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Mammalia 74 (2010): 97–103 © 2010 by Walter de Gruyter • Berlin • New York. DOI 10.1515/MAMM.2009.069

Short Note

A contribution from Barn Owl pellets analysis to known micromammalian distributions in Buenos Aires province, Argentina

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Keywords: agroecosystems; Pampean region; Rodentia; Sigmodontinae; *Tyto alba*.

The analysis of owl pellet samples is an extremely valuable tool for mammalogists (Yalden and Morris 1990). Studies on this topic around the world are eloquent about the potential and limitations of this methodology. For example, owl pellets can be used for inventorying small mammal communities (Cueto et al. 2008), studying small mammal distribution throughout geographical gradients (Avery et al. 2002, 2005, Pardiñas et al. 2003, Leveau et al. 2006), delimiting distributions on a regional scale (Avery et al. 2002, 2005, Pardiñas et al. 2003, 2004), or to track abundance changes in their preys, both spatially and temporally (Fulk 1976, Love et al. 2000, Millán de la Peña et al. 2003). In addition, owl pellet studies present advantages over traditional survey methods, because raptors can prey on rare species or in species not easily detected with other methods (e.g., traps; Yalden and Morris 1990).

It is usually accepted that micromammalian distributions in the Pampean region of Buenos Aires province, central-eastern Argentina, are relatively well established. However, a detailed study of available information clearly demonstrated that this assertion is partially incorrect (Pardiñas et al. 2004, in press). Much of the work done in this province encompasses part of the northern, eastern, and some south-eastern areas, mostly in or near the littoral fringe of La Plata River and the Atlantic coast (Galliari and Goin 1993). However, a very different situation is the norm for the rest of the large territory of the province, including some southern and most of the central portions (Pardiñas et al. 2004, in press).

In this study, we present the results of an extensive small mammal survey conducted in the Pampean region of the Buenos Aires province through the analysis of Barn Owl [*Tyto alba* Scopoli 1769 (Aves, Tytonidae)] pellet samples. Although these collections were part of another study, it quickly became apparent that they were adding to the known distribution pattern of some micromammals. In addition, we provided some comments regarding species abundance at different localities and the biogeographic implications of some of these records.

The province of Buenos Aires (307,571 km^2) is located in central-eastern Argentina, between 33°–41° S and 57°–63° W. Its territory is almost entirely included within the Pampean eco-region and encompasses four ecological units or districts that can be distinguished according to differences in geomorphology, soils, drainage, physiography, land use patterns, and vegetation: the Rolling Pampa, the Southern Pampa, the Flooding Pampa and the Inland Pampa (Soriano et al. 1992). Native grasslands through most of the Pampean region were gradually converted to agroecosystems over the past two centuries. Primary uses of the land, with some differences between areas, are for agriculture and livestock breeding (see Baldi and Paruelo 2008). Climate of the Pampean region is characterized by an east-west moisture gradient and increasing continentality toward the northwest (Burgos 1968). Mean annual precipitation decreases from 1200 mm in the northeastern to 600 mm in the southwestern regions. Mean annual temperatures show a similar trend, with values between 23°C (north) and 20°C (south) for January and 10°C (north) and 7°C (south) for June (Burgos 1968).

Fresh Barn Owl pellets were collected during July and August 2006–2007 (winter) and January and February 2007–2008 (summer) from nest sites distributed in the four districts of the Pampean region included in the Buenos Aires province (Figure 1). One to three deposit places were found at each locality. The diet of *Tyto alba* at the localities of Diego Gaynor and Villa Cacique were previously studied by Bellocq (1990) and Leveau et al. (2004), respectively. All other localities are studied for the first time. Mammalian preys were identified to the lowest taxonomical level possible by the examination of the skull and dentaries, following published literature (Massoia and Fornes 1965, 1969, Mas-

