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Recent photographic records, a new specimen, and a review of the distribution and habitat associations of *Caluromys lanatus* (Mammalia, Didelphidae) in Paraguay

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ABSTRACT

The brown-eared woolly opossum, *Caluromys lanatus* (Olfers, 1818), is distributed broadly in South America east of the Andes, including eastern and southern Paraguay. Nevertheless, its habitat and distribution are poorly documented in Paraguay by either specimens or photographs. We have compiled all known records from the scientific literature, specimens, and photographs of known provenance, to provide an updated evaluation of this opossum in Paraguay. We list and map 15 localities (including one likely erroneous), and provide comments on each of the records. In Paraguay the species is primarily associated with the Atlantic Forest, but may also be encountered in other habitats.

Keywords: Arboreality, Atlantic Forest, distribution, habitat, Mesopotamian Grasslands

RESUMEN - Registros fotográficos recientes, un nuevo espécimen y una revisión de la distribución y asociaciones de hábitat de *Caluromys lanatus* (Mammalia, Didelphidae) en Paraguay

La cuica lanosa, *Caluromys lanatus*, se distribuye ampliamente en Sudamérica al este de los Andes, incluyendo el este y sur de Paraguay. Sin embargo, su hábitat y distribución en Paraguay están poco documentados. Recopilamos los registros reportados en la literatura científica, especímenes y fotografías de procedencia conocida, para proporcionar una evaluación actualizada de esta zarigüeya en Paraguay. Enumeramos y mapeamos 15 localidades (una de las cuales es probablemente errónea) y proporcionamos comentarios sobre cada uno de los registros. En Paraguay, la especie está asociada principalmente al Bosque Atlántico, pero también puede encontrarse en otros hábitats boscosos.

Palabras claves: Arborealidad, Bosque Atlántico, distribución, hábitat, Pastizales Mesopotámicos

The brown-eared woolly opossum, *Caluromys lanatus* (Olfers, 1818), is distributed in northern and central South America east of the Andes, from Colombia and Venezuela through central Brazil, eastern and southern Paraguay, to southern Brazil and northeastern Argentina (Cáceres & Carmignotto 2006; Gardner 2008; Costa et al.

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2021). In Paraguay the species has been reported from several localities in forested eastern regions of the country (Brown 2004; Smith 2009). Because it is nocturnal, primarily arboreal and is not hunted, this species is seldom seen and even more rarely collected. We are aware of only six specimens previously reported from Paraguay. Because this opossum is unmistakable in appearance, photographs may also document its distribution. This paper reviews and summarizes previously reported localities based on literature, specimens and photographs, and reports a recently collected specimen documenting a previously unreported locality. Further, we comment on several earlier reports in the literature, and evaluate the species' distribution in Paraguay in terms of ecoregion and habitat associations.

A meticulous review of the relevant literature was conducted, and inquiries made to museums known to house specimens of Paraguayan mammals. Additionally, we contacted persons known or thought to have photographic documentation of this species in Paraguay.

We have documented the historical or recent presence of *Caluromys lanatus* from 11 localities in eastern Paraguay. These records are based on six records reported in the literature, eight existing specimens (two with photographs, including the new record reported herein), and two additional photographic records. One locality reported in the literature is apparently erroneous, as discussed below. These reports are listed and discussed in chronological order, and correspond to those listed in Table 1 and shown in Figure 1.

