

Small mammals (Didelphimorphia, Rodentia and Chiroptera) from Pampean Region, Argentina

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ABSTRACT: We studied small mammal assemblages recovered from owl pellets collected at 11 locations throughout the Argentina's Pampean Region. We identified 21 species, including two marsupials, one bat, and 18 rodents. From the analysis of this dataset, we could distinguish three main groups of small mammals that currently inhabit the Pampean Region: 1) a group of taxa related to Pampean agroecosystems (*Calomys* spp., *Akodon azarae*, and *Oligoryzomys flavescens*); 2) a group of Brazilian species (*Cavia aperea*, *Oxymycterus rufus*, *Necromys lasiurus*, *Necromys obscurus*, *Holochilus brasiliensis*, and *Monodelphis dimidiata*); and 3) a group including species from Patagonia, Espinal and Monte phytogeographic provinces (*Microcavia australis*, *Oligoryzomys longicaudatus*, *Eligmodontia typus*, *Graomys griseoflavus*, and *Akodon molinae*). In addition, we documented the first record of a species of the large-bodied group of *Calomys* in Buenos Aires province, expanding its distribution ca. 420 km southward.

INTRODUCTION

The Pampean Region is a large ecosystem of grasslands plains located in Central-Eastern Argentina, including southern Córdoba and Santa Fe provinces, and most of La Pampa and Buenos Aires provinces (León 1991). This region is ecologically interesting, since it comprises three different phytogeographic provinces: Pampa, Espinal and Monte (Cabrera 1976). From a zoogeographic perspective, it also partially coincides with the zoogeographic Pampean Dominion, an ecotonal area that has suffered constant environmental changes during the Quaternary, acquiring Patagonian and Brazilian characteristics alternatively (Ringuelet 1961). In addition, during the last centuries, environmental changes have been intensified by human activities, gradually transforming the natural Pampean grasslands into a mosaic of agroecosystems (León and Burkart 1998), resulting in substantial changes in the taxonomic structure of the small mammal assemblages inhabiting this area (Pardiñas *et al.* 2010; Teta *et al.* 2010).

Small mammal assemblages from this area have been mainly studied through the use of trapping techniques or from material recovered from owl pellets (*e.g.* Reig 1964; Massoia and Fornes 1965; Contreras 1968; 1973; Massoia 1976; Galliari and Pardiñas 2000; Pardiñas *et al.* 2004; Leveau *et al.* 2006). When comparing this fauna with that of other regions of Argentina, the taxonomy and distribution of small mammals in the Pampean Region is one of the best established. In spite of this, recent extensive studies conducted at the Pampas revealed that gaps still exist in the knowledge of the small mammal communities (Pardiñas *et al.* 2004; 2010; Teta *et al.* 2010).

In this study, we provide a list of small mammal species recovered from owl pellets collected at 11 locations throughout the Pampean Region. In addition, we report for the first time a large-bodied species of *Calomys* (*sensu* Corti *et al.* 1987) in the Pampean Region, expanding

southward the geographic distribution of the large-bodied group of this genus.

MATERIALS AND METHODS

During the last decade, pellets of barn owls (*Tyto alba*, Aves, Tytonidae) were collected at 11 locations throughout the Pampean Region (Figure 1 and Appendix I). Studied samples were deposited at the Museo de Historia Natural de San Rafael (MHNSR), Mendoza province, Argentina.

The climate of the Pampean Region is determined by the Atlantic anticyclone, which reduces its effects from northeast to southwest. This results in a heterogeneous climate, which changes gradually from humid in the northeastern area (mean annual precipitation of 1200 mm; mean annual temperature of 18°C) to dry subhumid in the southwestern area (mean annual precipitation of 600 mm; mean annual temperature of 14°C; Burgos 1968).