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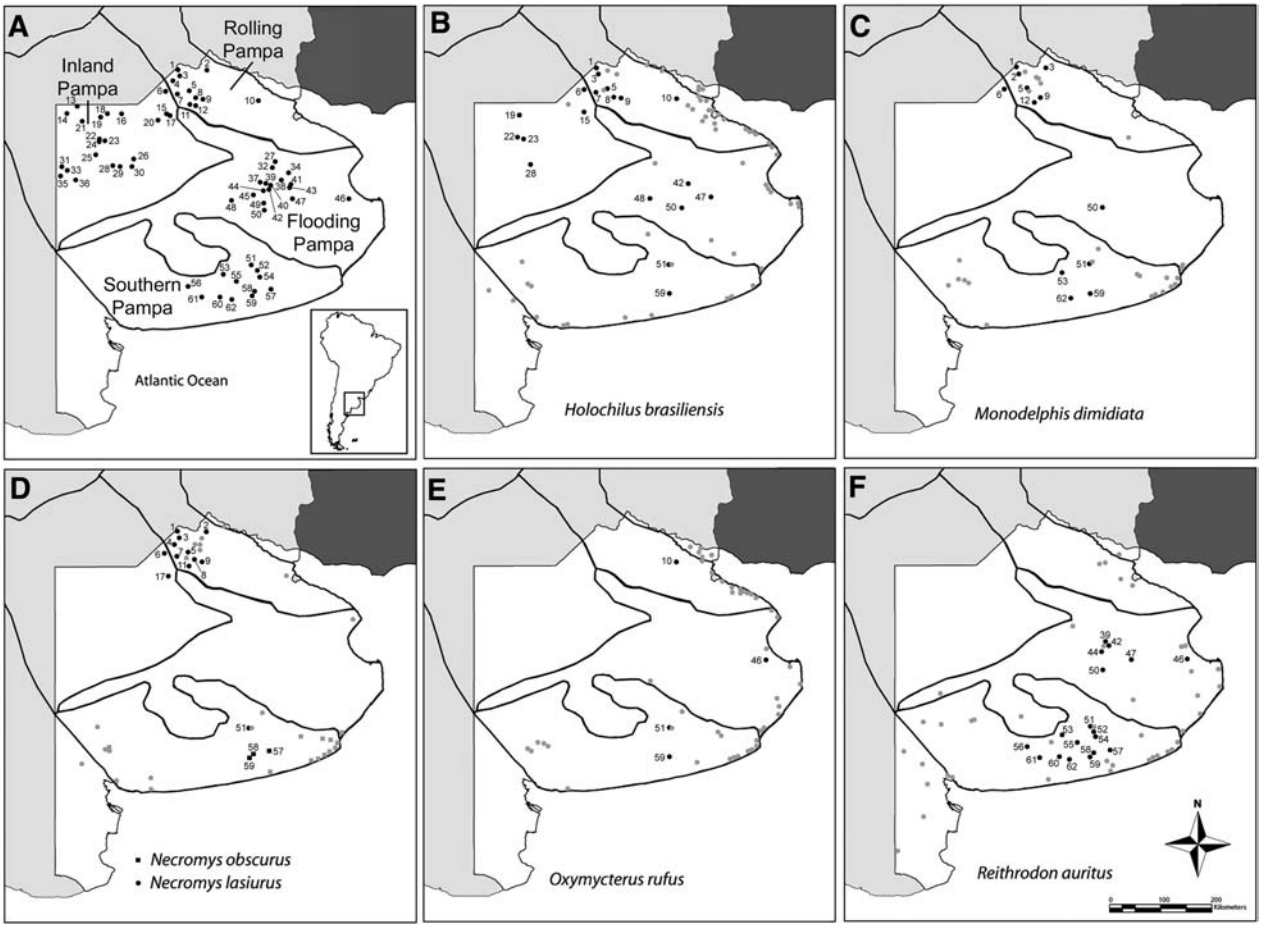

Figure 1 (A) Studied localities and (B–F) new locality records (black circles) for selected micromammal species in Buenos Aires province, central-eastern Argentina. Previous records are shown with gray circles and were compiled from several sources (Massoia 1976, Galliari et al. 1991, Pardiñas 1999, Galliari and Pardiñas 2000, Flores et al. 2007).

soia 1976, Galliari and Pardiñas 2000) and by comparisons with reference collections housed at the Museo de Ciencias Naturales ''Bernardino Rivadavia'' (Buenos Aires, Argentina). Studied samples are housed in the Laboratorio de Ecología de Poblaciones, Universidad de Buenos Aires (Argentina). The taxonomy employed here follows Wilson and Reeder (2005), with modifications according to D'Elía et al. (2008a).