Records from the literature

Record 1—Félix de Azara (1801, 1802) and type specimen. In the prologue to his *Apuntamientos* (Azara 1802), Azara infers that the Spanish edition should be considered the definitive work with additional animals described and errors corrected. The French translation of his field notes had been published without his consent earlier as *Essais* (Azara 1801). Azara (1802) described this species as the *Lanoso*, but the scientific name was based on the specimen described as the *Micouré second ou micouré laineux* of Azara (1801). Azara (1801: pag. 175, misprint for pag. 275) stated that he saw only one specimen that was given to him by Don Garcia Francia (NB: José Engracia García Rodrigues França, Portuguese born administrator of the town of Yaguarón for the Spanish crown, and father of the future President José Gaspar Rodríguez de Francia) who had obtained it from a person who had “taken it in Caazapá at a distance of 50 leagues” (=200km from Asunción) (Original text: “*Je n’ai vu que celui que je décris ici, et que Don Garcia Francia obtint d’une personne qui lui dit l’avoir pris dans le Caazapa, á une distance de 50 lieues (20 myriamètres, 5 cinquièmes)*”). Azara (1802) also mentions receiving the specimen from Don Garcia Francia but omits the locality information and provides additional information on a second individual found by his associate, the parish priest of the town of San Ignacio Guazú (Misiones department) Pedro Blas Nosedá. Azara stated that this second male individual was “taken in the grasslands



around 27°” (Original text: “*Mi amigo D. Pedro Blas Noseda pilló otro macho en los campos hacia 27 grados ...*”) which indeed approximates to the latitude of the town of San Ignacio Guazú (26°53′12″S 57°01′42″W). Cabrera (1916) located the specimen that Azara received from García Francia in the Museo de Ciencias Naturales de Madrid, noting that there was no collection locality accompanying the specimen or in the correspondence that referred to the specimen shipment. However, he restricted the type locality to Caazapá, Paraguay based on the locality mentioned in the text of the *Essais* (Azara 1801). This is the same specimen that was later recatalogued as MNCN-M2630 (Museo Nacional de Ciencias Naturales, Madrid) in Voss et al. (2009).

Records 2 and 3—Johann Rudolph Rengger (1830). Rengger (1830) gives two localities for the species, stating “I only have this opossum just from the Missions and found it at Villarrica.” (Original text: “*Ich habe diese Beutelratte bloss in den Missionen und bei Villa Rica angetroffen.*”). According to Ramella & Perret (2011) Rengger collected in the Villarrica area between 24 October and 22 November 1820, and collected in the Missions region between 28 March and 14 June 1821. Rengger (1835) specifically mentions being in the mission towns of Santa Rosa on 11 April 1821 and Santa Maria on 11 April 1821, 28 May 1821 and 7 and 8 June 1821. However, he makes no reference in that work to any collections that may have been made at either locality, and all of his specimens were confiscated by the Paraguayan government (since having been destroyed). Wagner (1847) gives the more precise locality of Santa Maria, although this is merely a duplicate of Azara’s vague locality “grasslands around 27°”, and does not represent an additional locality record.

Record 4—Arnaldo de Winkelried Bertoni (1914, 1939). Bertoni (1914) states that in the Alto Paraná region of Paraguay (which he defines essentially as the historical extent of the Atlantic Forest) he has recorded the species only at Puerto Bertoni, Alto Paraná department (where the author resided). According to the introduction to the work, the cutoff date for the inclusion of records in Bertoni (1914) was June 1913, so the species must have been recorded at that locality sometime prior to that date. The same text was repeated verbatim in Bertoni (1939).

Record 5—Paul Matschie (1916). Matschie (1916) lists (*Micoureus*) “*laniger* Desm. Caazapa, Asuncion. Paraguay”. This was interpreted by Brown (2004) as two localities, Caazapá and Asunción, and both were mapped in that work. However, comparison with other listings suggests that Matschie understood Caazapá to be in or part of a larger geographic denomination of “Asunción”, a misunderstanding derived from a misreading of Azara (1801). Thus the inclusion of Asunción within the species’ range is an error.

Specimens in collections

Record 1. (See above, under “Records from the literature”).

Record 6—AMNH 66780. Skin and skull, adult male, collected by Francisco Schade in “monte” (forest).

Record 7—UMMZ 134007. Skull and fluid-preserved specimen, collected by Philip Myers.



Record 8—CBMI-M 0061. Taxidermically mounted specimen collected by personnel of Itaipú Binacional on 15 February 1980. Precise locality information not available, but was listed as “Ciudad del Este”, Paraguay in the museum database.

