

FIRST RECORDS OF *Monodelphis kunsi* PINE (DIDELPHIMORPHIA, DIDELPHIDAE) FROM PARAGUAY, WITH AN EVALUATION OF ITS DISTRIBUTION

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ABSTRACT: Recent field work in Paraguay has increased our knowledge of its mammal fauna, especially in terms of its distribution. Herein, we report three specimens of *Monodelphis kunsi* (Didelphidae), which are the first for the country and represent a significant range extension for this species. Two of the specimens come from a natural mixture of Cerrado and Atlantic Forest, on eastern Paraguay, whereas the third one is from the central Chaco. We review other records of *Monodelphis* species for the country and discuss geographic variation among *M. kunsi* specimens in Paraguay, as well as in regard to previous records in South America. Although this wide geographic range includes distinct habitats, we found no evidence of significant variation among specimens.

RESUMEN: Primer registro de *Monodelphis kunsi* Pine (Didelphimorphia, Didelphidae) para Paraguay, y una evaluación sobre su distribución. Recientes estudios de campo en Paraguay han incrementado nuestro conocimiento sobre los mamíferos, especialmente sobre su distribución geográfica. Aquí se reportan los primeros ejemplares de *Monodelphis kunsi* (Didelphidae) para ese país, que representan una considerable extensión geográfica para la especie. Dos ejemplares fueron capturados en un área de Cerrado y Bosque Atlántico, en la región oriental de Paraguay; el tercero proviene del Chaco central. Revisamos los registros de *Monodelphis* para Paraguay y discutimos la variación geográfica entre ejemplares de *M. kunsi* de Paraguay, así como con registros previos en Sudamérica. Aunque este amplio rango geográfico incluye distintos hábitats, no encontramos variación significativa entre especímenes.

Key words. Didelphidae. *Monodelphis kunsi*. Paraguay.

Palabras clave. Didelphidae. *Monodelphis kunsi*. Paraguay.

Recent field work in Paraguay has provided new information on the small mammal fauna in that country, which is one of the more poorly known in South America (Pine, 1982; Myers et al., 2002). This field work has included the collection of two specimens of short-tailed opossum that did not match the description of

any *Monodelphis* species previously recognized for the country. During the study of these specimens, a third specimen was found in the Field Museum of Natural History (Chicago), which represents the same species. Based on morphological comparisons with available material and published descriptions of other

Monodelphis species, we refer these specimens to *M. kunsii* Pine 1975, which adds an additional species of the genus to the fauna of Paraguay, and provides important intermediate localities between the eastern (Brazil) and western (Bolivia and Argentina) portions of the distribution previously reported.

Monodelphis kunsii, the Pygmy Short-tailed Opossum, is a poorly known species with an apparently wide geographic distribution (Mares et al., 1989; Emmons, 1998; Vargas et al., 2003). The species was originally described from La Granja (13°18' S, 64°09' W, below 200 m), west bank of Rio Itonamas, 4 km north of Magdalena, Province of Itenez, Department of Beni, Bolivia (Pine, 1975). Subsequent reports have extended its distribution into south-

ern (Anderson, 1982), eastern (Emmons, 1998), and western (Vargas et al., 2003) Bolivia, south-central Brazil (Mares et al., 1989; Carvalho et al., 2002), and northern Argentina (Jayat and Miotti, 2005) (**Table 1, Fig. 1**).

The two new Paraguayan specimens of *M. kunsii*, with Texas Tech University field collection numbers TK 67127 and TK 121105, were collected at Puesto Aguara Ñu (24°11' S, 55°16' W), Reserva de Biósfera del Bosque Mbaracayú, Department of Canindeyú, in Sherman live traps set on the ground. The specimens were collected by I. Mora, S. Fernandez, and F. Ramirez. Specimen TK 67127, an adult female, was prepared as a skin, skull, and skeleton (**Fig. 2**), and will be deposited in the Museo Nacional de Historia

Table 1

Geographic localities for known specimens of *Monodelphis kunsii*.