We analyzed a total of 90 samples from 62 localities identifying a total of 32,892 prey-items. At least 14 taxa are represented in the studied samples (Table 1). In two cases, including the native rodent genus *Calomys* Waterhouse 1837 and the exotic *Rattus* Fischer 1803, it was not determined whether one or two species are involved. Two species of *Calomys* – *C. laucha* (Fischer 1814) and *C. musculinus* (Thomas 1913) – are widely sympatric in the Pampean region of the Buenos Aires province (Massoia and Fornes 1965), accounting for up to 60% of the small mammal communities in most of our studied localities. All micromammal species found in the owl pellet samples belonged to species previously cited for the Pampean region (Galliari et al. 1991, Pardiñas et al. in press). The most relevant findings are discussed in the following paragraphs.

Previous records for the small marsupial *Monodelphis dimidiata* (Wagner 1847) (Figure 2A) correspond to four isolated areas in the north, northeastern, southeastern, and southwestern corners of the province (Flores et al. 2007). Our finding partially fills the gap between the southern populations, enlarging its distribution ca. 90 km to the west and north from the previous nearest records in this area. In addition, we found this species in the Flooding Pampa, an area without previous references for this species.

New locality records for the marsh rat *Holochilus brasiliensis* (Desmarest 1819) (Figure 2B) enlarge its distribution ca. 100 km to the west in the northwestern corner of the Buenos Aires province. In addition, its presence is confirmed in the Flooding and Inland pampas, two areas where the previous records were mostly peripheral (Massoia 1976).

Necromys lasiurus (Lund 1840) (Figure 2C) has a wide and fragmentary distribution in the Pampean region (Galliari and Pardiñas 2000). Our findings in the northern corner of Buenos Aires province expanded ca. 50 km to the west its known distribution and almost triplicate its range area in this sector. A similar situation was observed with *Necromys obscurus* (Waterhouse 1837) (Figure 2D). This species enlarged

Table 1 Micromammal assemblages of the Pampean region of the Buenos Aires province, central-eastern Argentina (localities arranged by latitude).

