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Short Note

Discovery of *Juliomys* (Rodentia, Sigmodontinae) in Paraguay, a new genus of Sigmodontinae for the country's Atlantic Forest

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Although Paraguay is a country with a long history of mammalogy (de Azara 1801, 1802, Rengger 1830; see historical accounts in Hershkovitz 1987 and Myers et al. 2002), its mammal fauna is one of the least known in South America (Pine 1982, Myers et al. 2002). This assertion is corroborated by the recent discovery in the country of several new mammal species, including one representing a new family (de la Sancha et al. 2007, D'Elía et al. 2008). Based on the known distributions of rodent and marsupial species from neighboring countries (e.g., Anderson 1997, Massoia et al. 2000, Pardiñas et al. 2005, Flores 2006, Teta et al. 2006, 2007), the potential to find new species for Paraguay is quite high.

Accordingly, in this contribution we report the first record for Paraguay of *Juliomys*, a rare sigmodontine rodent (regarded as a Sigmodontinae *incertae sedis* by D'Elía et al. 2007), collected during an on-going study on the effects of habitat fragmentation on the Atlantic Forest in eastern Paraguay. As a part of that study a mammal survey was conducted at Refugio Biológico Limoy, one of a chain of small private reserves owned by the Itaipú Binacional along the Paraná River. Created in 1984 as an erosion control system for the Itaipu Binacional hydroelectric dam, Limoy is one of the largest of these reserves, with an extension of 14,828 ha. It is located approximately 160 km northeast of the town of Hernandarias, Departamento Alto Paraná, Paraguay.

Working in Limoy in December of 2006 we trapped several specimens of small mammals, one of which was clearly distinctive by the reddish coloration of the nose and rump. Further morphological examination, as well as detailed analyses of molecular gene sequences of the mitochondrial cytochrome-*b*, confirmed our suspicion that this specimen represented a record of a species thus far unknown in the country. External measurements were taken in the field. Cranial measurements were recorded using digital calipers following Costa et al. (2007). Genetic comparison was based on the first 801 bp of the cytochrome-*b* (cyt b) gene. The new sequence was gathered following the protocol detailed in D'Elía and Pardiñas (2004) and was deposited in GenBank (accession number FJ026733). This sequence was integrated to the matrix analyzed by Pardiñas et al. (2008), which includes all available cyb b sequences of *Juliomys* and outgroup selected following D'Elía et al. (2006). Sequence alignment was conducted by eye. Observed (p) sequence divergence was estimated with PAUP* (Swofford 2000) disregarding those sites with missing data. Aligned sequences were subjected to maximum parsimony (MP) analysis (Farris 1982). In the MP analysis, characters were treated as unordered and equally weighted. PAUP* was used to perform 200 replicates of heuristic searches with tree bisection-reconnection branch swapping and random addition of sequences. Clade support was assessed by performing 1000 parsimony jackknife (JK; Farris et al. 1996) replications with 5 addition sequence replicates each and the deletion of one-third of the characters. Clades with $<50\%$ of support were allowed to collapse.

Delineations of the Atlantic Forest bioregion for our map were obtained from Olson et al. (2001) which was constructed using ArcGIS9 version 9.1.

- Order Rodentia Bodwich, 1821
- Suborder Myomorpha Brandt, 1855
- Family Cricetidae Fischer, 1817
- Subfamily Sigmodontinae, Wagner 1843
- Genus *Juliomys* González 2000
- *Juliomys pictipes* (Osgood 1933)

Type locality Restricted to Puerto Caraguatay (26°37′ S, 54°46′ W, 92 m), Montecarlo, Misiones, Argentina by Pardiñas et al. (2007) (see also Pardiñas et al. 2008).