The small mammal assemblages studied came from the Pampa (locations 1 to 9) and from the Espinal (locations 10 and 11) phytogeographic provinces. The Pampa is composed by plains and a few isolated mountainous areas; the vegetation is characterized by grasslands, halophytic and psammophytic steppes, reedbeds, and shrublands, dominated by grasses such as *Stipa*, *Aristida*, *Melica*, *Briza*, *Bromus*, *Eragrostis*, and *Poa*. The Espinal surrounds the Pampa on its northern, western and southern boundaries; the vegetation is characterized by xerophytic forests, savannas and steppes of *Prosopis*, *Acacia*, *Celtis*, *Schinus* and *Geophroea decorticans* (Cabrera 1976; León 1991).

From the disaggregated owl pellets, we identified cranial remains to the lowest taxonomic level possible by comparisons with reference collections deposited at Museo de La Plata (MLP) and published literature (*e.g.* Massoia and Fornes 1965; Massoia 1976; Galliari and Pardiñas 2000). Nevertheless, an open taxonomy was used for *Myotis* Kaup, 1829; *Ctenomys* Blainville, 1826

and *Rattus* Fischer, 1803; since their fragmentary remains were difficult to indentify to the species level. In addition, *Calomys laucha* (Fischer, 1814) and *Calomys musculinus* (Thomas, 1913) are almost indistinguishable from craniodental remains (Pardiñas and Lescano 1995).

For each taxon, we calculated the minimum number of individuals (MNI) by quantifying the most frequent element (maxilla or mandible) from either the right or the left side.

Data on the small mammal assemblage from the location of Olavarría (locality 5) was previously published by Fernández et al. (2009). Nevertheless, when carefully revising the remains named as *Calomys* cf. *C. laucha*-*C. musculinus* by those authors, we realized that a few specimens were morphologically different and larger than the mean body size of the other specimens of *Calomys*. Therefore, we made morphological and quantitative comparisons between these larger specimens and reference material of species of *Calomys* that belong to the large-bodied group (see below for this grouping) inhabiting the proximities of the Pampean Region [*C. callosus* (Rengger, 1830), *C. callidus* (Thomas, 1916), and *C. venustus* (Thomas, 1894)], and the most frequent species of the small-bodied group (*C. musculinus*) inhabiting the Pampean Region. Collection numbers of *Calomys* specimens are given in Appendix I.

RESULTS AND DISCUSSION

Small mammal assemblages are listed in Table 1. A total of 3,421 small mammals were recovered from the pellets of the 11 analyzed samples. Among the 21 identified taxa, the sigmodontine rodent *Calomys* cf. *C. laucha*-*C. musculinus* was the most frequent taxon in almost all locations,

constituting 63% of the total specimens, followed by *Akodon azarae* (Fischer, 1819) and *Oligoryzomys flavescens* (Waterhouse, 1837) (13.5% and 10.6%, respectively). *Mus musculus* Linnaeus, 1758 constituted 3.3% of the total sample and was especially abundant in Eastern locations, whereas *Eligmodontia typus* Cuvier, 1837 constituted 3.2% of the total specimens identified, being present only in the Espinal (*i.e.* Laguna Chasicó and Marahué). The remaining small mammals were scarcely represented (*e.g.* *Ctenomys*, *Myotis*, and *Thylamys pallidior* Thomas, 1902).

The fossil record reveals that recent small mammal assemblages were already established in the Pampean Region during the Pleistocene (Pardiñas et al. 2010). However, at that time, some rodent species, such as *C. laucha* and *C. musculinus*, were much less frequent than they are today. During the last four centuries, especially during the 19th and 20th centuries, the development of agroecosystems would have favoured these species (though increases of population size and extension of their geographic ranges), to the detriment of other populations of rodents, such as *Reithrodon auritus* (Fischer, 1814) or *Necromys lasiurus* (Lund, 1840) (see Pardiñas et al. 2010; Teta et al. 2010). Genetic studies of population structure of *C. laucha* and *C. musculinus* confirm the hypothesis of recent range expansion (*e.g.* Chiappero et al. 2002; González-Ittig et al. 2007).