	Locality	Latitude	Longitude	SR	Aa	Csp	Ca	Ct	Hb	Lc	Md	Mm	Nl	No	Of	Or	Rsp	Ra	N
1	Pearson	-33.6508	-60.8946	RP	+	+			+		+	+	+		+				743
2	Juan Pujol	-33.6712	-60.2946	RP	+	+	+			+	+		+		+				183
3	Estancia (Ea.) San Federico	-33.7857	-60.8592	RP	+	+			+		+	+	+		+		+		821
4	El Arbolito	-33.9138	-60.9447	RP	+	+							+		+				217
5	Roberto Cano	-34.0868	-60.6691	RP	+	+			+		+	+	+		+		+		1177
6	Trinidad	-34.0994	-61.1395	IP	+	+	+		+		+		+		+				554
7	Rojas	-34.1705	-60.9004	RP	+	+			+				+		+				58
8	Hunter	-34.2475	-60.5327	RP	+	+	+		+				+		+				126
9	La Invencible	-34.2756	-60.3856	RP	+	+			+		+		+		+		+		161
10	Diego Gaynor	-34.3014	-59.2457	RP	+	+	+		+			+			+	+	+		1624
11	Los Indios	-34.3725	-60.6525	RP	+	+							+		+				230
12	Inés Indart	-34.3992	-60.5362	RP	+	+					+	+			+		+		229
13	Cañada Seca	-34.4115	-62.9596	IP	+	+						+			+		+		558
14	Santa Regina	-34.5465	-63.1740	IP	+	+						+			+				436
15	Las Parvas	-34.5648	-61.1353	IP	+	+			+			+			+				138
16	Germania	-34.5749	-62.0500	IP	+	+						+			+				264
17	Saforcada	-34.5762	-61.0771	IP	+	+							+		+		+		62
18	Pichincha	-34.5811	-62.3539	IP	+	+									+				19
19	Blaquier	-34.6346	-62.4806	IP	+	+			+			+			+				326
20	Bermudez	-34.6943	-61.3284	IP	+	+									+				133
21	El Día	-34.7375	-62.8318	IP	+	+						+			+				172
22	Ea. La Providencia	-35.0970	-62.5049	IP	+	+			+			+			+				428
23	Encina	-35.1274	-62.3913	IP	+	+			+			+			+				1862
24	Hereford	-35.1327	-62.5123	IP	+	+									+				221
25	Santa Inés	-35.4043	-62.5761	IP	+	+						+			+				473
26	Ea. 13 de abril	-35.5046	-61.8041	IP	+	+						+			+				501
27	Videla Dorna	-35.5458	-58.8878	FP	+	+						+			+		+		117
28	Marucha	-35.6303	-62.2295	IP	+	+			+			+			+		+		906
29	Larramendi	-35.6472	-62.0861	IP	+	+						+			+				1105
30	Pedro Gamén	-35.6481	-61.8395	IP	+	+		+				+			+		+		667
31	Valentin Gomez	-35.6511	-63.2540	IP	+	+									+				98
32	Gorsh	-35.6692	-58.9641	FP	+	+						+			+				154
33	Sundblad	-35.7657	-63.1371	IP	+	+									+				83
34	Ea. La Invernada de Giribone	-35.7691	-58.6384	FP	+	+									+		+		628
35	Roosvelt	-35.8488	-63.2954	IP	+	+						+			+				498
36	Lertora	-35.9235	-62.9753	IP	+	+						+			+		+		654
37	6.3 km ONO Coronel Boerr	-35.9278	-59.1349	FP	+	+													9
38	Newton	-35.9317	-58.7759	FP	+	+						+			+				1098
39	Coronel Boerr	-35.9405	-59.0678	FP	+	+									+			+	47

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(Table 1 continued)

	Locality	Latitude	Longitude	SR	Aa	Csp	Ca	Ct	Hb	Lc	Md	Mm	Nl	No	Of	Or	Rsp	Ra	N
40	Rosas	-35.9672	-58.9400	FP	+	+									+				35
41	Ea. San Miguel de la Tempestad	-36.0125	-58.5830	FP	+	+									+				194
42	Tapera al sur de Rosas	-36.0328	-59.0124	FP	+	+			+						+			+	620
43	Ibañez	-36.0382	-58.6028	FP	+	+						+			+				52
44	Plaza Montero	-36.1480	-59.1469	FP	+	+						+			+			+	524
45	Pardo	-36.2449	-59.3655	FP	+	+									+				401
46	Ea. Santa Lucia	-36.3040	-57.3921	FP	+	+									+	+		+	140
47	Casalins	-36.3116	-58.5531	FP	+	+			+						+			+	416
48	Campodónico	-36.3443	-59.7974	FP	+	+			+						+				254
49	Colman	-36.4096	-59.1430	FP	+	+									+				141
50	Miranda	-36.5333	-59.1320	FP	+	+	+		+		+				+		+	+	412
51	Villa Cacique	-37.6863	-59.3973	SP	+	+	+		+		+	+	+		+	+	+	+	891
52	La Negra	-37.7914	-59.3146	SP	+	+						+			+			+	62
53	Alzaga	-37.8595	-59.9719	SP	+	+	+				+	+			+			+	1366
54	Claraz	-37.8898	-59.2851	SP	+	+						+						+	76
55	Almirante Chapar	-38.0310	-59.6580	SP	+	+									+			+	65
56	La Sortija	-38.1121	-60.6885	SP	+	+						+			+			+	1466
57	San José	-38.1686	-58.9908	SP	+	+						+		+	+			+	1121
58	Lumb	-38.2178	-59.3144	SP	+	+						+		+	+			+	809
59	Deferrari	-38.3023	-59.3863	SP	+	+			+		+	+		+	+	+		+	2368
60	San Mayol	-38.3163	-60.0265	SP	+	+						+			+			+	2205
61	Paraje La Tigra	-38.3339	-60.4200	SP	+	+						+			+			+	366
62	Ochandio	-38.3815	-59.7985	SP	+	+					+	+			+			+	1128