Known distribution Misiones Province in Argentina (Osgood 1933, Pardiñas et al. 2008), and the Brazilian states of Santa Catarina, Paraná, São Paulo, Rio de Janeiro, and Minas Gerais (Pine 1980, González 2000,

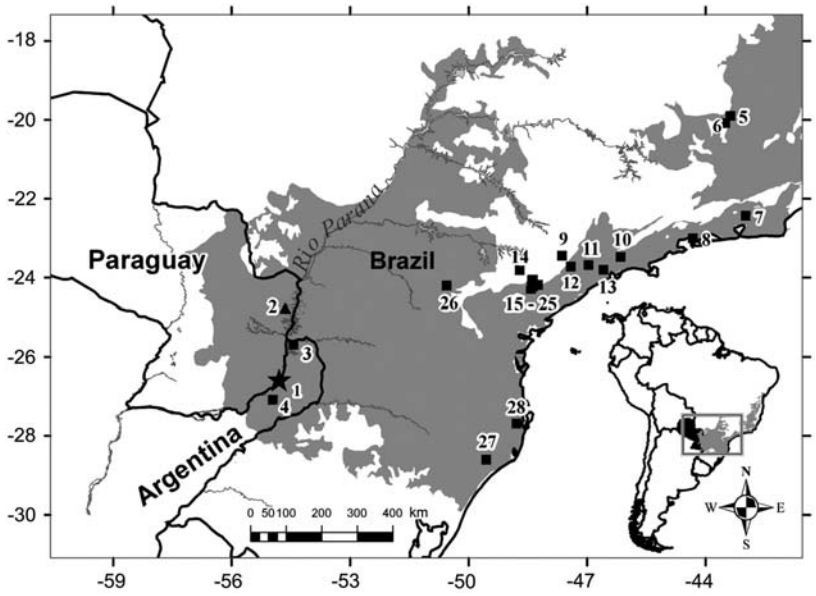

Figure 1 Recording localities of *Juliomys pictipes*. The new Paraguayan locality is indicated by a triangle; the type locality of *J. pictipes* is indicated by a star. Numbered localities (squares) correspond to those listed in Appendix I. Delineation of the Atlantic Forest bioregion for our map was obtained from Olson et al. (2001). Map was constructed using ArcGIS9 ver. 9.1.

Cherem et al. 2004, Cherem 2005, Oliveira et al. 2005, Costa et al. 2007).

New record Departamento Alto Paraná, Refugio Biológico Limoy, North of Rio Limoy, 24°48′ S, 54°27′ W. In addition to being the first Paraguayan record, this is also the first record west of the Paraná River (Figure 1). The Paraguayan specimen is an adult female (TK145073; Noé de la Sancha field number, ND 46), prepared as a skin, skull and skeleton. The specimen is housed at the Departamento de Biología, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Asunción, San Lorenzo, Paraguay under catalog number CZ014 and is accompanied by liver and spleen tissues (collected and stored in 80% ethanol) currently housed at the Natural Sciences Research Laboratory (NSRL) of the Museum of Texas Tech University under TK145073.

Taxonomy The form *pictipes* was originally described by Osgood (1933) and allocated in the genus *Thomasomys*. Sixty years later it was transferred to *Wilfredomys* by Musser and Carleton (1993). González (2000) erected *Juliomys* with *pictipes* as its unique species. Later, Oliveira and Bonvicino (2002) described *J. rimofrons* from Brejo da Lapa, Minas Gerais, Brazil. Recently, a third species, *J. ossitenuis*, was described with type locality in Fazenda Neblina, Minas Gerais, Brazil (Costa et al. 2007). The three species of *Juliomys* differ in external and internal morphological characters, chromosomal complements, and cyt b gene sequences (Costa et al. 2007, see also Pardiñas et al. 2008). *J. pictipes* has no taxon under its synonymy.

Description The Paraguayan specimen has soft orange-brown dorsal pelage, a white venter, and orange rump and nose. The tail is slightly bicolor and ends with a small tuft of long hairs. The feet are small, short, round, stubby, and are covered by distinct orange fur on the dorsal portions with lighter bands proceeding towards the digits. Foot pads are very distinctive and extremely large. Whiskers are extremely long. Ears are of medium size and furry. Eyes are large.

