ARTÍCULO

STATUS, CONSERVATION AND DISTRIBUTION OF PARAGUAYAN HYSTRICOMORPHA 2. ECHIMYIDAE (RODENTIA)

Estado, conservación y distribución de la hystricomorpha 2 de Paraguay. Echimyidae (Rodentia)

Smith, P. * [1]

ABSTRACT: Six species of spiny rat (Echimyidae) have been documented to occur in Paraguay belonging to two subfamilies: Echimyinae (4 species in 4 genera) and Euryzgomatomyinae (2 species in 2 genera). No species have been the subject of specific field studies in Paraguay. Only one species is widespread through the country: *Myocastor coypus*. Two species show ecoregion associations: *Clyomys laticeps* (Cerrado) and *Kannabateomys amblyonyx* (Atlantic Forest). For several species the current national IUCN threat classification is considered to inadequately reflect threat levels.

KEYWORD: *Clyomys, Euryzygomatomys, Kannabateomys, Myocastor, Proechimys, Thrichomys.*

RESUMEN: *Se ha documentado la presencia de seis especies de ratas espinosas (Echimyidae) en Paraguay pertenecientes a dos subfamilias: Echimyinae (4 especies en 4 genera) y Euryzgomatomyinae (2 especies en 2 genera). Ninguna especie ha sido objeto de estudios de campo específicos en Paraguay. Sólo una especie está muy extendida en todo el país: Myocastor coypus. Dos especies muestran asociaciones ecorregionales: Clyomys laticeps (Cerrado) y Kannabateomys amblyonyx (Bosque Atlántico). Para varias especies, se*

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considera que la actual clasificación nacional de amenazas de la UICN no refleja adecuadamente los niveles de peligro de extinción.

PALABRAS CLAVES: *Clyomys, Euryzygomatomys, Kannabateomys, Myocastor, Proechimys, Thrichomys*

INTRODUCTION

Six species of Echimyidae occur in Paraguay which can be classified in two subfamilies according to the latest taxonomic review (Fabre *et al*., 2017): Echimyinae (4 species in 4 genera) and Euryzgomatomyinae (2 species in 2 genera). The formerly recognized monotypic family Myocastoridae is now included within Echimyidae (Patton *et al*., 2015; Fabre *et al*., 2017).

Despite three of these species being included in the earliest Paraguayan mammalian works, they remain poorly known in the country and few records exist for most species. The first species to be documented in Paraguay were *Myocastor coypus* and *Euryzygomatomys spinosus* (Azara, 1802), and these species was also found by Rengger (1830) in addition to a third species, *Proechimys longicaudatus*, which he described for the first time. It was then almost a century before two additional species were collected by William Foster at Sapucaí, *Kannabateomys amblyonyx pallidior* and *Thrichomys fosteri*, these being described as a new subspecies and species respectively by Thomas (1903) and still considered valid today. The final species to be documented in the country was *Clyomys laticeps*, this also being described as a new subspecies *C. l. whartoni* Moojen,1952, although this taxon is no longer recognized as valid.

In the first attempt to list the mammals of Paraguay of the 20th Century Bertoni (1914, 1939) included six echimyids along with *Ctenomys* in the family Octodontidae. He stated erroneously that *Echymys longicaudatus* Rengger (sic) was “probably a variety of *E. cayennensis*” Desmarest, a name now in the synonymy of *Proechimys guyannensis* (É. Geoffroy St.-Hilaire, 1803), which is distributed north of the Amazon River (Smith, 2024). He omitted *Clyomys laticeps* (which had still not been documented), but included as the sixth species *Loncheres cristatus* (Desmarest, 1817) on the basis of Trouessart (1897) who

included Paraguay in a composite distribution associated with that name. It seems that this unidentifiable name was included entirely *fide* Trouessart, and Bertoni may not have known what species was intended by it, he frequently ceding to the knowledge of whom he considered learned colleagues in his works (Smith, 2024).

There have been no field studies focusing specifically on Echimyids in Paraguay. However, several named taxa have their type locality in the country (Rengger, 1830; Thomas, 1903; Moojen, 1952). One taxonomic study focused principally on Paraguayan specimens, revalidating the species *T. fosteri* (D` Elía and Myers, 2014).

Several reviews of the national conservation status of Paraguayan Echimiyids have been published (Gamarra de Fox *et al*., 1998; Morales, 2007; CDC, 2009; Saldívar *et al*., 2017). The latest review considered three species to be nationally Data Deficient (*Euryzygomatomys spinosus, Kannabateomys amblyonyx* and *Proechimys longicaudatus*), and three species to be Least Concern (*Clyomys laticeps, Myocastor coypus* and *Thrichomys fosteri*). The Ministerio de Ambiente y Desarrollo Sostenible (MADES) does not follow IUCN categorizations, and does not consider any species of echimyid to be threatened (Resolución 632-2017). None of the species are listed by CITES. Comments on these assessments are made in the species accounts and discussion.

This work represents the first attempt to review what is known of the Paraguayan Echimyidae and to summarise their distribution with respect to ecoregion associations.

MATERIAL AND METHODS

Specimens of Echimyidae from the major zoological collections in Paraguay were reviewed during 2022-2023, identifications were confirmed by inspection of the specimens and locality data was collated from museum databases and specimen labels. The location of specimens in non-Paraguayan museums was gleaned from the literature and from Vert Net (which returned 77 results for Echimyidae and 11 for Myocastoridae). Where possible specimens considered to represent significant geographical range extensions were reviewed with the

assistance of museum curators. Those that did not present noteworthy distributions were assumed to be correct and not examined.

Collection codes for museums housing Paraguayan specimens are as follows (number of specimens housed in parentheses):

AMNH (3) American Museum of Natural History, New York, USA.

CBMI (2) Colección Biológica Mamíferos Itaipú, Hernandarias, Paraguay.

CZPLT (38) Colección Zoológica Para La Tierra, Pilar, Paraguay.

FMNH (3) Field Museum of Natural History, Chicago, USA.

HI (2) Harrison Institute, Cambridge University, Cambridge, UK.

MACN (1) Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina

MCZ (1) Museum of Comparative Zoology of Harvard, Cambridge, USA.

MHNG (1) Museum d'Histoire Naturelle Genève, Geneva, Switzerland.

MNHNP (7) Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay.

MNRJ (4) Museu Nacional da Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.

MSB (4) Museum of Southwestern Biology, Albuquerque, New Mexico, USA.

MTD (4) Staatliches Museum für Tierkunde, Dresden, Germany.

MVZ (10) Museum of Vertebrate Zoology, Berkley, California, USA.

MZUSP (1) Museu de Zoologia, Universidade de São Paulo, Brazil.

NHM (2) Natural History Museum, London, UK.

TTU (20) Museum of Texas Tech University, Lubbock, USA.

UACH (8) Colección de Mamíferos, Universidad Austral de Chile, Valdivia, Chile

UMMZ (40) University of Michigan, Ann Arbor, USA.

UMZC (1) University Museum of Zoology, Cambridge, UK.

USNM (10) United States National Museum, Smithsonian Institution, Washington, USA.

Species accounts begin with the current common name, scientific name and author is presented for each species in bold type following Patton *et al*. (2015). The original described name, author and type locality follow. There then follows a referenced list of the synonyms used in the Paraguayan literature with a (hopefully self-explanatory) single word descriptor of the subject of the publication, as follows: biogeography, checklist, conservation, description, distribution, guide, history,

mention, mortality, nomenclature, parasitology, specimen/s, taxonomy, tracks and uses.

The synonymy deals only with Paraguayan literature or literature citing Paraguayan specimens and is not intended to be a complete list of synonymy for the species.