Reference	Country	State or Department	Locality	Latitude	Longitude	Elev. (masl)
Jayat and Miotti (2005)	Argentina	Salta	Gral. Jose de San Martin, Finca Falcon	22° 18' S	63° 58' W	700
Pine (1975)	Bolivia	Beni	Itenez, La Granja, west margin R. Itonamas	13° 18' S	64° 09' W	200
Vargas et al. (2003)	Bolivia	La Paz	Iturrealde, PNAAMI Alto Madidi	13° 20' S	68° 47' W	250
Vargas et al. (2003)	Bolivia	Santa Cruz	Parque Nacional Noel Kempff Mercado	14° 39' S	60° 53' W	200
Salazar et al. (1994)	Bolivia	Tarija	Tapecua	21° 26' S	63° 55' W	1500
Anderson (1982)	Bolivia	Tarija	Río Lipeo	22° 41' S	64° 26' W	640
Mares et al. (1989)	Brazil	Distrito Federal	Brasilia, 20 km S	15° 58' S	47° 55' W	1100
Carvalho et al. (2002)	Brazil	Goais	Serra do Mesa, 20 km NW Colinas do Sul	14° 09' S	48° 04' W	N/A
Carvalho et al. (2002)	Brazil	Goias	Serra do Mesa, 49 km SW Minacu	13° 31' S	48° 13' W	N/A
Carvalho et al. (2002)	Brazil	Goias	Serra do Mesa, 55 km N Niquelandia	14° 28' S	48° 27' W	N/A
JL Patton (pers. comm.)	Brazil	Minas Gerais	Reserva do Jacob, Nova Ponte	19° 06' S	47° 46' W	750
This report	Paraguay	Canindeyú	Reserva de Biosfera del Bosque Mbaracayú	24° 11' S	55° 16' W	200
This report	Paraguay	Presidente Hayes	Cruce de los Pioneros	22° 40' S	59° 46' W	370