Our specimen matches the skull description and emended diagnosis of *J. pictipes* recently provided by Pardiñas et al. (2008) (Figure 2). External measurements (mm) for the Paraguayan specimen are: TL (total length)=190, tail=97, HF (hind foot length including claw)=20, ear=15, and weight 25.0 g. Cranial measurements (mm, after Tribe 1996) are as follows: occipitonasal length (ONL), 25.69; palatal length (PL), 11.26; post-palatal length (PPL), 9.90; molar row-crown length (MRC), 3.89; first molar breadth (M1B), 1.10; palatal bridge length (PBL), 3.83; temporal fossa length (TFL), 7.85; diastema length (DL), 6.06; incisive foramen length (IFL), 4.40; incisive foramen breadth (IFB), 1.64; palatal breadth at first molar (PB1), 2.82; palatal breadth at third molar (PB3), 2.98; mesopterygoid fossa breadth (MFB),

Figure 2 Skull and lower jaw of the Paraguayan specimen of *Juliomys pictipes* (Colección de Mamíferos number CZ014; TK145073). Scale bar=5 mm.

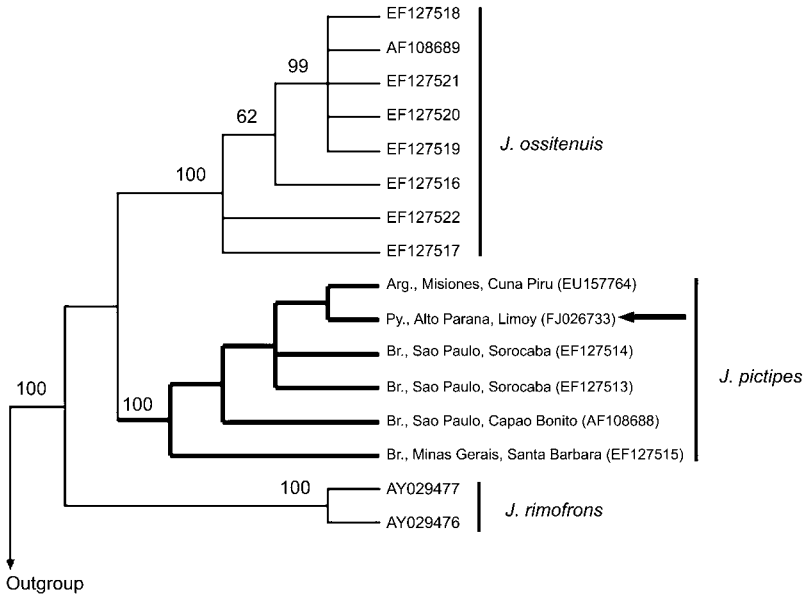

Figure 3 Strict consensus tree of the 136 most parsimonious trees (length 1048 steps, confidence interval=0.483, RI (retention index)=0.625) obtained in the maximum parsimony analysis of the cytochrome-*b* gene sequences. The sequence obtained from the new Paraguayan record is indicated by an arrow. Numbers above branches indicate parsimony jackknife (left); only jackknife values >50% are shown.

1.66; breadth across incisor tips (BIT), 1.81; braincase breadth (BCB), 11.00; skull height (SH), 7.71; rostral height (RH), 4.87; rostral breadth (RB), 4.34; rostral length (RL), 7.36; nasal length (NL), 8.17; zygomatic plate length (ZPL), 2.31; zygomatic breadth (ZB) 13.50); interorbital breadth (IOB), 4.13; greatest length of mandible (GLM), 12.91; mandibular molar row-alveolar length (MMR), 3.96; and depth of ramus (DR), 2.97.

Genetic and phylogenetic analyses Six cyt b sequences of *J. pictipes* are available; these haplotypes were recovered from specimens collected in one Argentinean (Misiones Province), three Brazilian (one in Minas Gerais and two in São Paulo States) and one Paraguayan localities. Observed genetic variation among these cyt b haplotypes is moderate: it ranges from 0.13% to 2.3%. Comparisons between the Paraguayan haplotype and the others range from 0.13% to 1.84% (pairwise comparisons with haplotypes from the type locality in Misiones, Argentina and Santa Bárbara, Minas Gerais, Brazil). The Paraguayan haplotype is the first one of this species to be analyzed from the western basin of the Parana River; despite the small sample size of our study, these results suggest that the Parana River would have not molded the genetic structure of *J. pictipes*. Moreover, in general, our results extend the finding of Pardiñas et al. (2008) on the lack of a pattern of isolation by distance among *J. pictipes* localities and corroborate previous morphological assertions that *J. pictipes* is a widespread species (Costa et al. 2007, Pardiñas et al. 2008).