Local names: All local common names published in the Paraguayan literature known to us are provided. An attempt to reference the earliest published usage for each name is made.

Comments: Addressing noteworthy or confusing themes in the Paraguayan literature.

There then follows a "hierarchical reliability" approach to the Paraguayan distribution of each species by department (Fig. 1). This approach is taken so as to not unduly bias understanding by depending solely on the limited specimen record. The hierarchies are, in order of documented reliability: 1) examined specimen, 2) specimen not examined, 3) published literature record, 4) published or author examined photographic record, 5) reliable field observation by one of the authors or knowledgeable local observer. Records are presented with the political department in bold capitals, followed by the details of the record (in alphabetical order). For specimen records this involves the specimen number (museum codes) followed by the locality. These records are also mapped distinguishing the hierarchical categories so that readers may interpret their reliability for themselves. Records corresponding to categories 4) published

Fig. 1. Map showing the political departments of Paraguay: Chaco region – Alto Paraguay (APY), Boquerón (BOQ), Presidente Hayes (PHA); Oriental region – Amambay (AMA), Alto Paraná (APA), Caaguazú (CAA), Canindeyú (CAN), Caazapá (CAZ), Central (CEN), Concepción (CON), Cordillera (COR), Guairá (GUA), Itapúa (ITA), Misiones (MIS), Ñeembucú (ÑEE), Paraguarí (PAR), San Pedro (SPE).

photographic record, 5) reliable field observation; include only localities that are not covered by any one of the previous three categories.

The criteria for inclusion of literature was that it was published in Paraguay or specifically deals with Paraguay, or in the case of international publications that it makes specific reference to Paraguayan specimens. The maps included in Neris *et al*. (2002) were omitted from this compilation. These maps were based on interviews with local people and contain numerous, obvious errors that I am keen not to perpetuate here. Also excluded are the results of Rapid Ecological Evaluations produced and published locally, due to the tendency amongst authors to extrapolate distributions without the necessary evidence in an effort to enhance the results produced after limited field time. Every effort was made to be thorough in this regard, though undoubtedly some obscure references will have been missed.

A statement on the ecological affinities of each species in Paraguay is provided based on the ecoregions defined in Guyra Paraguay (2005) and Mereles (2013) (Fig. 2). These can be broadly defined as follows: Atlantic Forest (subtropical humid forests of eastern Paraguay); Cerrado (central South American bushy savanna of northern eastern Paraguay); Dry Chaco (low, arid thorn forest and scrub of the western Occidental region); Humid Chaco (palm savanna and marshlands of the Paraguay River Basin); Pantanal (gallery forests and swamps of the north-eastern Chaco); Cerrados del Chaco (an area of Cerrado in the northern Chaco contiguous

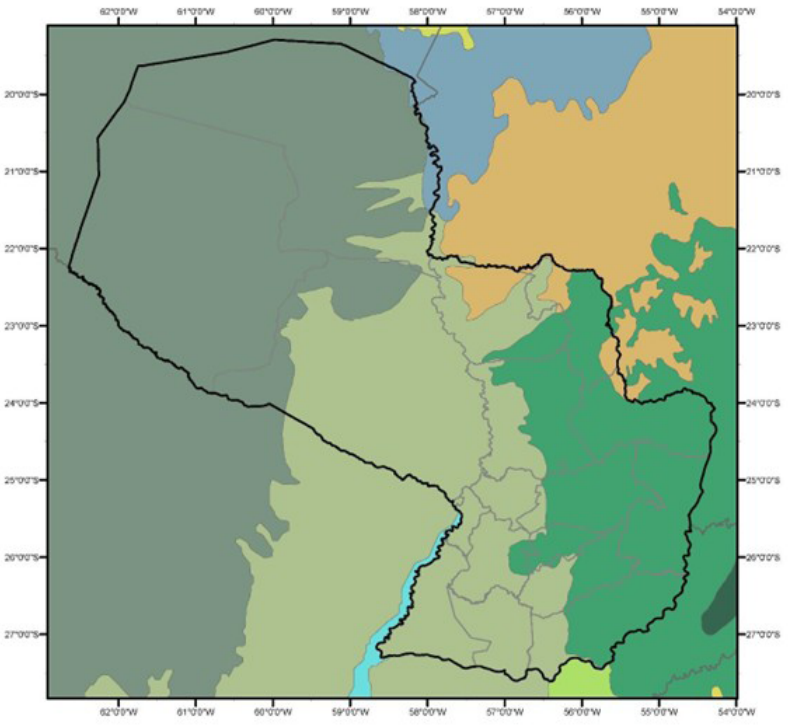

Fig. 2. Map showing Paraguayan ecoregions. Blue (Pantanal); Dark Green (Dry Chaco and Cerrados del Chaco); Light Green (Humid Chaco); Orange (Cerrado); Bright Green (Atlantic Forest).

with the Chiquitania of Bolivia) and Mesopotamian Grasslands (flooded grasslands of the southern Oriental region).

RESULTS

Subfamily Echimyinae Gray, 1825

Tribe Myocastorini Fabre *et al*., 2017

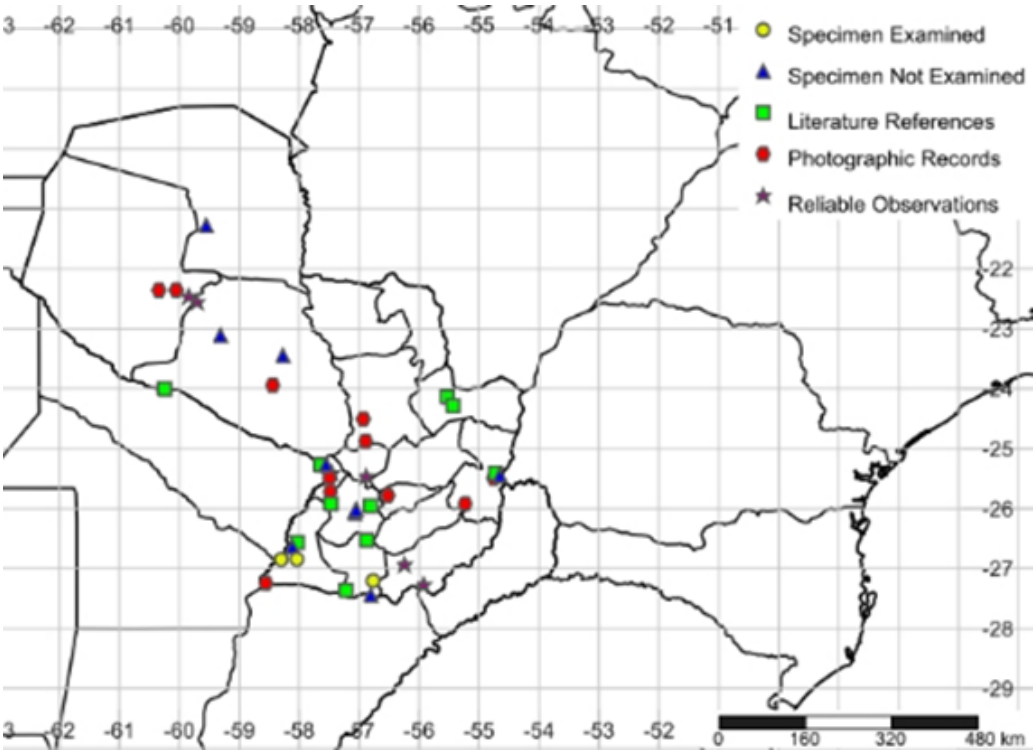

Fig. 3. Distribution of *Myocastor coypus* in Paraguay.