Record 9—CBMI-M 0095. Taxidermically mounted specimen collected by personnel of Itaipú Binacional on 13 May 1983 at “Hernandarias Vivero Forestal”, Paraguay according to the museum database.

Record 10—CBMI-M 0016. Skull of specimen collected by personnel of Itaipú Binacional on 21 July 1983 at “Hernandarias Refugio de Fauna”, Paraguay according to the museum database.

Record 11—MNHNP 5452, Figure 2A. Skin only specimen. It was brought dead to personnel of Reserva Natural Tapytá, Caazapá department in January 2009 by workers of the company Desarrollos Madereros from a nearby *Eucalyptus* plantation.

Record 15—CZCEN-M 0232, Figure 2B. Skull and skeleton, sex undetermined. Found dead on an unpaved road and photographed by personnel of Estancia Yvaga, Caaguazú department. It was buried for about two weeks before being recovered and transferred to personnel of the Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Asunción, who prepared the specimen.

Photographic records

Record 11. (See above, under “Specimens in collections”).

Record 12—Velázquez and Ramírez Pinto (2014). Four photographs shown on page 23, of an individual captured in February 2013 in the Reserva Natural del Bosque Mbaracayú, Canindeyú department. The animal was anesthetized, photographed and released.

Record 13—Figure 2C. This individual was found comatose after a wildfire. It was nursed back to health, maintained in captivity for about a year, and released “in Hernandarias” (S. Molina Iriondo, pers. com.), presumably in one of the Itaipú Binacional natural reserves, Alto Paraná department.

Record 14—Figure 2D. This individual was captured in Taguató, Itapúa department after dogs chased it up an electrical power pole. It was transferred alive to Hans Hostettler, who photographed it. It later escaped into the forest at Estancia Gambach, Área Para Parque Nacional San Rafael, Itapúa department. Note that the dorsal pelage in this individual is darker than those in the other three photographs, and similar to the individual shown in Velázquez and Ramírez Pinto (2014).

Record 15. (See above, under “Existing specimens”).

Other reports

One of the authors (Paul Smith) has seen photographs of two individuals from Itapúa department, neither of which could be located for this review: (1) A photograph taken by forest guard Eustaquio Medina of an individual that entered the

forest guard accommodation during 2015 (no precise date) at Estancia Nueva Gambach, Itapúa department. Paul Smith was present at Estancia Nueva Gambach at the time, and so is able to confirm the locality and the identification, but did not see the live animal. (2) A photograph of a roadkill individual from “near Capitán Miranda”, Itapúa department was shared on social media during 2020. Though it is certainly an individual of this species, the photographer is unknown, and the locality could not be independently confirmed.

Ecoregion and habitat associations of Caluromys lanatus in Paraguay

The brown-eared wooly opossum is highly arboreal. Across its broad distribution it inhabits a variety of humid forests that include primary, secondary, disturbed and gallery forests, and plantations, usually at elevations below 500 masl (Gardner 2008; Costa et al. 2021). In Paraguay it appears to be associated extensively with the Upper Paraná Atlantic Forest (UPAF) ecoregion, in which the forest cover has been substantially reduced and fragmented during the last several decades (Huang et al. 2007; WWF 2014; Da Ponte et al. 2017; Mansourian et al. 2020; de la Sancha et al. 2021). Several of the records reviewed here are from near the limits of the UPAF or (in one case) in an ecoregion characterized by natural grasslands. Because this opossum is arboreal, we assume it was encountered in the small forest patches or riparian forests within the grassland matrix. This suggests that it is capable of migrating across non-forested habitat to suitable forests, at least occasionally. If so, it may be less impacted by forest fragmentation than other forest-dependent species which are unable to move among fragments.