The MP analysis retrieved 136 shortest trees (length: 1048 steps; consistency index: 0.483; retention index: 0.625). The topology of their consensus (Figure 3) resembles that found by Pardiñas et al. (2008). Here, the Paraguayan haplotype is sister (JK<50) to the haplotype recovered from the Argentinean specimen.

Natural history The specimen reported here was collected in a well conserved, primary forest with ferns and low lianas. According to Pine (1980), A.M. Olalla captured two male specimens (FMNH 94552 and 94553) in SE Brazil (Lagoa do Rocha, 21°53′ S, 47°05′ W) by hand and at a height ranging from 5 to 8 m above ground. Our specimen was captured with a Sherman live trap (H.B. Sherman Traps, Inc., USA) placed at approximately 1.5 m above ground; this fact in combination with *J. pictipes* large eyes, short, wide feet, large footpads and long tail indicates that this species is mostly arboreal (see also Pardini et al. 2005). In fact, the perceived rarity of the species is quite likely an artifact of the trapping techniques used by most mammalogists; for example, Graipel (2003) showed that when appropriate sampling regimes are used, *Juliomys* sp. (likely *J. pictipes*, but see Cherem et al. 2004) is the most common rodent captured in the understory (46 captures in 4000 trap nights) and the only rodent caught in the canopy (39 captures in 1000 trap nights) of a secondary Atlantic Forest in northern Santa Catarina state.

The Paraguayan specimen collected on December 2006 was a pregnant female with three embryos (Crown-rump-length=13 mm); Pardiñas et al. (2008) also reported 3 embryos in a pregnant female caught in late August in Misiones, Argentina. No reproductive data is available for any Brazilian specimens of the species.

Final considerations In this publication, we present the first report of *Juliomys* for Paraguay which also corresponds to the first report for the genus west of the Paraná River. A similar scenario was recently reported for other sigmodontine rodents by D'Elía et al. (2008). All these records show that the mammal fauna of the Paraguayan Atlantic Forest is more similar to that of the Argentinean and Brazilian counterparts than previously

envisioned. We submit that further work in the region of eastern Paraguay will result in additional new species for the country, especially by using pitfall traps and carrying canopy trapping. Furthermore, revisions of museum collections may be another valuable source of unpublished records for Paraguay (e.g., de la Sancha et al. 2007, Percequillo et al. 2008).

It is noteworthy that almost a century ago de Bertoni (1914) cited *Wiedomys pyrrhorhinus* (referred to as *Oryzomys pyfrrohorhinus* sic), another form with an orange nose, for Trinidad, Itapua, in southeastern Paraguay. Currently, *W. pyrrhorhinos* is known only from Ceara to Minas Gerais in Brazil (Oliveira and Bonvicino 2006). Meanwhile, *W. cerradensis*, the second living known species of *Wiedomys*, has been recorded only at its type locality in the state of Bahia, Brazil (Gonçalves et al. 2005). Similarly, *Wilfredomys oenax*, another orange-nosed sigmodontine, is known from northeastern Uruguay and southeastern Brazil (states of Rio Grande do Sul to Sao Paulo, Oliveira and Bonvicino 2006). Given the large gap between the known distributions of *Wiedomys* and *Wilfredomys* in Paraguay, and that at that time the forms *pictipes* and *oenax* were still undescribed (i.e., all known orange-nosed mice were referred to *pyrrhorhinus*), it is likely that de Bertoni's specimen was a *Juliomys*. Unfortunately, Bertoni did not particularize a voucher specimen as the basis of his reference; therefore, the exact taxonomic identification of his specimen cannot be assessed.