+, presence; SR, subregion; RP, Rolling Pampa; SP, Southern Pampa; FP, Flooding Pampa; IP, Inland Pampa; Species codes are as follows: Aa, *Akodon azarae*; Csp, *Calomys* spp.; Ca, *Cavia aperea*; Ct, *Ctenomys* sp.; Hb, *Holochilus brasiliensis*; Lc, *Lutreolina crassicaudata*; Md, *Monodelphis dimidiata*; Mm, *Mus musculus*; Nl, *Necromys lasiurus*; No, *Necromys obscurus*; Of, *Oligoryzomys flavescens*; Or, *Oxymycterus rufus*; Rsp, *Rattus* spp.; Ra, *Reithrodon auritus*.

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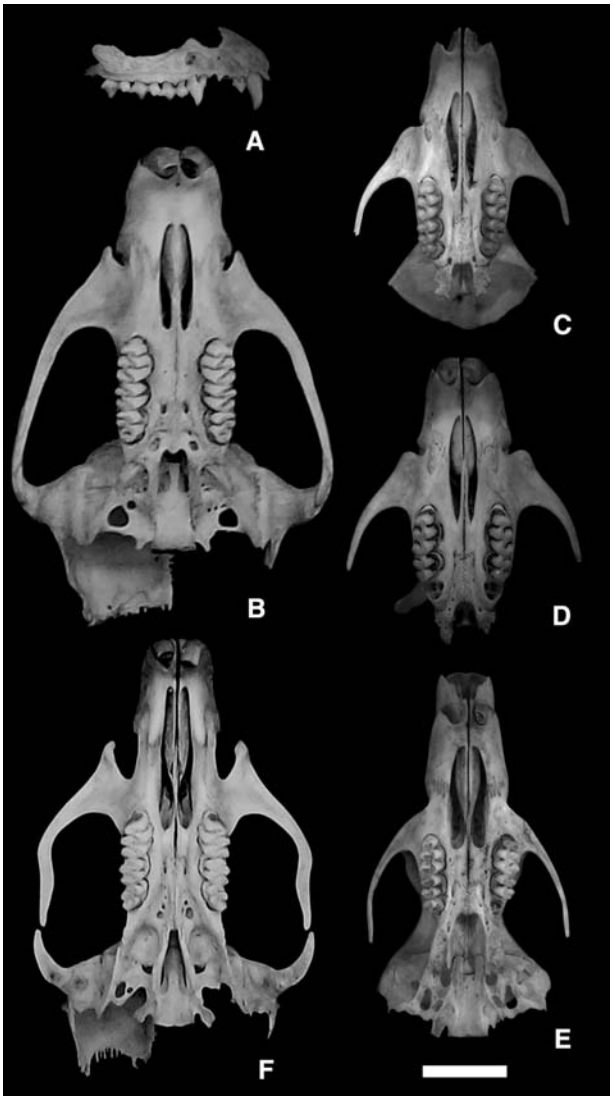

Figure 2 Specimens recovered in the owl pellets from the Pampean region of the Buenos Aires province, Argentina: (A) *Monodelphis dimidiata* [59], lateral view of the right maxillary; (B) *Holochilus brasiliensis* [59], ventral view of the skull; (C) *Necromys lasiurus* [5], ventral view of the skull; (D) *Necromys obscurus* [59], ventral view of the skull; (E) *Oxymycterus rufus* [51], ventral view of the skull; (F) *Reithrodon auritus* [53], ventral view of the skull. The number between brackets corresponds to the locality of collection (see Table 1). Scale=5 mm.