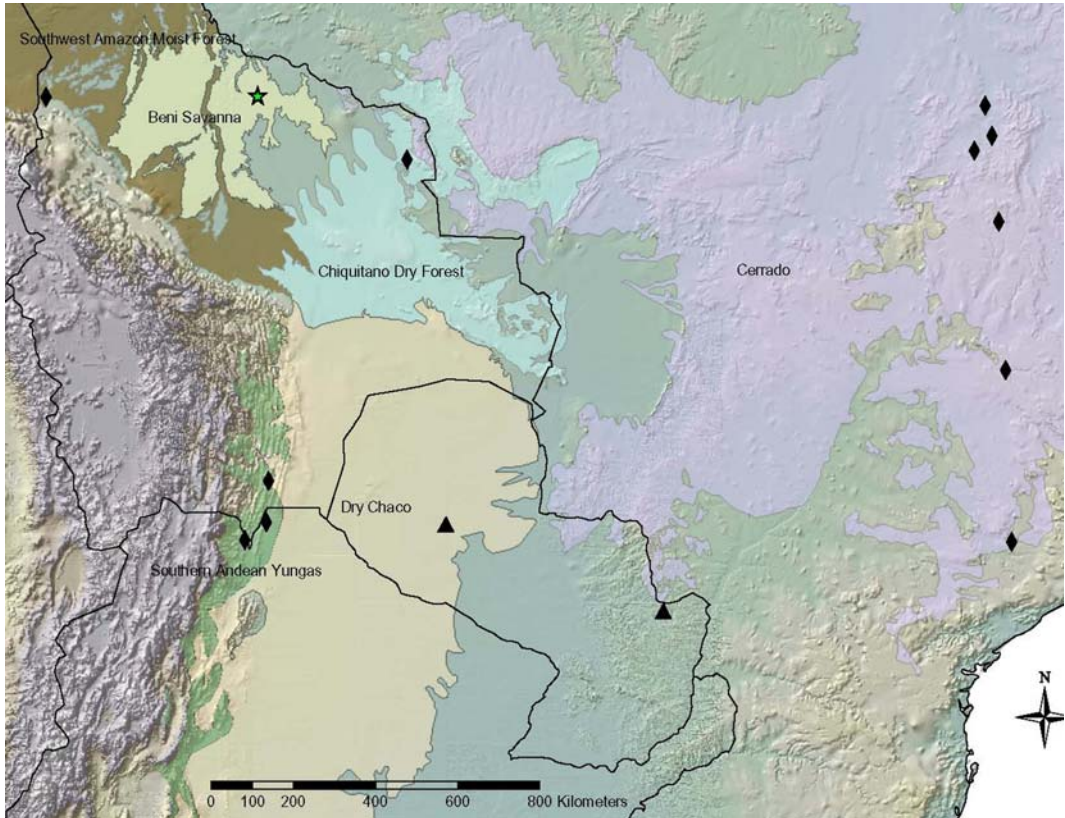


Fig. 1. Geographic distribution of *M. kunsii* based on previously published records, and Paraguayan specimens reported herein. Ecoregions as defined by the World Wildlife Fund (Olson and Dinerstein, 2002) are superimposed to indicate ecoregional differences among localities.

Natural del Paraguay. Specimen TK 121105, an adult of undetermined sex, was damaged by ants and thus only skull and skeleton were preserved. Both specimens have permanent upper and lower third premolars, and fourth molars, indicating that they are adults. The short tail and small adult size, as well as all other observable characters, agree for both specimens with the description of *M. kunsii*, and leave no doubt that they are referable to this species. Frozen tissues (heart, kidney, liver, lung, spleen, and blood) were collected for both specimens, and are deposited in the Museum of Texas Tech University frozen tissue collections, under the TK numbers indicated above.

A third specimen (FMNH 164094), an adult male, was encountered in the mammal collec-

tions of the Field Museum of Natural History. This specimen was collected in Colonia Filadelfia, Boquerón, in 1997 by C. J. Yahnke. Although the specimen, identified as *M. domestica*, is preserved intact in alcohol, preventing us from comparing cranial and dental traits, it has the same external characteristics (see below) of the two animals from Canindeyú.

The specimens show the typical small size, short tail, compact body, and short and stout limbs characteristics of the genus *Monodelphis* (Nowak, 1999; Pine and Handley, in press). This unique combination of traits, coupled with coloration, separates these specimens from any other small didelphids in the region, which either have long tails like those of *Gracilinanus* or *Cryptonanus*, or if short-tailed, show dra-



Fig. 2. Skin and skull of Paraguayan *Monodelphis kunsii*, specimen TK 67127. Top: Dorsal and ventral view of the skin. Bottom: Dorsal and ventral view of the skull.

matic and contrasting differential coloration in dorsal and ventral view, as in *Thylamys*. Short uniformly reddish-brown dorsal fur, without any distinguishable coloration marks, paler underparts, and lack of sagittal crest (Fig. 2) are all typical of *M. kunsii* specimens (Anderson, 1982). *Monodelphis kunsii* has been identified as the smallest *Monodelphis* and it is perhaps the smallest didelphid other than *Chacodelphis formosa* (see Pine, 1975; Voss et al., 2004; Teta et al., 2006). Both TK 67127 and TK 121105 have fully erupted fourth molars (Fig. 2), which are characteristic of adult *Monodelphis*, and confirm that these are adults, rather than juveniles of a larger species. See Table 2 for measurements of these specimens.

Puesto Aguara Ñu is an area of natural Cerrado (Marin et al., 1998) surrounded by cattle pastures, croplands, and what is perhaps the largest remnant of the Interior Atlantic Forest (Bosque de Mbaracayú) in Paraguay. The dominant habitat is Cerrado composed of tall grasses and bushes and punctuated by occasional palm trees and termite mounds. The soil is sandy and well-drained. Trapping in the Mbaracayú Reserve has been conducted extensively in both habitats (Cerrado and Atlantic Forest), and *M. kunsii* has not been encountered in the forest. The third specimen reported here comes from Cruce de los Pioneros, Km 402 Trans Chaco highway (Chris Yahnke, pers. comm.) in the central Chaco of western Paraguay. Microhabitat conditions for this specimen are unknown; however, four of the five specimens identified as *M. domestica* in Yahnke's (1999) dissertation were caught in "forest", and the other in "wooded habitat", indicating that the *M. kunsii* must have been encountered in the generally-dense thorn scrub forest of 6-12 m in height typical of the central Paraguayan Chaco. This is not only a remarkable record in terms of distribution but also in regard to the presence of this species in another major biogeographic region.