Finally, this new record shows that the Paraguayan Atlantic Forest, as its counterparts in Argentina and Brazil, harbors important mammal diversity and merits serious conservation efforts. Regrettably, only approximately 13.4% of the original Atlantic Forest remains in Paraguay; the main cause of deforestation is agriculture, primarily soy, and wood exploitation (Fleytas 2007). Therefore, it is important that more studies be conducted in forest remnants, more vouchers be collected, and more measures be taken to preserve what is considered one of the major hotspots for biodiversity and endemism in the world (Olson and Dinerstein 2002).

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References

Anderson, S. 1997. Mammals of Bolivia taxonomy and distribution. Bull. Am. Mus. Nat. Hist. 231: 1–652.

Bertoni, A.W. 1914. Fauna paraguaya: catálogos sistemáticos de los vertebrados del Paraguay: peces, batracios, reptiles, aves, y mamíferos conocidos hasta 1913 Asunción: Establecimiento Gráfico M. Brossa. Descripción física y económica del Paraguay, numeración novenal 59: 1–83.

Cherem, J.J. 2005. Registros de mamíferos não voadores em estudos de avaliação ambiental no sul do Brasil. Biotemas 18: 169–202.

Cherem, J.J., P.C. Simoes-Lopes, S. Althoff and M.E. Graipel. 2004. List of mammals from Santa Catarina State, southern Brazil. Mastozool. Neotrop. 11: 151–184.

Costa, L.P., S.E. Pavan, Y.L.R. Leite and V. Fagundes. 2007. A new species of *Juliomys* (Mammalia: Rodentia: Cricetidae) from the Atlantic Forest of southeastern Brazil. Zootaxa 1463: 21–37.

de Azara, F. 1801. Essais sur l'historie naturelle des quadrupedes de la province du Paraguay. Tome Second. Imprière C. Pougens, Paris. pp. 1–449.

de Azara, F. 1802. Apuntamientos para la historia natural de los quadrúpedos del Paraguay y Río de La Plata. Tomo segundo. Imprenta de la Viuda de Ibarra, Madrid. pp. 1–328.

D'Elía, G. and U.F.J. Pardiñas. 2004. Systematics of Argentinean, Paraguayan, and Uruguayan swamp rats of the genus *Scapteromys* (Rodentia, Cricetidae, Sigmodontinae). J. Mammalogy 85: 897–910.

D'Elía, G., L. Luna, E.M. González and B.D. Patterson. 2006. On the Sigmodontinae radiation (Rodentia, Cricetidae): an appraisal of the phylogenetic position of *Rhagomys*. Mol. Phylogenet. Evol. 38: 558–564.

D'Elía, G., U.F.J. Pardiñas, P. Teta and J.L. Patton. 2007. Definition and diagnosis of a new tribe of sigmodontine rodents (Cricetidae: Sigmodontinae), and a revised classification of the subfamily. Gayana 71: 187–194.

D'Elía, G., I. Mora, P. Myers and R.D. Owen. 2008. New and noteworthy records of Rodentia (Erethizontidae, Sciuridae, and Cricetidae) from Paraguay. Zootaxa 1784: 39–57.

de la Sancha, N., S. Solari and R.D. Owen. 2007. First records of *Monodelphis kunsi* Pine (Didelphimorphia, Didelphidae) from Paraguay, with an evaluation on its distribution. Mastozool. Neotrop. 14: 241–247.

Farris, J.S. 1982. The logical basis of phylogenetic analysis. In: (N. Planick and V. Funk, eds) Advances in cladistics: proceedings of the second meeting of the Willi Hennig Society. Columbia University Press, New York. pp. 7–36.

Farris, J.S., V.A. Albert, M. Källersjö, D. Lipscomb and A.G. Kluge. 1996. Parsimony jackknifing outperforms neighbor-joining. Cladistics 12: 99–124.

Fleytas, M.C. 2007. Cambios en el Paisaje: Evolución de la cobertura vegetal en la Región Oriental del Paraguay. In: Biodiversidad del Paraguay: Una aproximación a sus realidades. Fundación Moisés Bertoni.

Flores, D. 2006. Orden Didelphimorphia Gill 1872. In: (R.M Barquez, M.M. Diaz, R.A. Ojeda, eds) Mamíferos de Argentina: Sistemática y Distribución. Sociedad Argentina para el Estudio de los Mamíferos, Tucumán, Argentina. pp. 31–45.