Based on ecological and biogeographic characteristics of the species recorded in this study, we can distinguish three main groups of terrestrial small mammals in the Pampean Region. One group is related to the natural grasslands and agroecosystems of the Pampa (*Calomys* spp., *A. azarae*, and *O. flavescens*). *Akodon azarae*, *O. flavescens* and *C. laucha* are distributed from southern Brazil to the southern Pampean Region; whereas *C. musculinus* has a wider distribution, from Bolivia to southern Patagonia (Pardiñas et al. 2010). The second group comprises Brazilian species [*Cavia aperea* Erxleben, 1777; *Oxymycterus rufus* (Fischer, 1814); *N. lasiurus*; *Necromys obscurus* (Waterhouse, 1837); *Holochilus brasiliensis* (Desmarest, 1819) and *Monodelphis dimidiata* (Wagner, 1847)]. These species present wide distributions, in temperate and humid grasslands, ranging from southern Brazil to the southern Pampean Region, with the exceptions of *N. obscurus* on the one hand, which is restricted to the coast of Uruguay, Buenos Aires Province (Argentina), and hills in the Tandilia System; and *C. aperea* on the other hand, which presents a wider distribution throughout South America (Redford and Eisenberg 1992; Pardiñas et al. 2010). The third group includes species from Patagonia, Espinal and Monte phytogeographic provinces [*T. pallidior*; *Microcavia australis* (I. Geoffroy Saint-Hilaire and d'Orbigny, 1833); *Oligoryzomys longicaudatus* (Bennett, 1832); *E. typus*; *Graomys griseoflavus* (Waterhouse, 1837); *Akodon molinae* Contreras, 1968]. *T. pallidior*, *M. australis*, *O. longicaudatus* and *E. typus* are commonly associated with Patagonian and Monte environments, whereas *G. griseoflavus* and *A. molinae* are mostly restricted to the Espinal and Monte (Redford and Eisenberg 1992; Pardiñas et al. 2010). The exotic murids *M. musculus* and two species of *Rattus* [*i.e.* *R. rattus* (Linnaeus, 1758) and *R. norvegicus* (Berkenhout, 1769)], commonly associated with human settlements, could be regarded as an additional group.

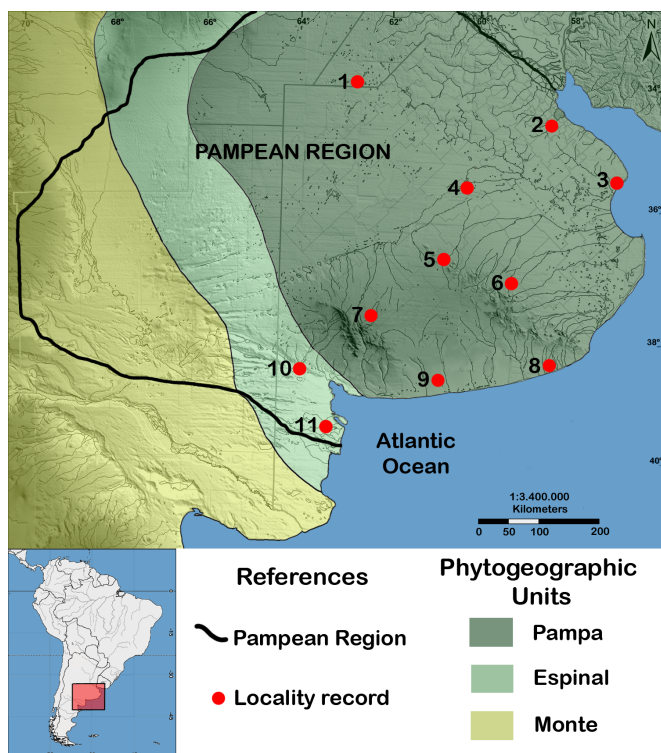


FIGURE 1. Map of the study area, Pampean Region, Argentina. Locations: 1. Diego de Alvear; 2. Tristán Suarez; 3. Pipinas; 4. Saladillo; 5. Olavarría; 6. Tandil; 7. Quiñihual, 8.3 km N of Centinela del mar; 9. Oriente; 10. East coast of Laguna Chasicó; 11. Marahué. Main phytogeographic units according to Cabrera (1976).