Specimen TK 67127 has uniformly short and brown dorsal fur (Fig. 2), which grades into a pale cream and grizzled mid-ventrally, while FM 164094 is much lighter both dorsally and ventrally. Comparatively, *M. sorex* is a larger species with reddish sides and dark reddish at crown of the head and the rump, and *M. domestica* is a larger species, with uniformly gray dorsal fur, but also longer fur and relatively larger ears. Our skin specimen shows no evidence of dorsal stripes which are present on *M. americana* and on *M. iheringi*, and to date neither of these species have been found in Paraguay.

Four species in the genus *Monodelphis* have previously been reported from Paraguay: *M. domestica* and *M. sorex* (Myers and Wetzel, 1979; Pine and Handley, in press), *M. scalops* from the Itaipú Binacional Reserve, Alto Paraná (Contreras and Silvera-Avalos, 1995), and *M. brevicaudis* with no precise

Table 2

Body and cranial measurements (mm), and weight (g) for known specimens of *Monodelphis kunsi*. Acronyms correspond to: American Museum of Natural History, New York (AMNH), Academy of Natural Sciences, Philadelphia (ANSP), Colección Boliviana de Fauna, La Paz, Bolivia (CBF), Sam Noble Oklahoma Museum of Natural History, Oklahoma (OMNH), Museum of Texas Tech University, Lubbock (field catalog numbers, TK), United States National Museum, Washington DC (USNM). Specimens collected by Jorge Pablo Jayat (JPJ) will be deposited at the Colección Mamíferos Lillo, Universidad Nacional de Tucumán, Argentina. Measurements follow Voss et al., 2001.

Specimen ID	TL	T	HF	E	W	CBL	LIB	ZB	PL	PB	MTL	LM	M1-M3
AMNH 263968	115	41	12	10	8.0	21.00	4.50	10.50	10.50	7.20	8.70	4.70	4.10
ANSP 18191	113	42	12	12	-	-	4.40	-	10.90	7.00	8.20	4.60	4.30
CBF 7360	112	39	11	10	16.0	23.10	4.95	12.50	11.80	5.10	9.10	-	5.10
CBF 7435	147	45	11	14	30.0	27.85	5.15	15.75	12.50	5.14	10.90	5.75	5.15
JPJ 1394	103	41	11	11	7.5	19.20	4.10	10.00	10.10	7.08	8.50	4.70	4.16
JPJ 1508	115	40	11	11	7.5	-	-	-	-	6.80	8.34	-	3.92
JPJ 1544	133	43	13	12	14	-	-	-	-	7.30	9.30	-	4.20
OMNH 2265	114	36	14	11	14.0	23.70	4.50	11.80	12.40	7.40	9.40	5.00	4.30
TK 67127	119	39	11	10	8.5	21.40	4.29	10.90	11.05	7.38	8.77	4.66	4.30
TK 121105	116	38	11	10	9.0	21.51	4.38	11.48	11.31	7.41	8.82	4.93	4.16
USNM 461384	-	-	-	-	-	23.20	4.50	12.00	11.70	7.00	9.30	5.00	4.30

record besides the country name (Azara, 1801; Hershkovitz, 1959). The Paraguayan specimen reported as *M. scalops* by Contreras and Silvera-Avalos (1995) is misidentified, the specimen in question being a *M. sorex* (de la Sancha, pers. obs.). The specimen is housed in the collection of Museo de Ciencias Naturales de Itaipú Binacional, Hernandarias, Paraguay, with catalog number AWSA-0001. Although *M. breviceaudis* was either regarded as a valid taxon (Hershkovitz, 1959; Brown, 2004), or as a senior synonym for *M. breviceaudata* (Bertoni, 1939) or *M. domestica* (Wetzel and Lovett, 1974), the name is regarded as a synonym of *M. sorex* by Gardner (1993, 2005) and Pine and Handley (in press). Therefore, *M. kunsi* is the third *Monodelphis* species known for Paraguay. At Bosque Mbaracayú, we found *M. kunsi* in sympatry with *M. domestica*.