Coypu *Myocastor coypus* (Molina, 1782) (Fig. 3)

Mus coypus Molina, 1782: 287. Type locality “Rio Maipo, Santiago Province, Chile.”

Myopotamus Bonariensis É. Geoffroy St.- Hilaire, 1805: 82. Type locality “Rio Parana, Paraguay” assigned by Woods *et al*. (1992).

Myopotamus Bonariensis Rengger (1830: ecology)

Myocastor coypus Bertoni (1914: checklist); Migone (1916: parasitology); Bertoni (1939: checklist); López (1986: distribution); Van Humbeck and Silvera Avalos (1995: distribution); Gamarra de Fox and Martin (1996: distribution); Gamarra de Fox *et al*. (1998: conservation); Yahnke *et al*. (1998: distribution);

Villalba and Yanosky (2000: tracks); Esquivel (2001: guide); Fariña and Hostettler (2003: checklist); Cartes (2004: habitat); Neris and Franco Rivarola (2005: guide); Guyra Paraguay (2008: conservation, distribution); Itaipú Binacional (2010: guide); Patton (2015: specimens, taxonomy); de la Sancha *et al*. (2017: checklist); Saldívar *et al*. (2017: conservation); Epp (2018: guide); Gengler (2018: distribution); Ortega and Weiler (2018: mortality); Weiler *et al*. (2019: guide); Weiler *et al*.(2020: mention); Smith (2024: ethnography, history); Weiler *et al*. (2023: guide); Martínez *et al*. (2024: mortality); Entidad Binacional Yacyretá (undated: guide)

Myocastor coipus Cartes (2004: habitat); Rumbo (2010: biogeography)

Myocastor coypu Myers *et al*. (1982: distribution); Myers *et al*. (2002: distribution)

Myocaster coypus Masi Pallarés (2011: guide)

Local names: **ACHE:** Pavya pura (Esquivel, 2001); Pavyá purá (Villalba and Yanosky, 2000); **GUARANÍ:** Kihyá (Bertoni, 1914); Kyhdyá (Migone, 1916); Kyja (Itaipú Binacional, 2010); Ky'ja (Villalba and Yanosky, 2000); Quiyá (Azara, 1802); **MENNO:** Biberratte (Epp, 2018); **SPANISH:** Castor (Van Humbeck and Silvera Avalos, 1995); Coipo (Esquivel, 2001); Coypo (Esquivel, 2001); Falsa nutria (Esquivel, 2001); Nutria (Azara, 1802); Ratón de bañado (Itaipú Binacional, 2010);

Azara (1802) considered that the name Quiyá was derived from "master of the lice" in reference to a supposed high parasite load, but Smith (2024) argued that it is more likely a contraction of Qui jara meaning "largest of the Quis", with Qui referring to a large rodent.

Comments: This is the *Quiyá* of Azara (1802, 2: 1) and *le Quouiya* of Azara (1801, 1: 5). Azara (1802) described the species as "scarce" in Paraguay and noted that they are easily domesticated. Rengger (1830) also noted the scarcity of the species in the country.

Three (Hollister, 1914) or four (Osgood, 1943) subspecies are sometimes recognized, with Paraguayan specimens usually attributed to *M. c. bonariensis* (É. Geoffroy St.- Hilaire, 1805) (Cabrera, 1961). However, no modern analysis has tested the validity of these subspecific units (Emmons *et al*., 2015; Patton, 2015). Allen (1895), Tate (1935) and Osgood (1943) summarized the nomenclatural history of

this monotypic genus and these were updated by Patton (2015).

De la Sancha *et al*. (2017) recognized the monotypic the family Myocastoridae Ameghino, 1902 but molecular data suggests that it is a subfamily nested within the Echimyidae (Leite and Patton, 2002; Carvalho and Salles, 2004; Galewski *et al*., 2005; Upham and Patterson, 2012; Patton, 2015). It had previously been treated as a subfamily of the Capromyidae Smith, 1842 (e.g. Masi Pallarés, 2011), but that family is now also usually treated as a subfamily of Echimyidae (Patton *et al*., 2015)

Geographical distribution: Widespread at low density in temporary and permanent open and semi-open wetlands across the country, and occurring in all ecoregions. Largely associated with major rivers and their tributaries and floodplains (especially the Paraguay River), with the historic extent of the Atlantic Forest perhaps previously acting as a barrier to dispersal.

The species is typically uncommon, and at least in the Dry Chaco (Alto Paraguay, Boquerón departments) undertakes local nomadic movements in response to water availability. Western limits to the range in the xeric Dry Chaco of Boquerón may be limited by the presence of permanent or semi-permanent water sources. To date there are no confirmed reports from Amambay, Caaguazú, Caazapá or Concepción departments, but presence in those departments seems likely.

The misleading biogeographical associations postulated by Rumbo (2010) are the result of applying the mapped geographical ecoregions of Dinerstein (1995) to an incomplete dataset and without reference to on the ground habitat data. Considered to be of Least Concern by the latest IUCN review (Saldívar *et al*., 2017), however the species is a popular target for subsistence hunters.

Examined specimens: **MISIONES:** 4 km S of Santiago on Ruta 20 (CZPLT 1530); **ÑEEMBUCÚ:** Estancia Santa Ana (CZPLT 550); Pilar Military Base (CZPLT 549).

Specimens not examined: **"Paraguay"** UMMZ 2645, 85388 **ALTO PARAGUAY:** Estancia Tres Marias (TTU 79836; Patton, 2015); **ALTO PARANÁ:** Hernandarias (CBMI 107, 109); **CENTRAL:** Asunción (AMNH 234803; Rengger, 1830; Torres *et al*., 2021); **ITAPÚA:** Isla Yacyretá (MNHNP 1235, 1236, 1237; Gamarra de Fox and Martin, 1996): **ÑEEMBUCÚ:** Estancia Yacare (TTU 80583; Patton, 2015); **PARAGUARÍ:** 7km SSW Ybycuí (UMMZ 124716); Ybycuí (UMMZ 124717; Gamarra de Fox and Martin, 1996,

Yahnke *et al*. 1998; Patton, 2015); **PRESIDENTE HAYES:** 2 km SW of headquarters Estancia Juan de Salazar (MSB 57389; Patton, 2015); Waikthlatingmayalwa (UMZC E3364).

Literature references: **ALTO PARANÁ:** Area of influence of Itaipú reservoir (Van Humbeck and Silvera Avalos, 1995; Gamarra de Fox and Martin, 1996); **CANINDEYÚ:** Reserva Bosque Mbaracayú (Esquivel, 2001; Fariña and Hostettler, 2003); Reserva de Patrimonio Aché de Kuetuvy (Centrón *et al*., 2013); **CENTRAL:** Bahía de Asunción (Guyra Paraguay, 2008); **CENTRAL/CORDILLERA/SAN PEDRO:** Ruta III (Ortega and Weiler, 2018); **CENTRAL/PARAGUARÍ:** Lago Ypoá (Guyra Paraguay, 2008); **MISIONES:** Estancia La Graciela (Guyra Paraguay, 2008); Refugio de Vida Silvestre Yabebyry (Gamarra de Fox and Martin, 1996, Guyra Paraguay, 2008); **ÑEEMBUCÚ:** Estancia Redondo (Guyra Paraguay, 2008); **PARAGUARÍ:** Isla Alta (Gengler, 2018); **PRESIDENTE HAYES:** Estero Patiño (Guyra Paraguay, 2008).