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We thank Rob Voss for information regarding the AMNH specimen (Record 6), Humberto Sarubbi for photographs of the animal and habitat of Record 15, Santiago Molino Iriondo for photographs of Record 13, Hans Hostettler for photographs of the specimen from Taguató (Record 14), Myriam Velázquez for photographs of the Mbaracayú specimen (Record 12, which was captured during the Project PINV-052: La Salud de los Ecosistemas, Transmisión de Enfermedades y Alteración del Hábitat en la Reserva de Biosfera del Bosque Mbaracayú, Paraguay, ejecutado por la Fundación Moisés Bertoni, Estación Biológica Corrientes (CECOAL-CONICET-UNNE) y CEDIC, y cofinanciado por el Consejo Nacional de Ciencia y Tecnología - CONACYT, con recursos del FEEI y a través de su programa Prociencia). Herib Caballero generously provided information on Don Garcia Francia, the historical figure mentioned in this paper.



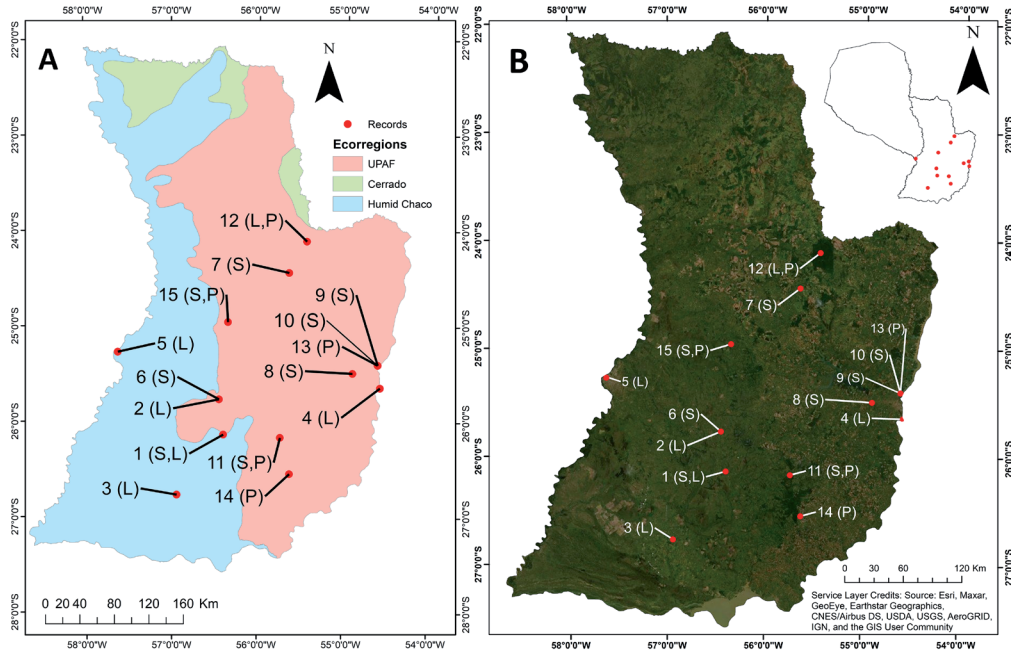


Figure 1. Maps of eastern Paraguay, showing known localities for *Caluromys lanatus*. Numbers refer to locality numbers in Table 1, where records are listed in chronological order. Letters in parentheses refer to type of record: L, literature; S, specimen; P, photograph. A) Ecoregions designation and distribution follow Clay et al. (2008); B) current land cover, with forested areas darker green.