TABLE 1. Minimum number of individuals (MNI) of small mammals recovered from pellets of *Tyto alba* collected at 11 locations in the Pampean Region, Argentina: 1. Diego de Alvear; 2. Tristán Suarez; 3. Pipinas; 4. Saladillo; 5. Olavarría; 6. Tandil; 7. Quiñihual; 8.3 km N of Centinela del Mar; 9. Oriente; 10. East coast of Laguna Chasicó; 11. Marahué.

	1	2	3	4	5	6	7	8	9	10	11
MAMMALIA											
DIDELPHIMORPHIA											
<i>Monodelphis dimidiata</i>						1	1				
<i>Thylamys pallidior</i>						3	1				
CHIROPTERA											
Vespertilionidae											
<i>Myotis</i> sp.				1			1				5
RODENTIA											
Ctenomyidae											
<i>Ctenomys</i> sp.			16						1	7	
Caviidae											
<i>Cavia aperea</i>		3					2				
<i>Microcavia australis</i>									1		1
Cricetidae											
<i>Akodon azarae</i>	10	43	66	81	15	57	47	88	15	11	28
<i>Akodon molinae</i>										1	3
<i>Necomys lasiurus</i>						14	2				
<i>Necomys obscurus</i>								6			
<i>Oxymycterus rufus</i>						43	4	3			
<i>Oligoryzomys flavescens</i>	46	47	50	73	17	51	27	40	8	2	
<i>Oligoryzomys longicaudatus</i>											20
<i>Holochilus brasiliensis</i>					1	2	2				
<i>Calomys</i> cf. <i>C. laucha-C. musculus</i>	113	21	42	158	46	62	538	122	799	56	197
<i>Calomys</i> sp.					4						
<i>Eligmodontia typus</i>										51	59
<i>Graomys griseoflavus</i>										1	6
<i>Reithrodon auritus</i>		1	2			2	34	2	14	1	
Muridae											
<i>Mus musculus</i>					5	7	15	13	69		3
<i>Rattus</i> sp.				1	6	1	2		1		
Total	169	115	176	314	94	243	676	274	908	130	322

TABLE 2. Descriptive statistics of craniodental measurements of large-bodied *Calomys* from Olavarría and selected samples of *C. venustus*, *C. callosus*, *C. callidus*, and *C. musculus*. Sample size in parentheses, mean \pm SD, and range of variation. Measurements are in mm. * Data from Bonvicino et al. (2010: Table 3).

	Rostral width	Interorbital constriction	Palatal length	Palatal width	Incisive foramina length	Maxillary toothrow length	Upper diastema length
<i>Calomys</i> sp.	4.87 \pm 0.28	4.42 \pm 0.25	11.64 \pm 0.15	2.42 \pm 0.23	5.97 \pm 0.30	4.33 \pm 0.20	6.67 \pm 0.30
(4)	4.46 – 5.07	4.20 – 4.77	11.48 – 11.83	2.19 – 2.69	5.64 – 6.29	4.19 – 4.63	6.32 – 7.03
<i>C. venustus</i>	5.13 \pm 0.31	4.37 \pm 0.19	12.29 \pm 0.58	2.93 \pm 0.17	5.92 \pm 0.28	4.81 \pm 0.35	6.67 \pm 0.44
(10)	4.64 – 5.60	4.13 – 4.65	11.46 – 13.32	2.63 – 3.13	5.43 – 6.28	4.44 – 5.44	6.29 – 7.57
<i>C. callosus</i>	4.91 \pm 0.46	4.19 \pm 0.36	11.60 \pm 0.74	2.86 \pm 0.29	5.89 \pm 0.47	4.35 \pm 0.25	6.75 \pm 0.56
(10)	4.40 – 5.79	3.39 – 4.59	10.57 – 12.93	2.33 – 3.22	5.01 – 6.68	4.05 – 4.79	5.71 – 7.39
<i>C. callidus</i> *	5.2	4.6			5.9	4.1	6.6
(11)	4.8 – 5.6	4.3 – 5.0	–	–	5.3 – 6.4	3.8 – 4.4	4.7 – 7.1
<i>C. musculus</i>	3.32 \pm 0.37	3.48 \pm 0.09	7.96 \pm 0.62	2.35 \pm 0.15	4.04 \pm 0.41	3.34 \pm 0.16	4.84 \pm 0.40
(11)	2.40 – 3.74	3.39 – 3.69	6.74 – 8.89	2.13 – 2.63	3.31 – 4.66	3.15 – 3.57	4.34 – 5.67