Graipel, M.E. 2003. A simple ground-based method for trapping small mammals in the forest canopy. Mastozool. Neotrop. 10: 177–181.

Gonçalves, P.R., F.C. Almeida and C.R. Bonvicino. 2005. A new species of *Wiedomys* (Rodentia: Sigmodontinae) from Brazilian Cerrado. Mamm. Biol. 70: 46–60.

González, E.M. 2000. Un nuevo genero de roedor sigmodontino de Argentina y Brasil (Mammalia: Rodentia: Sigmodontinae). Comunicaciones Zool. Mus. Hist. Nat. Montevideo 12: 1–12.

Hershkovitz, P. 1987. A history of the recent mammalogy of the Neotropical region from 1492–1850. Fieldiana (n. ser.) 39: 11–98.

Massoia, E., A. Forasiepi and P. Teta 2000. Los marsupiales de la Argentina. L.O.L.A., Buenos Aires. pp. 1–71.

Musser, G.M. and M.D. Carleton. 1993. Family Muridae. In: (D.E. Wilson and D.M. Reeder, eds) Mammal species of the world: a taxonomic and geographic reference, 2nd edn. Smithsonian Institution Press, Washington, DC. pp. 501–755.

Myers, P., A. Taber and I. Gamarra de Fox. 2002. Mamíferos de Paraguay. In: (G. Ceballos and J.A. Simonetti, eds) Diversidad y Conservación de los Mamíferos Neotropicales. CONABIO-UNAM, Mexico, DF. pp. 453–502.

Oliveira, J.A. and C.R. Bonvicino. 2002. A new species of Sigmodontine rodent from the Atlantic forest of eastern Brazil. Acta Theriol. 47: 307–322.

Oliveira, J.A. and C.R. Bonvicino. 2006. Ordem Rodentia. In: (N. Reis, A. Peracchi, W. Pedro and I. Lima, eds) Mamíferos do Brasil. Londrina, SC. pp. 347–406.

Oliveira, J.A., G. Silveira, V.J. Rocha and C.E.F. Silva. 2005. Ordem Rodentia. In: (N. Reis, A. Peracchi, H. Fandiño-Mariño and V. Rocha, eds) Mamíferos da Fazenda Monte Alegre – Paraná. Eduel, Londrina, SC. pp. 161–191.

Olson, D.M. and E. Dinerstein. 2002. The Global 200: priority ecoregions for global conservation. Ann. Missouri Bot. Gard. 89: 199–224.

Olson, D.M., E. Dinerstein, E.D. Wikramanayake, N.D. Burgess, G.V.N. Powell, E.C. Underwood, J.A. D'Amico, I. Itoua, H.E. Strand, J.C. Morrison, C.J. Loucks, T.F. Allnutt, T.H. Ricketts, Y. Kura, J.F. Lamoreux, W.W. Wettengel, P. Hedao and K.R. Kassem. 2001. Terrestrial ecoregions of the world: a new map of life on Earth. Bioscience 51: 933–938.

Osgood, W.H. 1933. Two new rodents from Argentina. Field Mus. Nat. Hist. Publ., Zool. Ser., 20: 11–14.

Pardini, R., S.M. de Souza, R. Braga-Neto and J.P. Metzger. 2005. The role of forest structure, fragment size and corridors in maintaining small mammal abundance and diversity in an Atlantic forest landscape. Biol. Conserv. 124: 253–266.

Pardiñas, U.F.J., G. D'Elía, S. Cirignoli and P. Suarez. 2005. A new species of *Akodon* (Rodentia, Cricetidae) from the northern campos grasslands of Argentina. J. Mammalogy 86: 462–474.

Pardiñas, U.F.J., P. Teta, G. D'Elía, S. Cirignoli and P.E. Ortiz. 2007. Missing type localities of sigmodontine (Cricetidae, Sigmodontinae) rodents: some solutions. In: (D.A. Kelt, E.P. Lessa, J. Salazar-Bravo and J.L. Patton, eds) The quintessential naturalist: honoring the life and legacy of Oliver P. Pearson. University of California Publications in Zoology, Berkeley, CA. pp. 775–798.