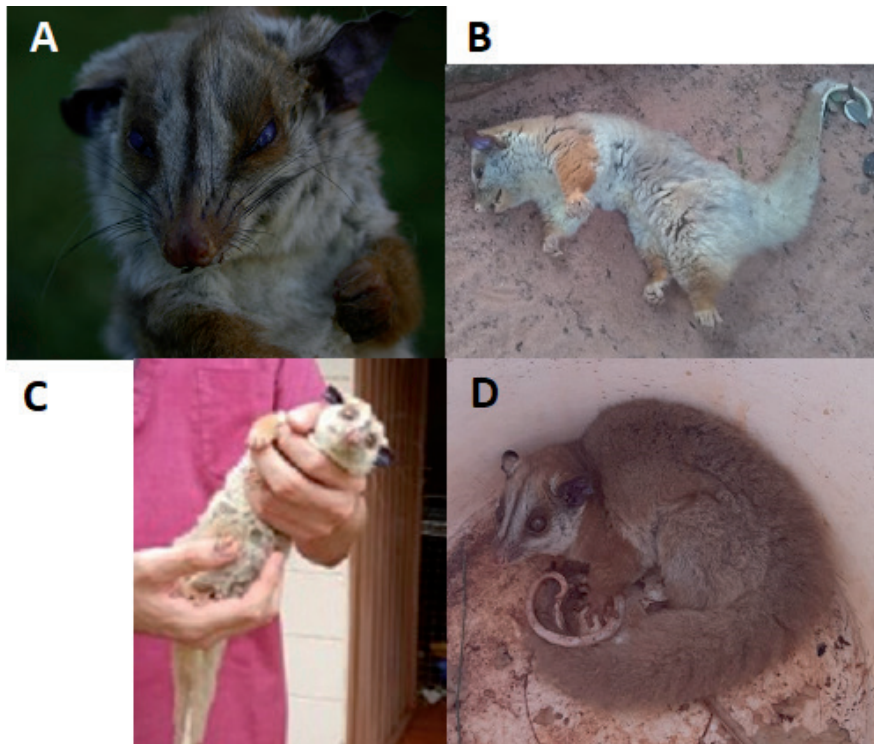


Figure 2. Photographic records of *Caluromys lanatus* in Paraguay. Record numbers correspond to those included in the Discussion and in Table 1 and Figure 1. A) Record 11, Tapytá, Caazapá department; B) Record 15, Estancia Yvaga, Caaguazú department; C) Record 13, Hernandarias, Alto Paraná department; D) Record 14, Taguató, Itapúa department.