Photographic records: **ALTO PARANÁ:** c20km S of Santa Rita at -25.920253 -55.231985 (https://www.inaturalist.org/observations/124367122); Ciudad del Este (https://www.inaturalist.org/observations/105675029); **BOQUERÓN:** Colonia Fernheim (CON; Ro Si); Fortín Toledo (FPMAM802PH); **CENTRAL:** Guarambaré (CON; Christian Benítez); **CORDILLERA:** Arroyos y Esteros, km69 of Ruta III (CON; Oscar Bordon); **ÑEEMBUCÚ:** Paso de Patria (Sergio D. Ríos); **GUAIRÁ:** Villarrica (CON; Marcos Saldívar); **PARAGUARÍ:** Pacheco, Carapeguá (CON; Sever Páez Mendoza); **PRESIDENTE HAYES:** Puerto Falcón (CON; Oscar Bordon); Ruta Tranchaco km 200 (FPMAM799PH); **SAN PEDRO:** Colonia Volendam (CON; Marko Fast).

Reliable observations: **CENTRAL:** Itauguá (Dominic Oviedo-Löwen); **CORDILLERA:** Ruta 2 km 88 near Itacurubí de la Cordillera (Sergio D. Ríos); **ITAPÚA:** Arroyo Quiteria, Ita Paso (Oscar Ramírez); General Artigas (José Paredes); **PRESIDENTE HAYES:** Hoffnungshau (PS); Loma Plata, lagoons on access road (PS).

Long-tailed Spiny-Rat *Proechimys longicaudatus* (Rengger, 1830) (Fig. 4)

Echimys Longicaudatus Rengger, 1830: 236. Type locality “below the 21st parallel, northern Paraguay”.

Echymys longicaudatus Bertoni (1914: checklist, distribution); Bertoni (1939: checklist, distribution)

Proechimys longicaudatus Myers *et al*. (1982: distribution); Patton (1987: taxonomy); Gamarra de Fox *et al*. (1998: conservation); Yahnke *et al*. (1998: distribution); Myers *et al*. (2002: distribution, nomenclature); Ziegler *et al*. (2002: distribution, specimens); Rumbo (2010: biogeography); Patton and Leite (2015: taxonomy) de la Sancha *et al*. (2017: checklist); Saldívar *et al*. (2017: conservation); Smith (2024: history)

Proechimys c.f. *longicaudatus* Gamarra de Fox and Martin (1996: distribution)

Proechimys longuicaudatus Gamarra de Fox *et al*. (1998: conservation)

Local names: **GUARANÍ:** Anguja (Gamarra de Fox *et al*., 1998); **SPANISH:** Ratón espinoso (Gamarra de Fox and Martin, 1996).

Comments: Thomas (1904: 240) erred in saying that "Rengger's type was obtained on the 21st parallel of latitude; therefore, not far south of Corumbá". Rengger (1830: 236) in fact wrote: "The wild guaranies, *who live in Paraguay below the one and twentieth parallel*, brought me a second genus of spiny rats during my stay among them in 1821" [my emphasis]. Rengger's locality is thus considerably farther south than Corumbá which lies on the 19th parallel (Smith, 2024). The current concept of *P. longicaudatus* is probably a species complex (Patton and Leite, 2015), but the type locality is in Paraguay meaning that the name will be retained for Paraguayan populations regardless of any future taxonomic changes.

Patton (1987) stated that a specimen from "54 km E of Agua Dulce" was "to be deposited in the National Museum, Asunción, Paraguay" but I was unable to locate a specimen in the collection with that locality.

Geographical distribution: Terrestrial. Restricted to the northern Paraguayan Chaco in Alto Paraguay department. Gamarra de Fox *et al*. (1998) considered the species "Threatened" on the basis of "restricted range". Considered Data Deficient by the latest IUCN review (Saldívar *et al*., 2017), but this may be an artefact of the distribution reflecting a poorly-sampled area of the country.

Examined specimens: **ALTO PARAGUAY:** Palmar de las Islas (CZPLT-M 698, 791).

Specimens not examined: **ALTO PARAGUAY:** Cruce 4 de Mayo (MNHNP 1740, 1742; Gamarra de Fox and Martin, 1996; Yahnke *et al*., 1998); Fortín Madrejón (MTD 24905, 24906, 24907, 24908; Ziegler *et al*., 2002).

Literature references: **ALTO PARAGUAY:** 54 km E of Agua Dulce (Patton, 1987; Patton and Leite, 2015).

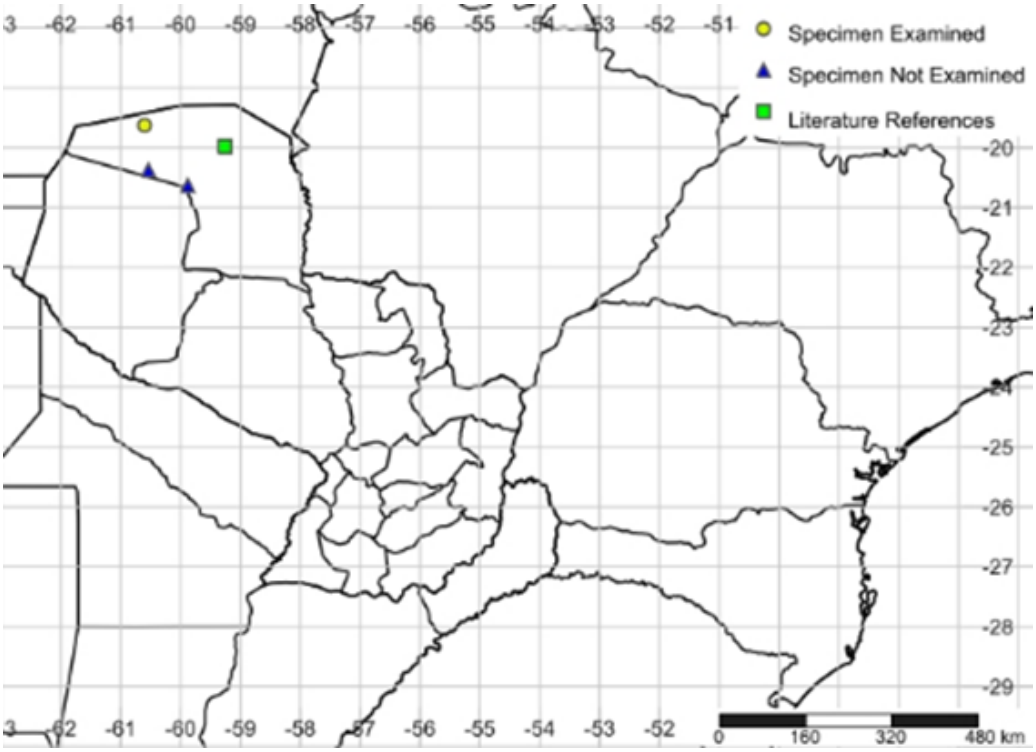

Fig. 4. Distribution of *Proechimys longicaudatus* in Paraguay.

Paraguayan Punaré *Thrichomys fosteri* Thomas, 1903 (Fig. 5)

Thrichomys fosteri Thomas, 1903:227. Type locality "Sapucay, Paraguay."

Trichomys fosteri Bertoni (1914: checklist, distribution); Bertoni (1939: checklist, distribution)

Thrichomys apereoides Myers *et al*. (1982: distribution); Gamarra de Fox and Martin (1996: distribution); Gamarra de Fox *et al*. (1998: conservation)

Trichomys apereoides Gamarra de Fox *et al*. (1998: conservation); Yahnke et al. (1998: distribution)

Thrichomys aperiodes Myers *et al*. (2002: distribution, nomenclature)

Thricomys aperiodes Myers *et al*. (2002: distribution, nomenclature)

Thricomys fosteri Myers *et al*. (2002: distribution, nomenclature)

Trychomys apereoides Rumbo (2010: biogeography)

Thrichomys fosteri D'Elia and Myers (2014: taxonomy); de la Sancha *et al*. (2017:

checklist); Saldívar *et al*. (2017: conservation); Smith (2024: history)

Thrichomys pachyurus Pessôa et al. (2015: specimens, taxonomy)

Local names: **GUARANÍ:** Anguja (Gamarra de Fox *et al*., 1998); **SPANISH:** Ratón espinoso (Gamarra de Fox and Martin, 1996).