Some species of small mammals recorded by previous surveys in the Pampean Region (e.g. Pardiñas et al. 2010; Teta et al. 2010) were not recorded in this study. These include, for example, species restricted to the northeastern area and belonging to the second (Brazilian) group [e.g. *Holochilus chacarius* Thomas, 1906; *Oligoryzomys nigripes* (Olfers, 1818); *Scapteromys aquaticus* Thomas, 1920; *Bibimys torresi* Massoia, 1979; and *Deltamys kempi* Thomas, 1917], and species belonging to the above-mentioned third group (e.g. *Akodon iniscatus* Thomas, 1906; and *Phyllotis xanthopygus bonariensis* Crespo, 1964).

As mentioned above, few specimens of the genus *Calomys* from Olavarría were larger and morphologically different from those determined as *Calomys* cf. *C. laucha-C. musculus* (Table 2 and Figure 2). Some authors informally grouped the species of *Calomys* by their size into two groups: small- and large-bodied size [e.g. Corti et al. (1987); see external measurements of some of the species of these two groups in Bonvicino et al. (2010: Table 3)]. In fact, molecular phylogenies show the existence of two natural groups: highland and lowland *Calomys* (e.g. Salazar-Bravo et al. 2001; Almeida et al. 2007). In

addition, these studies also supported a monophyletic clade containing all large-bodied species within the lowland *Calomys* group. Among the species of this large-bodied clade, only *C. venustus* has been registered in the northwestern Pampean Region, whereas *C. callosus* and *C. callidus* have a distribution that reaches the northern boundaries of this region. The taxonomy of these three species is controversial. Hershkovitz (1962) considered *C. venustus* and *C. callidus* as synonyms of *C. callosus*. Later studies based on morphometric, cytogenetic and molecular data have supported the validity of these species (e.g. Corti et al. 1987; Salazar-Bravo et al. 2001; 2002). Nevertheless, Contreras et al. (2003) on the basis of cytogenetic data and the relocation of the type locality of *C. callosus* (outside the range of its geographic distribution), stated that this species and *C. callidus* should be considered as conspecific.

In this context, we observed that the large specimens from Olavarría presented some morphological characteristics shared with species of the large-bodied group of *Calomys*. These include prominent lateral and divergent borders of the frontals, and parallel maxillary tooththrows (Figure 2). On the contrary, smoother and less divergent borders of the frontals, and convergent maxillary tooththrows are features of the small-bodied species of the genus registered in Buenos Aires Province to date (*C.*

laucha and *C. musculus*). The larger *Calomys* specimens from Olavarría also differed in other characteristics from the species of the large-bodied group (*C. venustus*, *C. callidus*, *C. callosus*): posteropalatal pits deeper (except when comparing with *C. venustus*); anterior border of the mesopterygoid fossa more attenuated M shape; zygomatic notch shallower and narrower; anterior border of the zygomatic plate nearly straight, as in all large-bodied species (with the exception of *C. venustus*, in which it is convex in its upper part). The craniodental measurements of the specimens of *Calomys* studied here are given in Table 2. Measurements of the specimens from Olavarría were within the range of those of the large-bodied group of *Calomys* and larger than those of *C. musculus*, with the exception of palatal width.