Mares et al. (1989), Emmons (1998), and Vargas et al. (2003) noted that *M. kunsi* is rare and poorly understood. Our specimens were collected in a Cerrado habitat, as were specimens previously reported from Brazil (Mares et al., 1989; Carvalho et al., 2002).

The type locality is in the Beni Savanna of Bolivia (Pine, 1975; Anderson, 1982), which da Silva and Bates (2002) regard as different from the Cerrado. Other records are from lowland tropical evergreen forest of western Bolivia (Vargas et al., 2003), the dry forest Yungas of Bolivia (Salazar et al., 1994), and most recently in Andean foothills in the Argentine Yungas (Jayat and Miotti, 2005). The Chaco and Cerrado localities reported in this paper, represent a biogeographic conundrum since these ecoregions differ considerably from other reported localities, in both habitat structure and forest composition. The diversity of habitats represented by these localities prompts us to question the taxonomic status of the recently reported specimens, because of the few specimens and reports for a species which seems adapted to so many habitat types. Its rarity in collections suggests that the species is rare in nature as well, and so it seems unlikely that *M. kunsi* could be a generalist adapted to such a diversity of habitats. From a biogeographic perspective, this might suggest a species complex, with each species

specialized to a particular habitat type. When known localities are plotted (**Fig. 1**) on the ecoregions map (Olson and Dinerstein, 2002), five discrete habitat units are noted from which *Monodelphis kunsi* has been reported: Beni Savanna (a lowland forest sensu Anderson 1982), below 300 m above sea level (masl); Brazilian Cerrado, 500-1700 masl; Argentine and Bolivian Andean Yungas, above 600 masl; Bolivian Southwestern Amazon Moist Forest (evergreen forest sensu Vargas et al., 2003), above 300 masl; and dry Chaco of western Paraguay, below 200 masl.

It is also remarkable that one of the specimens from the Department of Santa Cruz, Bolivia, was captured in a Cerrado habitat and the other in a nearby semi-evergreen forest (Emmons, 1988). Although the Canindeyú locality is mapped within the Alto Paraná Atlantic Forest ecoregion (200-250 masl), it is actually within one of the small areas where Cerrado extends into Paraguay.

Although the previous geographic records and the three Paraguayan specimens reported herein are all morphologically referable to *M. kunsi*, we note that a similar distribution pattern in opossums of the genus *Thylamys* represents at least three species: *T. velutinus*, *T. macrurus*, and *T. venustus* (Solari, 2003; Braun et al., 2005). The skin of specimen TK 67127 was first identified by R. H. Pine, who indicated that it should be *M. kunsi* or otherwise a new species.

Although there is considerable variation in fur coloration (especially ventrally) among specimens of *M. kunsi* (Pine and Handley, in press), it is similar to that seen in *M. adusta*. A lack of standardization among authors (e.g., Pine, 1975; Anderson, 1982; Vargas et al., 2003; Jayat and Miotti, 2005) has made comparison of published measurements difficult, and any analysis of geographic variation awaits a uniform reexamination of specimens.

The discovery of *M. kunsi* in Paraguay also alerts us to the possibility of other small marsupials being found there, among which the following seem most likely: *Chacodelphys formosa* (possibly in the Departments of

Neembucu, Misiones, Paraguari, Central, Cordillera, and Presidente Hayes), *Monodelphis scalops*, *M. theresa*, *M. americana* and *M. iheringi* (in the Departments of Canindeyú, Alto Paraná, and Itapúa), and possibly an undescribed *Thylamys* species (in the humid Chaco and/or the Atlantic Forest). All of these except for the *Thylamys* species are known from nearby regions of Brazil and Argentina. Recently *Chacodelphys formosa* has been rediscovered in regions of Argentina bordering Paraguay, along the Rio Pilcomayo (Teta et al., 2006).

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