Comments: Thrichomys fosteri was long treated as a synonym of *T. pachyurus* (Wagner, 1845: 146), until its specific distinctiveness was demonstrated (Nascimento *et al*., 2013; D'Elía and Myers, 2014). The nomenclatural history of this species was discussed in detail by D'Elía and Myers (2014). The species is named after the British-born, Paraguayan-based collector Guillermo Foster who collected the type specimen.

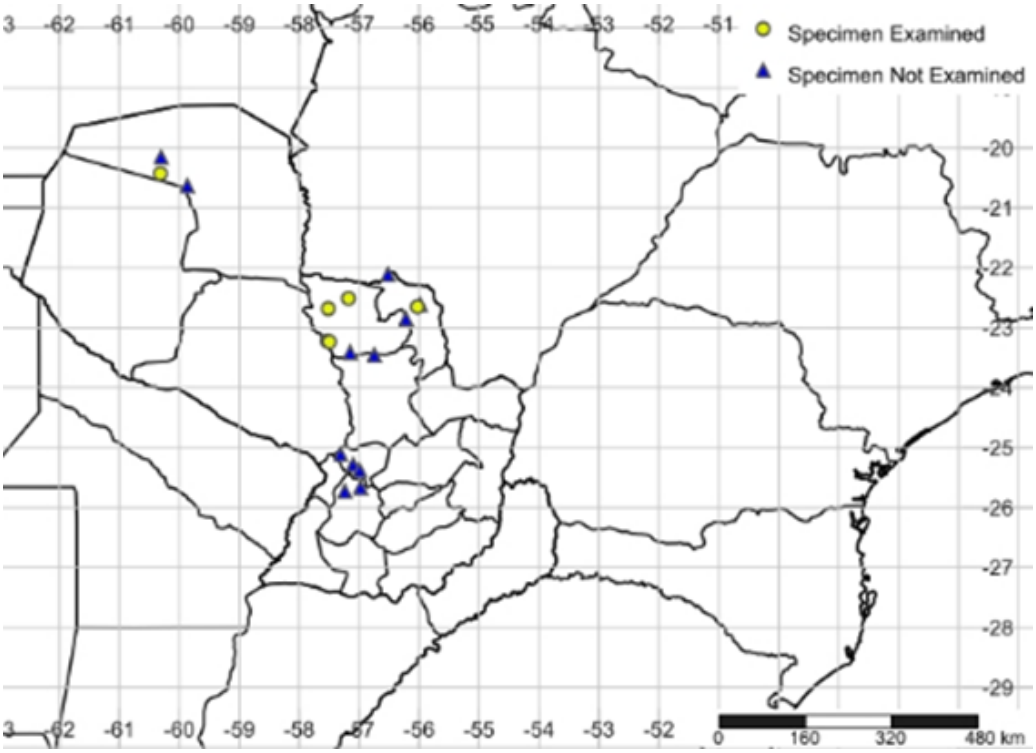

Fig. 5. Distribution of *Thrichomys fosteri* in Paraguay.

Geographical distribution: Rupicolous and semi-arboreal. Generally, in rocky areas where it is localized, but common in undergrowth of sub-humid forests that tend towards dry, in the northern Chaco, Cerrado and Central Forests ecoregions. Absent from xeric Dry Chaco forests and humid Atlantic Forest areas where rock formations are scarce or absent. Records are from Amambay, Alto Paraguay, Concepción, Paraguarí and Cordillera. The erroneous biogeographical associations

postulated by Rumbo (2010) are the result of applying the mapped geographical ecoregions of Dinerstein (1995) without reference to on the ground data.

Gamarra de Fox *et al*. (1998) considered the species “Threatened” on the basis of “restricted range”. Considered to be of Least Concern by the latest IUCN review (Saldívar *et al*. 2017).

Examined specimens: **ALTO PARAGUAY:** Cerro León (CZPLT 677, 679, 699, 702, 800); **AMAMBAY:** Antebi 22º 40.9' S 57º 30.9' W (CZPLT 681); Parque Nacional Cerro Corá (CZPLT 669, 673; Yahnke *et al*., 1998); **CONCEPCIÓN:** Estancia Santa Clara (CZPLT 674); Parque Nacional Serranía San Luis (CZPLT 667, 685, 692, 694, 753, 754); Property of Marcial Concha at 23º 14.12' S 57º 29.68' W (CZPLT 689, 696).

Specimens not examined: **ALTO PARAGUAY:** 50 km WNW of Fortín Madrejón, Misión Nuevo Tribu (UMMZ 124302, 125552, 125618; D‘Elia and Myers, 2014; Pessôa *et al*., 2015); Cerro León (TTU 118685, 118686, 118687, 118688, 118689, 118690, 118691); Parque Nacional Defensores del Chaco (MNHNP 640; Yahnke *et al*., 1998); **AMAMBAY:** 4 km by road SW of Cerro Corá (AMNH 248464, 248464, UMMZ 125549, 125550, 125551, D‘Elia and Myers, 2014); 28 km SW of Pedro Juan Caballero (UMMZ 125301; Gamarra de Fox and Martin, 1996; Pessôa *et al*., 2015); 32 km SW by road from Cerro Corá at -22.8543 -56.2201 (MSB 82569); Colonia Sargento Duré, Bella Vista del Norte (MSB 82570); **CONCEPCIÓN:** 8 km E of Concepción by road (MVZ 145309, 145320, 145321, 145322, 145323; Gamarra de Fox and Martin, 1996; Pessôa *et al*., 2015); Parque Nacional Serranía San Luis (TTU 118693, 118694, 118695, 118696, 118697, 118698); Property of Marcial Concha at 23º 14.12' S 57º 29.68' W (TTU 118693); Tacuatí, Aca-Poi (MNRJ 42373, 42374, USNM 293162, 293163); Villa Sana (=Paso Barreto) (HI 36, 38); **CORDILLERA:** 1.6 km south by road from Tobatí (MVZ 154324, 154325, 154326; UMMZ 126044, 126045, 126046, 126047, 126048, 126049, 126050, 126092, 126093, 126094, 126095, 126096, 126097, 126098, 126099, 126285, 134548, 134544, 134545, 134546, 134547; Gamarra de Fox and Martin, 1996; D‘Elia and Myers, 2014); 16 km NE from Piribebuy, at km82 (MSB 67449); Compañia Minas Cué near Emboscada, property of Filipinni Mora family (UMMZ 174959, 174960, 174963, 174964,

174966, 174967, 175100, UACH 7264, 7265, 7266, 7267, 7268, 7269, 7270, 7271, D'Elia and Myers, 2014); **PARAGUARÍ:** Saltos de Piraretá, 17 km SE Piribebuy by road (USNM 124301, 134549; Gamarra de Fox and Martin, 1996; D'Elia and Myers, 2014); Sapucay (FMNH 18202, 18203, 18204, MCZ 17767, MZUSP 002013, USNM 121408, 121409, 121410, 121411; Type specimen: NHM 1903.2.3.28; Gamarra de Fox and Martin, 1996; Pessôa *et al*., 2015).