The species of the large-bodied group of *Calomys* present a geographic distribution from the lowlands at central and southeastern Brazil, Paraguay and Bolivia to southern Córdoba, Santa Fe and Entre Ríos Provinces in Argentina. These species inhabit warm environments of the Chaco, Espinal, dry forests, savannas, and pampas (Contreras et al. 2003; Almeida et al. 2007; Bonvicino et al. 2010). Therefore, the material described here constitutes the first record of the large-bodied group of *Calomys* in Buenos Aires Province, expanding the known distribution of this group ca. 420 km southward. Despite the lack of an

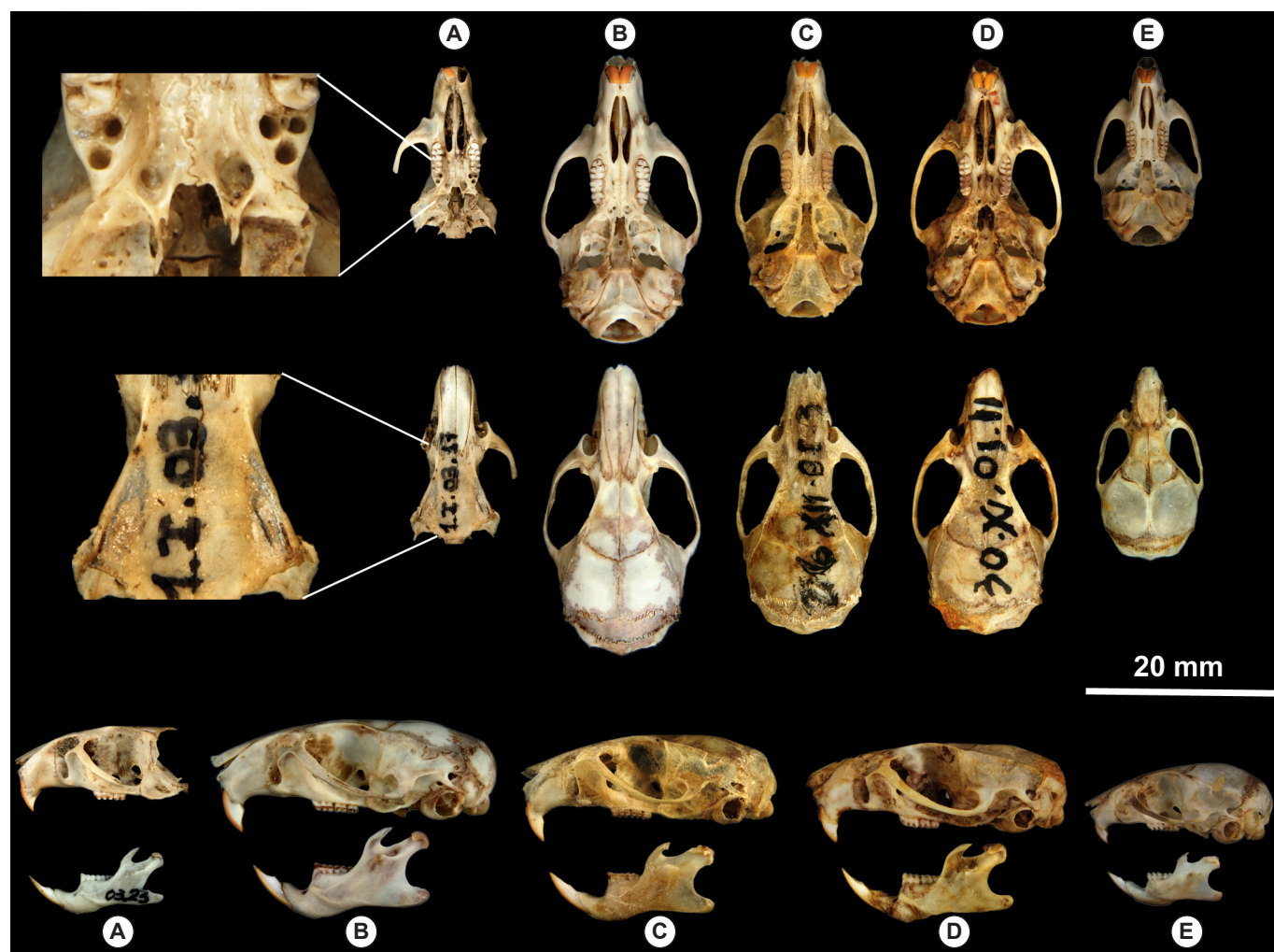


FIGURE 2. Skulls and mandibles of large-bodied *Calomys* from Olavarría and reference species. A. *Calomys* sp. (MLP 1.1.03.17, MLP-1.1.03.23); B. *C. venustus* (MLP 31. XII. 02. 68); C. *C. callidus* (MLP 26. XII. 01. 3); D. *C. callosus* (MLP 30. XI. 01. 11) and E. *C. musculus* (MLP 31. XII. 02. 07). Above: ventral view; middle: dorsal view; below: lateral view. Detailed views of *Calomys* sp. from Olavarría show morphological characters described in the text.

accurate identification of these remains, we do not discard the hypothesis that these specimens belong to a distinct species, possibly endemic to central Buenos Aires province. Future trapping efforts in the vicinity of Olavarría can shed light on their taxonomic status.

Our dataset shares similarities to previous studies in the Pampean Region. Nevertheless, the record of a species of *Calomys* of the large-bodied group in the center of this area points to the existence of gaps in our knowledge on the small mammal fauna of this region.