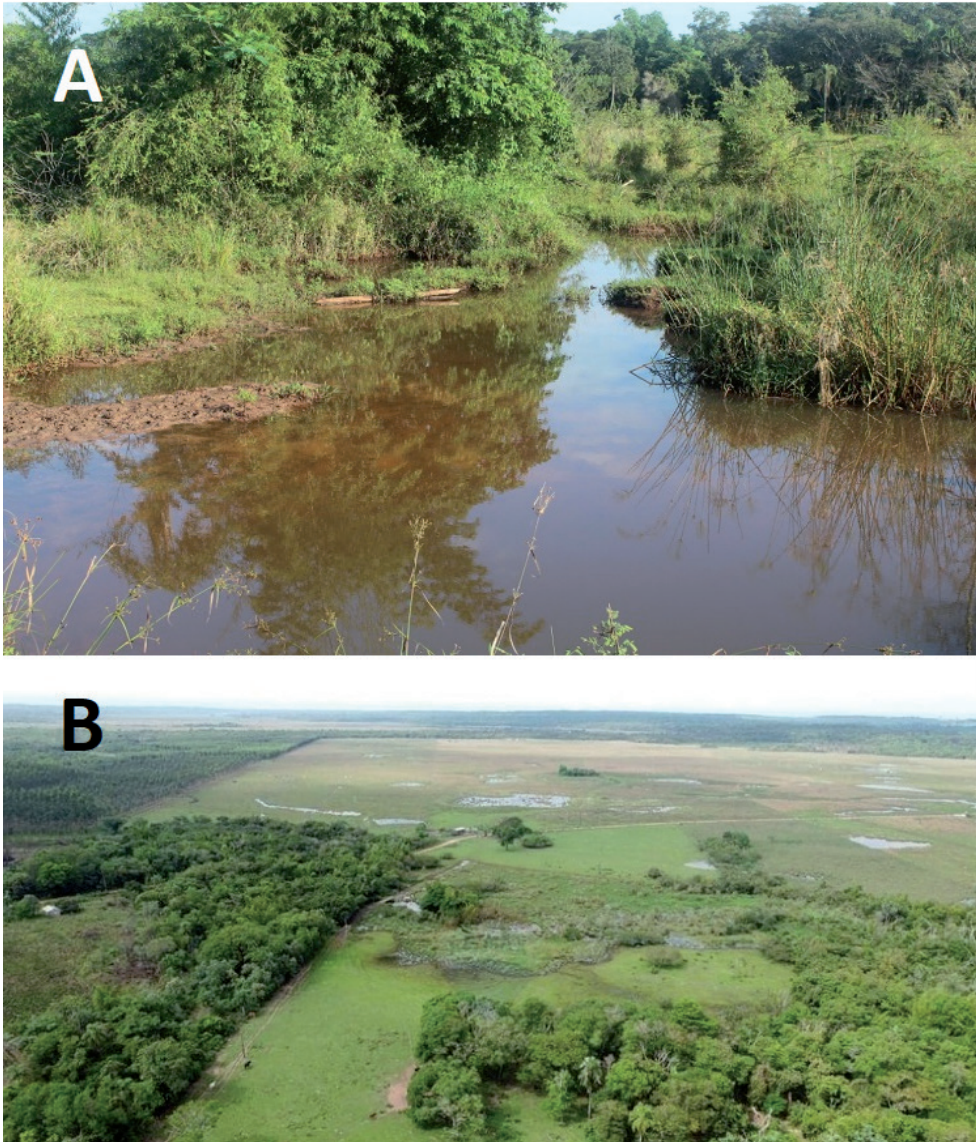


Figure 3. Habitat from locality of Record 15, Estancia Yvaga, Caaguazú department. A) stream, overgrown old field and secondary forest; B) aerial view of area, with secondary forest fragments and agricultural fields.

Table 1. Records of *Caluromys lanatus* in Paraguay, arranged chronologically. The table includes reports in the literature, museum specimens and photographs. Latitude and longitude have been transformed from each original description into decimal degrees. See Figure 1 for location of the records. See text for description and discussion of each record. Type of record: L, literature; S, museum specimen; P, photograph. Institution codes: AMNH, American Museum of Natural History, New York, USA; CMBI - M, Colección Biológica del Museo de Itaipú - Mamíferos, Hernandarias, Paraguay; FACEN, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Asunción, San Lorenzo, Paraguay; MNCN, Museo Nacional de Ciencias Naturales, Madrid, Spain; MNHNP, Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay; NA, not applicable (no specimen); UMMZ, University of Michigan Museum of Zoology, Ann Arbor, USA.

Record	Type	Inst. Code	Cat. no	Sex	Year	Department	Locality	Latitude	Longitude
1	S, L	MNCN	M2630		pre 1800	Caazapá	Caazapá	-26.15	-56.40
2	L	NA	NA		1820	Guairá	Villarrica	-25.78	-56.45
3	L	NA	NA		1821	Misiones	Santa María	-26.78	-56.94
4	L	NA	NA		pre 1914	Alto Paraná	Puerto Bertoni	-25.65	-54.59
5	L	NA	NA		pre 1916	Central	Asunción	-25.28	-57.62
6	S	AMNH	66780	Male	1923	Guairá	Villarrica	-25.78	-56.45
7	S	UMMZ	134007	Female	1979	Canindeyú	13.3 km by road N of Curuguaty	-24.45	-55.65
8	S	CMBI - M	0061	Female	1980	Alto Paraná	Ciudad del Este	-25.50	-54.91
9	S	CMBI - M	0095	Male	1983	Alto Paraná	Hernandarias, Vivero Forestal Itaipú	-25.41	-54.62
10	S	CMBI - M	0016		1983	Alto Paraná	Hernandarias, Refugio de Fauna Itaipú	-25.41	-54.62
11	S, P	MNHNP	5452		2009	Caazapá	Desarrollos Madereros	-26.18	-55.74
12	L, P	NA	NA	Male	2013	Canindeyú	Reserva Natural del Bosque Mbaracayú	-24.12	-55.45
13	P	NA	NA		2015	Alto Paraná	Itaipú Binacional	-25.41	-54.62
14	P	NA	NA		2022	Itapúa	Taguató	-26.56	-55.63
15	S, P	FACEN			2022	Caaguazú	Estancia Yvaga	-24.97	-56.35

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