its distribution to the interior grasslands of the Buenos Aires province ca. 110 km to the northwest from its previous nearest record. In addition, its small distributional range is almost duplicated in Argentina, restricted to the date to humid grasslands in coastal areas and hilly environments (Galliari and Pardiñas 2000). It is important to note that owing to its restricted and fragmented distribution, this species was listed as Near Threatened by the IUCN (D'Elía et al. 2008b).

Despite that our records for *Oxymycterus rufus* (Fischer 1814) (Figure 2E) are almost included within the recent range of this species, the reference for Diego Gaynor is noteworthy. The small mammal community of this locality was largely studied in the past three decades and no previous records for this species were made until recent years (Bellocq 1990). In fact, *O. rufus* was registered for the first time in this area around the decade of 2000 when some individuals were trapped in borders of cultivate fields (Bilenca et al. 2007). Our record is the second for this locality, which is located 40 km to the south of the nearest previous reference.

Reithrodon auritus (Fischer 1814) (Figure 2F) is mostly restricted to the eastern and southern half of the province. New locality records, showing relatively high frequencies (7–33% of the total identified specimens) in some sites, fill the gap between previous records in the Flooding and Southern Pampas. This is an interesting finding because *R. auritus* is in general a non-abundant element in the Pampean region (see Prado et al. 1987).

The sigmodontine rodent communities of the Pampean region are characterized by the dominance of *Calomys* spp., *Akodon azarae* (Fischer 1819), and *Oligoryzomys flavescens* (Waterhouse 1837) (Pardiñas et al. in press). Ecological, genetic, and paleontological studies have associated the prevalence of these species, and in particular of *Calomys* spp., with the transformation of large surfaces from natural pastures and grasslands to crop fields (Pardiñas 1995, 1999, González-Ittig et al. 2007, Pardiñas et al. in press). This situation created favorable conditions for *Calomys* spp., allowing populations to increase in size and to expand (Bilenca and Kravetz 1995, Pardiñas 1995). These same conditions were perhaps responsible for the fragmentation of the distributional ranges of some species, including local (e.g., *Necromys lasiurus* in some coastal areas; see Galliari and Pardiñas 2000) or total extinctions, and the decrease in the abundance of others (e.g., *Reithrodon auritus*; Pardiñas 1999). Our survey, encompassing a surface of ca. 150,000 km^2 of mostly unstudied areas, confirms this assertion. In fact, despite that we found a significant extension of range distributions for some species, the main distributional patterns do not change significantly (e.g., *Necromys lasiurus* is still restricted to four main discontinuous populations).

Our data confirm the importance of *Tyto alba* in recording small mammals and show that the analysis of regurgitated pellets can be an important tool for the inventory of rare or difficult-to-trap small mammals. This methodology permits to sample small mammal communities through very large areas at low cost, allowing detection of isolated populations of species with fragmentary distributions. Moreover, samples through different years are useful to detect small mammal changes in the communities, such as range expansions or extinctions, both at local and regional levels. In addition, taking into account the recent changes observed in the Pampean biota with regard to different land use and landscape structure (Attademo et al. 2005, Schrag et al. 2009), owl pellet analysis can be a valuable tool in evaluating the evolution of small mammal composition in short-term periods (Love at al. 2000).

Acknowledgements

We would like to thank Lucas and Carlos Leveau, Laura Solari and Jennifer Tregoning for their assistance during fieldwork. Ulyses F.J.

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Pardiñas and an anonymous reviewer made valuable comments on a first draft of this work. This study was funded by the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET, Argentina), the Universidad de Buenos Aires (grants UBACyT X282 and X406), and the Instituto Nacional de Tecnología Agropecuaria (INTA, Argentina; PNECO 1302).

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