Subfamily Echimyinae Gray, 1825
Tribe Echimyini Fabre *et al*., 2016

Atlantic Bamboo-Rat *Kannabateomys amblyonyx* Wagner, 1845 (Fig. 6)

Dactylomys amblyonyx Wagner, 1845: 146. Type locality "Ypanema".

Kannabateomys amblyonyx pallidior Thomas (1903: specimen, subspecies description); Myers *et al*. (2002: distribution, ecology, nomenclature)

Dactylomus amblionyx Bertoni (1914: checklist, distribution)

Dactylomys amblyonyx Bertoni (1939: checklist, distribution)

Kannabateomys amblyonyx Myers *et al*. (1982: distribution); Gamarra de Fox and Martin (1996: distribution); Gamarra de Fox *et al*. (1998: conservation); Yahnke *et al*. (1998: distribution); Myers *et al*. (2002: distribution, ecology, nomenclature); Cartes (2004: habitat); Morales (2007: conservation); CDC (2009: conservation); Rumbo (2010: biogeography); Emmons *et al*. (2015: specimens, taxonomy); de la Sancha *et al*. (2017: checklist); Saldívar *et al*. (2017: conservation); Owen *et al*. (2018: distribution, specimen); Smith (2024: history)

Kannabateomys amblyonix Gamarra de Fox *et al*. (1998: conservation); (2004: habitat); Cartes (2007: mention)

K.[annabateomys] amblyonyx Cartes (2007: mention)

Local names: **GUARANÍ:** Anguja (Gamarra de Fox *et al*., 1998); **SPANISH:** Rata tacuarera (Gamarra de Fox and Martin, 1996).

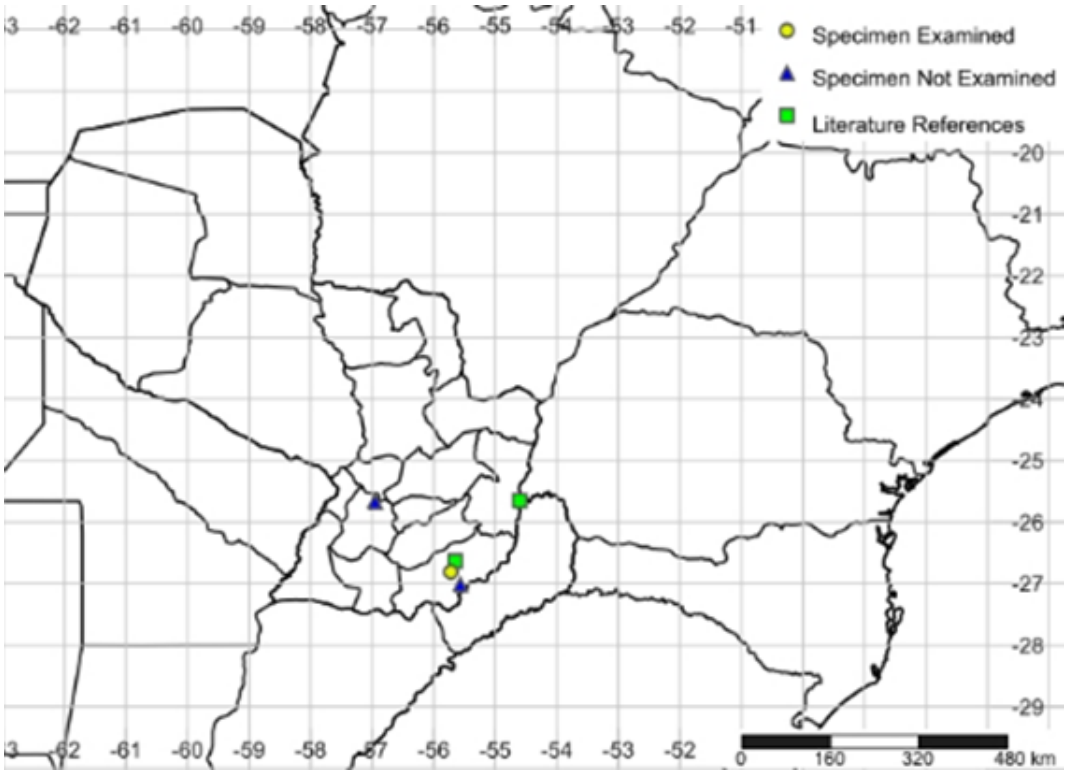

Fig. 6. Distribution of *Kannabateomys amblyonyx* in Paraguay.

Comments: Thomas described a new subspecies *K. a. pallidior* Thomas, 1903: 489 (Type locality Sapucay, 25° 40′ 04″ S 56° 57′ 20″ W) largely on the basis of the paler body colouration, especially highlighting the whiteness of the venter. However, he considered the skull to be identical to the nominate form and considered that it was too essentially similar in other respects to be regarded as more than a subspecies. I note that the most recently collected Paraguayan specimen (CZPLT-M 486) that I was able to examine also shows most of these subspecific characteristics. The subspecies is still considered valid, but a revision of the genus may be required (Emmons *et al*., 2015; de la Sancha *et al*., 2017)

Owen *et al*. (2018) raises questions about the collection locality of Capitán Meza for specimen MACN 336 collected by Adolf Neunteufel, suggesting it may have been a shipping locality. I agree that many of the specimens attributed to this locality in the museum database clearly did not come from this locality, however according to the map of collecting localities in his autobiography the majority of Neunteufel's collecting work was carried out in Itapúa department, Paraguay (Neunteufel, 1941).

Geographical distribution: Arboreal. An Atlantic Forest endemic species confined to

humid forest areas with bamboo stands, suggesting some affiliation to riparian areas. There are very few Paraguayan records, and the species is clearly uncommon. All modern records are from Itapúa department, but an old specimen from Paraguarí department (NHM 1903.4.7.20, collected 14 November 1902 by William Foster) and a literature report from Alto Paraná (Bertoni, 1914, 1939) suggest that at least previously the species may have been widespread through the Atlantic Forest zone of the Oriental region. The erroneous biogeographical associations postulated by Rumbo (2010) are the result of applying the mapped geographical ecoregions of Dinerstein (1995) without reference to on the ground data.

Gamarra de Fox *et al.* (1998) considered the species "Threatened" on the basis of "restricted range" and it was declared "in danger of extinction" by CDC (2009). Considered Data Deficient by the latest IUCN review (Saldívar *et al*., 2017), but I consider that endemism to the highly fragmented and rapidly disappearing Atlantic Forest ecoregion probably qualifies it for some level of threat status.

Examined specimens: **ITAPÚA:** Arroyo Palmito, 7.9 km southeast of Alto Vera (26.8111° S, 55.7201° W (CZPLT-M 486, Owen *et al*., 2018).

Specimens not examined: **ITAPÚA:** Capitán Meza (MACN 336, Owen *et al*., 2018); PARAGUARÍ: Sapucay (NHM 1903.4.7.20 Type of K. a. pallidior; Thomas, 1903; Gamarra de Fox and Martin, 1996; Emmons *et al*., 2015).

Literature references: **ALTO PARANÁ:** Puerto Bertoni (Bertoni, 1914, 1939); **ITAPÚA:** Estancia Nueva Gambach (Owen *et al*., 2018).

Subfamily Euryzygomatomyinae Fabre *et al.,* 2017

Broad-headed Spiny Rat *Clyomys laticeps* Thomas, 1909 (Fig. 7)

Echimys laticeps Thomas, 1909:240. Type locality "Lagoa Santa, on the Rio São Francisco, Minas Geraes" Brazil.