Pardiñas, U.F.J., P. Teta, G. D'Elía and C. Galliari. 2008. Rediscovery of *Juliomys pictipes* (Rodentia: Cricetidae) in Argentina: emended diagnosis, geographic distribution, and insights on genetic structure. Zootaxa 1758: 29–44.

Percequillo, A.R., E. Hingst-Zaher and C.R. Bonvicino. 2008. Systematic review of genus *Cerradomys* Weksler, Percequillo and Voss, 2006 (Rodentia: Cricetidae: Sigmodontinae: Oryzomyini), with description of two new species from eastern Brazil. Am. Mus. Novitates 3622: 1–46.

Pine, R.H. 1980. Notes on rodents of the genera *Wiedomys* and *Thomasomys* (including *Wilfredomys*). Mammalia 44: 195–202.

Pine, R.H., 1982. Current status of South American mammalogy. In: (M. Mares and H. Genoways, eds) Mammalian biology in South America. Spec. Publ. Series, Pymat. Lab. Ecol., 6. University of Pittsburgh, Linesville, PA. pp. 27–37.

Rengger, J.R. 1830. Naturgeschichte der Säugethiere von Paraguay. Schweighauserschen Buchhandlung, Basel. pp. xvi+1–394.

Swofford, D. 2000. PAUP*: phylogenetic analysis using parsimony (*and other methods), version 4.0. Sinauer Associates Inc., Sunderland, MA.

Teta, P., U.F.J. Pardiñas and G. D'Elía. 2006. Rediscovery of *Chacodelphys*: a South American marsupial genus previously known from a single specimen. Mamm. Biol. 71: 309–314.

Teta, P., E. Muschetto, S. Maidana, C. Bellomo and P. Padula. 2007. *Gracilinanus microtarsus* (Didelphimorphia, Didelphidae) en la provincia de Misiones, Argentina. Mastozool. Neotrop. 14: 113–115.

Tribe, C.J. 1996. The Neotropical rodent genus *Rhipidomys* (Cricetidae: Sigmodontinae) – a taxonomic revision. Ph.D. Dissertation. University College, London. pp. 1–316.

Appendix I

Gazetteer of known collecting localities for *Juliomys pictipes* based on our Paraguayan record and those reported in the literature (Cherem et al. 2004, Cherem 2005, Oliveira et al. 2005, Costa et al. 2007, Pardiñas et al. 2008). Numbers in bold font correspond to the same numbered localities on the map (Figure 1). Italicized proper names in the list below are of the largest administrative units (states, departments, provinces, etc.) recognized within each country. Latitude (in negative decimal degrees South) and longitude (in negative decimal degrees West) are given between brackets after the most restrictive place name for which they could be determined; elevations are in meters. Localities included are those based on voucher specimens (as reported in the original references, above) and deposited in the following collections: Centro de Investigaciones Ecológicas Subtropicales, Puerto Iguazú, Misiones, Argentina (CIES); Colección de Mamíferos del Centro Nacional Patagónico, Puerto Madryn, Chubut, Argentina (CNP); Museo de La Plata, Buenos Aires, Argentina (MLP); Colección de Zoología, Universidad Nacional de Asunción, San Lorenzo, Paraguay (CZ); Museu de Biologia Mello Leitão, Santa Teresa, Brazil (MBML), Museu Nacional, Rio de Janeiro, Brazil (MN), Museu de Zoologia João Moojen de Oliveira, Universidade Federal de Viçosa, Viçosa, Brazil (MZUFV), Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil (MZUSP), Departamento de Zoologia, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG), Coleção de Mamíferos, Universidade Federal de Santa Catarina, Santa Catarina, Brazil (UFSC), Museum of Vertebrate Zoology, University of California, Berkeley, USA (MVZ), and Field Museum of Natural History, Chicago, USA (FMNH).

ARGENTINA

1. *Misiones*, Puerto Caraguatay [-26.616, -54.76], holotype (FMNH 26814); also includes, Parque Provincial "Ernesto Che Guevara", Arroyo de Salamanca [-26.614, -54.780], 147 m (CNP 895).