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APPENDIX 1. Samples examined.

- Diego de Alvear (34°22' S, 62°07' W), General López, Santa Fé: MHNSR-0081;
- Tristán Suarez (34°53' S, 58°33' W), Ezeiza, Buenos Aires: MHNSR-0082;
- Pipinas (35°32' S, 57°13' W), Punta Indio, Buenos Aires: MHNSR-0083;
- Saladillo (35°38' S, 59°47' W), Saladillo, Buenos Aires: MHNSR-0084;
- Olavarría (36°53' S, 60°18' W), Olavarría, Buenos Aires: MHNSR-0085;
- Tandil (37°19' S, 59°08' W), Tandil, Buenos Aires: MHNSR-0086;
- Quinihual (37°49' S, 61°38' W), Coronel Suárez, Buenos Aires: MHNSR-0087;
- 3 km N of Centinela del mar (38°25' S, 58°12' W), General Alvarado, Buenos Aires: MHNSR-0088;
- Oriente (38°44' S, 60°36' W), Coronel Dorrego, Buenos Aires: MHNSR-0089;
- East coast of Laguna Chasicó (38°38' S, 63°01' W), Villarino, Buenos Aires: MHNSR-0090; and
- Marahué (39°32' S, 62°25' W), Villarino, Buenos Aires: MHNSR-0091.

Calomys sp., Olavarría (36°53' S, 60°18' W), Olavarría, Buenos Aires. Skulls: MLP-1.1.03.15; MLP-1.1.03.16; MLP-1.1.03.17; MLP-1994 Mandibles: MLP-1.1.03.18; MLP-1.1.03.19; MLP-1.1.03.20; MLP-1.1.03.21; MLP-1.1.03.22; MLP-1.1.03.23.

Calomys venustus, Arroyo Chucul (33°01' S, 64°10' W), Río Cuarto, Córdoba: MLP 31. XII. 02.68.

Calomys callidus, Ecia San Juan Porriahu (27°42' S, 57°11' W), San Miguel, Corrientes: MLP 26. XII. 01.3.

Calomys callosus, Cancha Larga (26°32' S, 60°58' W), Almirante Brown, Chaco: MLP 30. XI. 01.11.

Calomys musculinus, Arroyo Chucul (33°01' S, 64°10' W), Río Cuarto, Córdoba: MLP 31. XII. 02.07.