marmosa constantiae* is 14, and the fundamental number (FN) is 14; both the X and Y chromosomes are acrocentric (Palma and Yates 1996; Svartman 2009). Virtually no differences in mitochondrial d-loop sequences were detected within or among *Marmosa (Micoureus) demerarae*, *M. (M.) constantiae*, and *M. (M.) paraguayana*. Moreover, the structural composition of these sequences is very similar to the d-loop region of other didelphid species (Gomes Rocha et al. 2012).

## CONSERVATION

*Marmosa constantiae* is considered to be of “Least Concern” by the International Union for Conservation of Nature and Natural Resources as it is not suspected to be in decline and occurs in

several protected areas (Weksler et al. 2011). In Argentina, its known distribution is largely protected by Parque Nacional Calilegua in Provincia Jujuy (Heinonen and Bosso 1993) and Parques Nacionales El Rey and Baritú in Salta (Díaz et al. 2000; Flores and Díaz 2002) and it is considered “Near Threatened” (Díaz and Ojeda 2000) or potentially “Vulnerable” (Flores 2006) nationally. In Paraguay, it has been recorded in Parque Nacional Defensores del Chaco (Departamento Alto Paraguay), Parque Nacional Cerro Corrá (Departamento Amambay), and Reserva Natural Laguna Blanca (Departamento San Pedro—de la Sancha et al. 2012; Smith et al. 2012, Smith and Owen 2015), but no evaluation of the national conservation status has ever been performed. In Bolivia, it is widespread, under no apparent threat (Aguirre et al. 2009) and occurs in several protected areas including Parque Nacional Gran Chaco Kaa-Iya, Departamento Santa Cruz (Cuéllar and Noss 2003). In Brazil, the species is considered “Data Deficient” (Chiarello et al. 2008).

## REMARKS

De la Sancha et al. (2012:233) commented that *Marmosa constantiae* “is distributed in open areas of both Chaco and the Cerrado in eastern Paraguay,” but this was considered to be misleading by Smith and Owen (2015) who demonstrated that Paraguayan records are associated with forested habitats as in the rest of the species range. Ojeda and Mares (1989) described the species as scansorial, but further research has shown the species to be almost exclusively arboreal (Vieira 2006; Hannibal and Cáceres 2010; Smith et al. 2012).

Anderson (1997) stated that the specific name was given in honor of Mrs. Constant, the wife of C. Constant (1820–1905), a famed French taxidermist and collector. However, the species description (Thomas 1904:244) states that it is named “in honour of the donor of the present most valuable accession to the National Collection, in recognition of her enlightened method of commemorating her late husband’s memory,” this being in reference to Constance Sladen, nee Anderson (1848–1906), wife of Walter Percy Sladen (1849–1900) a respected member of the Linnean Society (Braun and Mares 1995; Beolens et al. 2009).

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