3. *Misiones*, Parque Nacional Iguazú, Sendero Macuco [-25.68, -54.43], approximately 200 m (CIES-M 23).

4. *Misiones*, Reserva Privada de Usos Múltiples de la Universidad Nacional de La Plata "Valle del Arroyo Cuña Pirú" [-27.083, -54.95], approximately 200 m (MLP 1.I.03.24).

PARAGUAY

2. *Alto Parana*, Refugio Biológico Limoy, North of Rio Limoy, [-24.80, -54.45], approximately 270 m (CZ 014).

BRAZIL

5. *Minas Gerais*, Estação de Pesquisa e Desenvolvimento Ambiental de Peti [-19.9, -43.37], 630–806 m (UFMG 3161–64).

6. *Minas Gerais*, Reserva Particular do Patrimônio Natural do Caraça, 25 km SW Santa Barbara [-20.08, -43.5], 1300 m (MN 69764, UFMG 3159–60).

7. *Rio de Janeiro*, Fazenda Boa Fé [-22.43, -42.98], 902 m (MN 62182).

8. *Rio de Janeiro*, Mata do Mamede [approximately -23, -44.32], no elevation provided (MN 69765).

9. *São Paulo*, Floresta Nacional de Ipanema, 20 km NW Sorocaba [-23.44, -47.63], 701 m (MVZ 197563-65, UFMG 3165-72).
10. *São Paulo*, Parque Natural Municipal da Serra do Itapety [-23.47, -46.15], 807–1141 m (MN uncataloged 61).
11. *São Paulo*, Reserva Florestal do Morro Grande, Caucaia do Alto [-23.68, -46.96], 800–1000 m (MZUSP 32263–66, 32649).
12. *São Paulo*, Piedade [approximately -23.72, -47.41], 800–1000 m (MZUSP31113).
13. *São Paulo*, Riacho Grande [approximately -23.80, -46.58], 777 m (MZUSP 30710, 30724, 30747, 30779).
14. *São Paulo*, Buri [approximately -23.81, -48.70], 666 m (MZUSP 31025).
15. *São Paulo*, Mulheres [-24.05, -48.37], 800–1000 m (MZUSP uncataloged AB 348, 388, 410).
16. *São Paulo*, Museros [-24.22, -48.40], 800–1000 m (MZUSP uncataloged AB 402, 562).
17. *São Paulo*, Fragmento Citadini [-24.06, -48.39], 800–1000 m (MZUSP uncataloged AB 78).
18. *São Paulo*, Fragmento Divisa [-24.06, -48.37], 800–1000 m (MZUSP uncataloged AB 75).
19. *São Paulo*, Três Quedas [-24.22, -48.37], 800–1000 m (MZUSP uncataloged AB 571).
20. *São Paulo*, Moacir [-24.22, -48.37], 800–1000 m (MZUSP uncataloged AB 378).
21. *São Paulo*, Paraguai [-24.23, -48.39], 800–1000 m (MZUSP uncataloged AB 559, 591).
22. *São Paulo*, Cogumelo [-24.23, -48.38], 800–1000 m (MZUSP uncataloged AB 557).
23. *São Paulo*, Fazenda Sakamoto, Campinho [-24.18, -48.24], 800–1000 m (MZUSP uncataloged AB 110, 113, 115, 141, 143, 145).
24. *São Paulo*, Fazenda Sakamoto, Portão [-24.18, -48.24], 800–1000 m (MZUSP uncataloged AB 124).
25. *São Paulo*, Fazenda Intervales [-24.33, -48.42], 700 m (MN 60570-71, 69766, MVZ 182079).
26. *Paraná*, Telêmaco Borba: Fazenda Monte Alegre [-24.2, -50.55], 885 m (MN 68336, MN 68347).
27. *Santa Catarina*, Barragem do rio São Bento [-28.60, -49.55], approximately 190 m (UFSC 3404).
28. *Santa Catarina*, Santo Amaro da Imperatriz [-27.68, -48.78], no elevation provided (UFSC 652, UFSC 670, UFSC 862-864).