Clyomys laticeps whartoni Moojen (1952: first record, subspecific description); Bezerra (2002: taxonomy); Myers *et al*. (2002: distribution, ecology, nomenclature)

Clyomys laticeps Gamarra de Fox and Martin (1996: distribution); Gamarra de Fox *et al*. (1998: conservation); Yahnke *et al*. (1998: distribution); Myers *et al*.

(2002: distribution, nomenlcature); Morales (2007: conservation); CDC (2009: conservation); Rumbo (2010: biogeography); Bezerra and Bonvicino (2015: specimens, taxonomy); de la Sancha *et al*. (2017: checklist); Saldívar *et al*. (2017: conservation)

Local names: **SPANISH:** Ratón espinoso (Gamarra de Fox and Martin, 1996).

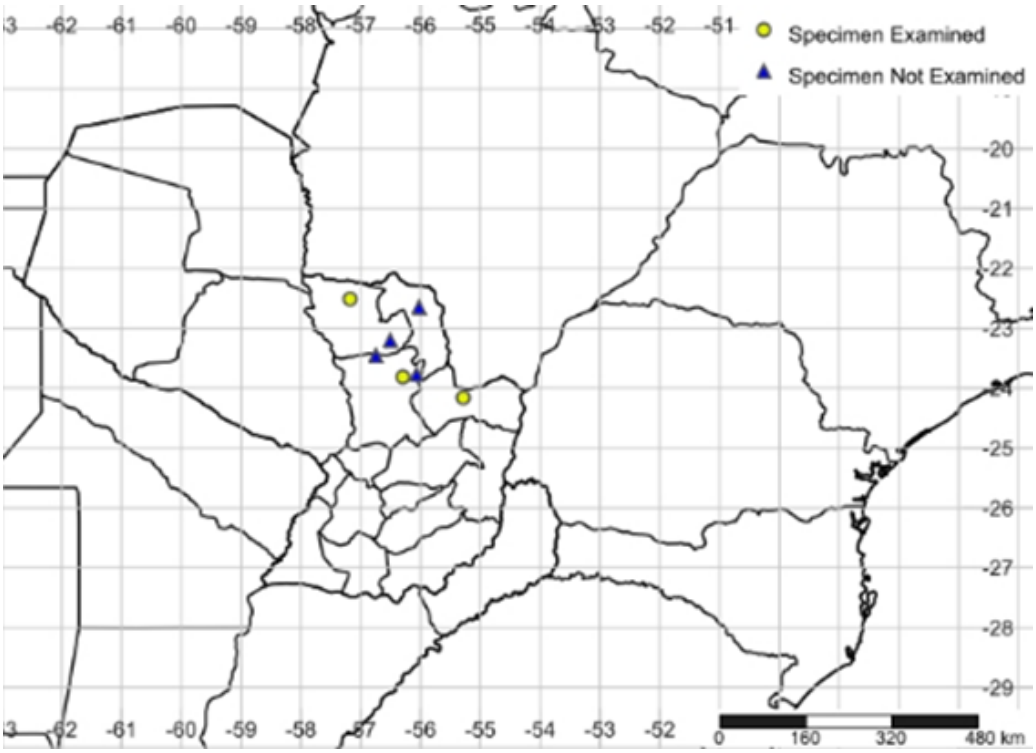

Fig. 7. Distribution of *Clyomys laticeps* in Paraguay.

Comments: C. l. whartoni Moojen, 1952: 102 is based on an adult male specimen (MNRJ 11400) collected "1 km north of Aca-poi, long. 56°7' W., lat. 23°5' S., Department of San Pedro, Partido de Taquati, Paraguay; approximately 60 km east-northeast of Puerto Ybapobo and 10 km south of the Rio Ypane" by Charles Wharton on 5 May 1950. This was also the first report of the species in Paraguay. The specimen was said to differ from the nominate in having "grayish patches on the gular region and median ventral surface", a shorter palate and larger bullae. Bishop (1974) considered only the shorter palate to be a good character, and multivariate analyses (Bezerra, 2002; Bezerra and Oliveira, 2010; Bezerra and Bonvicino, 2015) indicated that the species is monotypic.

To the Brazilian reproductive data summarized by Bezerra and Bonvicino

(2015) I add that two females pregnant with single embryos were collected in Paraguay on 29 October 2004, and that females with closed vaginas have been taken in March and October.

Clyomys. laticeps has been formerly included in *Mesomys* Wagner, 1845 and *Echimys* F. Cuvier, 1809, before being transferred to *Clyomys* Thomas, 1909 by Thomas (1916). Tate (1935) summarized the nomenclatural history of this monotypic genus and it was updated by Bezerra and Bonvicino (2015). *Clyomys* and *Euryzygomatomys* are sister genera (Fabre *et al*. 2017).

Geographical distribution: Semi-fossorial. Confined to the Cerrado ecoregion of the northern Oriental region, in *sensu strictu* and campo sucio Cerrado of Amambay, Canindeyú, Concepción and San Pedro departments. Contra Bezerra and Bonvicino (2015) and Bezerra *et al*. (2016) the species does not occur in Chaco habitats in Paraguay. The erroneous biogeographical associations postulated by Rumbo (2010) are the result of applying the mapped geographical ecoregions of Dinerstein (1995) without reference to on the ground data.

Declared "in danger of extinction" by CDC (2009), but considered to be of Least Concern nationally by Saldívar *et al*. (2017). While the species is locally common, I consider that endemism to the rapidly disappearing Cerrado ecoregion probably qualifies it for some level of threat status.

Examined specimens: **CANINDEYÚ:** Aguara Ñu, Reserva Natural del Bosque Mbaracayú (CZPLT 675, 678, 680, 684, 690, 700, 710, 712, 720, 721, 760, 769; TTU 118128, 118129; Owen and Smith, 2019); **CONCEPCIÓN:** Estancia San Luis (=Parque Nacional Serranía San Luis) (CZPLT 651); **SAN PEDRO:** Reserva Natural Laguna Blanca (CZPLT 31, 135, 481).

Specimens not examined: **AMAMBAY:** Parque Nacional Cerro Corá (USNM 554546, Gamarra de Fox and Martin, 1996); **CANINDEYÚ:** Aguara Ñu, Reserva Natural del Bosque Mbaracayú (TTU 118128, 118129; Bezerra and Bonvicino, 2015; Owen and Smith, 2019); **CONCEPCIÓN:** 28 km south of junction of Ruta 5 and Ruta 3 along Ruta 3 (=28 km south of Yby Yau) (MVZ 154318, 154319, UMMZ 161031; Gamarra de Fox and Martin, 1996; Bezerra and Bonvicino, 2015); **SAN PEDRO:** Tacuatí, Aca-

Poi (MNRJ 33503, USNM 293161; Type of C. l. *whartoni*: MNRJ 11400; Bezerra and Bonvicino, 2015); Yaguarete Forest (MNHNP 2904).

Guiara *Euryzygomatomys spinosus* (G. Fischer, 1814) (Fig. 8)

Rattus spinosus G. Fischer, 1814: 105. Type locality "peuplade d'Atira, un peu plus de huit lieues (44 kilomètres), a l'Orient de l'Assomption"

Echimys Spinosus Rengger (1830: ecology)

Mesomys spinosus Bertoni (1914: checklist, distribution); Bertoni (1939: checklist, distribution)

Euryzygomatomys spinosus Myers *et al*. (1982: distribution); Roguin (1986: distribution, specimen); Gamarra de Fox and Martin (1996: distribution); Gamarra de Fox *et al*. (1998: conservation); Yahnke *et al*. (1998: distribution); Myers *et al*. (2002: distribution, nomenclature); Cartes (2004: habitat); Cartes (2007: conservation); Morales (2007: conservation); CDC (2009: conservation); Rumbo (2010: biogeography); Bonvicino and Bezerra (2015: specimens, taxonomy); de la Sancha *et al*. (2017: checklist); Saldívar *et al*. (2017: conservation); Smith (2024: history)

Eurozygomatomys spinosus Gamarra de Fox *et al*. (1998: conservation)

Local names: **GUARANÍ:** Anguja (Gamarra de Fox *et al*., 1998); **SPANISH:** Ratón espinoso (Gamarra de Fox and Martin, 1996); Rata guira (Bonvicino and Bezerra, 2015).

Comments: This is the *Raton Espinoso* of Azara (1802, 2: 76). The name *Rattus spinosus* G. Fischer, 1814, is based on *Rat Épineux* of Azara (1801, 2: 73), and thus Atyrá, Cordillera department is the type locality. Azara (1802) provides a brief description of a burrow system which contained three females and a male, and made a comparison to the burrows of tucotucos *Ctenomys* sp. He noted that local people considered it a pest of manioc plantations.

Tate (1935) summarized the nomenclatural history of this monotypic genus and it was updated and corrected by Bonvicino and Bezerra (2015). *Clyomys and Euryzygomatomys* are sister genera (Fabre *et al*. 2017).

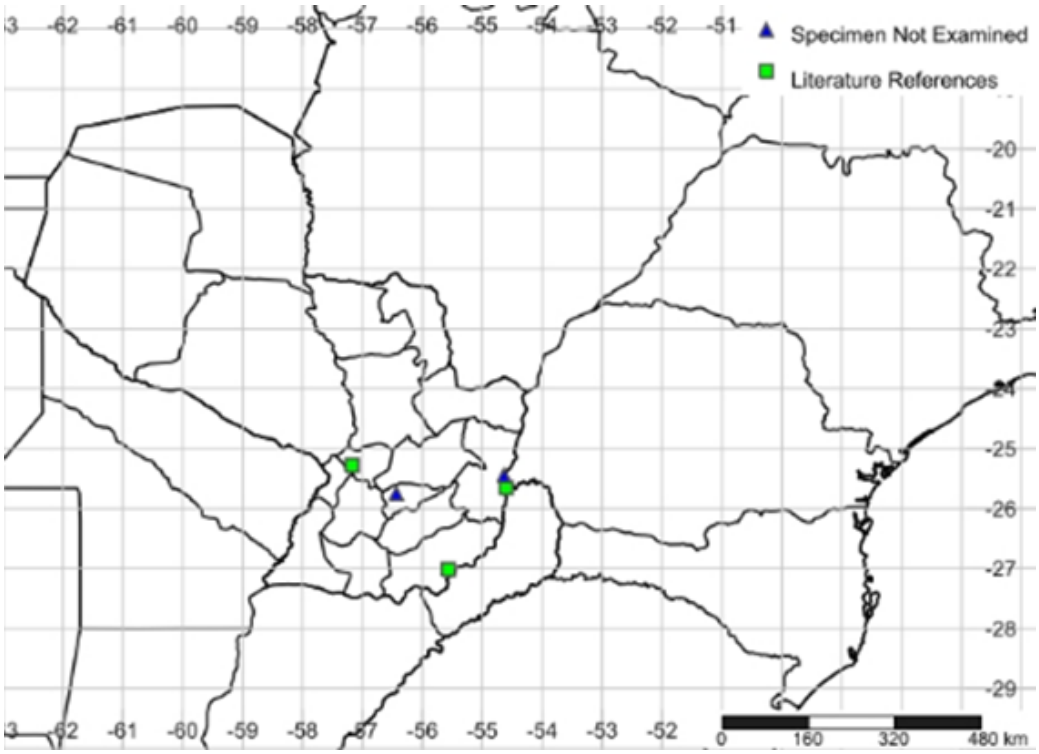

Fig. 8. Distribution of *Euryzygomatomys spinosus* in Paraguay.

Geographical distribution: Semi-fossorial. Endemic to the Atlantic Forest zone of eastern and southern Oriental region of Paraguay, where it can be found in forested habitats, riparian areas and sometimes open sandy areas such as wet meadows and grasslands. Rengger (1830) stated that he only found this species in "southern Paraguay".

Gamarra de Fox *et al*. (1998) considered the species "Threatened" on the basis of "restricted range" and it was declared "in danger of extinction" by CDC (2009). Considered Data Deficient by the latest IUCN review (Saldívar *et al*., 2017), but I consider that endemism to the highly fragmented and rapidly disappearing Atlantic Forest ecoregion and the extensive conversion of open habitats within it to agriculture probably qualifies it for some level of threat status.

Specimens not examined: **ALTO PARANÁ:** Centro Forestal Alto Paraná, Hernandarias (MNHG 1690.039; Roguin, 1986); **GUAIRÁ:** Villarrica (AMNH 66785; Bonvicino and Bezerra, 2015).

Literature references: **ALTO PARANÁ:** Puerto Bertoni (Bertoni, 1914, 1939); **CORDILLERA:** near Atyrá (Type locality: Azara, 1802; Gamarra de Fox and Martin, 1996, Bonvicino and Bezerra, 2015); **ITAPÚA:** Yaguarasapá (=Capitán Meza) (Bertoni, 1914, 1939).

DISCUSSION

The Echimiyids are widespread in Paraguay but poorly known and this is the first attempt to compile the available data on these species in the country.

I suggest that the national threat status of the Paraguayan Echimyids would benefit from deeper review. There has been a historically erratic approach to threat statuses afforded to these species, with the status of species considered to be of critical conservation concern, suddenly considered to be of Least Concern within a timeframe of a few years despite a lack of new data becoming available (Gamarra de Fox *et al*., 1998; Morales, 2007; CDC, 2009; Saldívar *et al*., 2017). According to the latest national mammalian conservation review (Saldívar *et al*., 2017) three species are considered to be Data Deficient, two of these, *Euryzygomatomys spinosus* and *Kannabateomys amblyonyx* are Atlantic Forest endemic species, while another considered Least Concern is *Clyomys laticeps* is a Cerrado endemic.

While it is true that there are few records of *Euryzygomatomys spinosus* and *Kannabateomys amblyonyx*, the former is apparently associated with sandy soil areas that occur in a matrix with Atlantic Forest and the latter is restricted to bamboo stands within this habitat that has had its total coverage reduced to about 10% of its former extent since the 1970s (Huang *et al*., 2007). It would thus seem both reasonable and necessary to infer a severe population decline in these species and afford them threat status rather than to err on the side of caution because of the limited number of available records (a situation which is unlikely to change any time soon).

A similar argument may be made for *Clyomys laticeps*, which, although locally common, is a species endemic to sandy soil Cerrado habitats, another globally threatened habitat. Though this species may be inferred to be under less threat than *Kannabateomys amblyonyx*, the rapid disappearance of its habitat in Paraguay deserves recognition in its threat status.

On the other hand, considering *Proechimys longicaudatus* to be Data Deficient seems reasonable, this species occurring only in the largely unexplored dry forests of Alto Paraguay department which are still largely intact (though

development of this region is beginning). This species may prove to be more common than is currently suggested by documented records. The remaining two species *Thrichomys fosteri* and *Myocastor coypus* are both relatively frequent where they occur, and though the latter at least suffers hunting pressure, neither appears to be under any significant conservation threat.

CONCLUSIONS

This is the first attempt to map the distribution and ecoregion associations of the Paraguayan Echimyidae. It is clear from the very few reported records for most species that their distribution and ecology is poorly-known and that further data is required to better understand the threats that they face. Nonetheless the current conservation assessments for the species do not reflect the available data and it is suggested that these be urgently reviewed in view of the proposals published here.

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