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Source: Edentata, 14(1) : 35-50

Published By: IUCN/SSC Anteater, Sloth and Armadillo Specialist Group

URL: https://doi.org/10.5537/020.014.0105

Edentata 14 (2013): **35–50**
Electronic version: ISSN 1852-9208
Print version: ISSN 1413-4411
http://www.xenarthrans.org

Distribution and status of the extant xenarthrans (Mammalia: Xenarthra) in the Southern Cone Mesopotamian savanna, Argentina

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Abstract The Southern Cone Mesopotamian savanna (MS), located in northeastern Argentina, is one of the least protected ecoregions (0.11%) of the country. Five of the seven historically present species of xenarthrans in this region are of conservation concern at the national level. This work reviews, updates and analyzes the current distribution and conservation status of the xenarthrans using a georeferenced database including records from four complementary methods: field surveys, interviews with local stakeholders, participatory monitoring, and bibliography review. Results were then compared with existing distribution maps. In total, 304 occurrence records were documented in 127 localities. Considering their relative presence (number of localities where the species is present divided by the total number of localities), the species with most records were *Dasypus novemcinctus* (71.7%) and *Dasypus hybridus* (63%); *Euphractus sexcinctus* and *Tamandua tetradactyla* were detected in a lower proportion (48.8 and 35.4%, respectively). *Cabassous tatouay* and *Myrmecophaga tridactyla* are rare species in the ecoregion. The extant xenarthrans that inhabit the MS are reviewed and information gaps for certain species are identified. We emphasize the importance of contributions from the local community, who provided 80% of the collected information for this study.

Keywords: *Cabassous tatouay*, Corrientes, *Dasypus*, *Euphractus sexcinctus*, Misiones, *Myrmecophaga tridactyla*, *Tamandua tetradactyla*

Distribución y status de los xenartros (Mammalia: Xenarthra) de la ecorregión de Campos y Malezales, Argentina

Resumen La ecorregión Campos y Malezales (CyM), localizada al noreste de Argentina, es una de las menos protegidas (0,11%) del país. Cinco de las siete especies de xenartros históricamente allí presentes se encuentran amenazadas o cercanas a la amenaza a nivel nacional. Este trabajo revisa, actualiza y analiza la distribución actual y el estado de conservación de los xenartros, empleando una base de datos georreferenciada con registros obtenidos a través de cuatro métodos complementarios: relevamientos de campo, entrevistas a pobladores locales, monitoreo participativo y recopilación bibliográfica. Se compararon los resultados con mapas de distribución potencial existentes. En total, se obtuvieron 304 registros de presencia en 127 localidades. Considerando la presencia relativa (número de localidades donde una especie está presente dividido por el número total de localidades), las especies con más registros fueron *Dasypus novemcinctus* (71,7%) y *Dasypus hybridus* (63%); *Euphractus sexcinctus* y *Tamandua tetradactyla* fueron detectados en menor proporción (48,8% y 35,4%, respectivamente); y *Cabassous tatouay* y *Myrmecophaga tridactyla* resultaron ser especies raras en la ecorregión. En este trabajo se presentan los xenartros que actualmente habitan la ecorregión CyM y se identifican vacíos de información para ciertas especies. Resaltamos la importancia de los aportes de la comunidad local que suministró para este estudio el 80% de la información recopilada.

Palabras clave: *Cabassous tatouay*, Corrientes, *Dasypus*, *Euphractus sexcinctus*, Misiones, *Myrmecophaga tridactyla*, *Tamandua tetradactyla*

Introduction

The Southern Cone Mesopotamian savanna ecoregion (MS) (Olson *et al*., 2001), located in southern Misiones and north-eastern Corrientes, Argentina, supports a unique zoogeographic composition (Chebez, 1996) but is under-represented in protected areas: only 0.11% of the ecoregion is currently protected (Burkart *et al.*, 2007). This area shares numerous endangered taxa with the Iberá Wetlands, the Pampas and the Chaco Savannas (Parera & Erize, 2002), including the maned wolf (*Chrysocyon brachyurus*), Pampas (*Ozotoceros bezoarticus*) and marsh deer (*Blastocerus dichotomus*), and the extirpated giant anteater (*Myrmecophaga tridactyla*) (Chebez & Cirignoli, 2008). However, our knowledge of faunal assemblages of some groups of mammals of the MS remains incomplete or fragmented, as is the case with xenarthrans.

This region is seriously threatened due to human activity, mainly as a consequence of the transformation of habitat to crops, urban areas, or plantations, and degradation due to cattle ranching (White *et al*., 2000; Henwood, 2010). In the MS ecoregion, grasslands have been used for more than 300 years for grazing (Forclaz *et al.*, 2002; Bilenca & Miñarro, 2004). However, more recently, other land uses such as agriculture and silviculture have been expanding. In fact, nowadays, the major threats to biodiversity are afforestation, illegal wildlife trade, uncontrolled fire management, and secondarily, the drainage and canalization of wetlands for rice crops (Viglizzo *et al.*, 2005).

The xenarthrans are endemic to the Neotropics (Eisenberg, 1979). They constitute the only mammal group that originated in South America (Abba *et al.*, 2012), and represent one of the four major placental lineages (Delsuc & Douzery, 2008). Despite their evolutionary significance, the global conservation status of xenarthrans places them among the mammals most at risk of extinction (Abba *et al*., 2012).

There are 18 species described for Argentina (Abba *et al*., 2012), seven of which are potentially present in MS. Four of these seven species are listed as a conservation concern by national (Ojeda *et al.*, 2012) and international (IUCN, 2013) Red Lists. Complicating matters, *Dasypus septemcinctus* and *Dasypus hybridus*, the small long-nosed armadillos are difficult to properly identify due to morphological similarities. Some authors (Hamlett, 1939; Abba *et al*., 2012) consider *D. septemcinctus* to be endemic to Brazil, whereas others authors suggest its presence in the south of the province of Misiones and in northern Corrientes (Chebez, 1996; Massoia *et al*., 2006).

Available information on xenarthrans is usually scarce and dispersed. In addition, the capture and direct observation of these species is difficult. Thus, the gathering of indirect data from diverse reliable sources is a valuable tool to help determine their distribution in the region.

With this in mind, the aim of this paper is to review, update and analyze the current distribution and conservation status of xenarthrans in the MS ecoregion by compiling existing information and incorporating new data from our own on-going studies in the area.

Materials and Methods

Study area

The Southern Cone Mesopotamian savanna ecoregion, locally known as *Campos y Malezales* (Burkart *et al*., 1999), covers 26,000 km^2 in the southern portion of Misiones and northeastern Corrientes. It is located between 27º and 30ºS, and 55º and 57ºW; bordered by the Uruguay River to the east, the Espinal ecoregion to the south, the Iberá wetlands to the west, and the Paraná River and Atlantic Rainforest to the north (Morello *et al*., 2012) (**Fig. 1**).

The predominant landscape is extensive grassland, with a gently undulating topography in the north and a flat plain in the south. The vegetation comprises, to the north, grasslands and meadows (*pajonales*) with several herbaceous communities ("*Campos*"); and to the south, uniform and almost pure meadows that grow over flood-prone and poorly drained soils ("*Malezales*") (Burkart *et al*., 1999). Trees appear in isolated patches or as riparian forests, whereas palms can form open woodlands or grow mixed with the grasses (Krapovickas & Di Giacomo, 1998).

In the north of this region, forestry plantations and crops like yerba mate, tea, and rice prevail; to the south, cattle are grazed on extensive ranches on natural grasslands commonly managed with fire (Viglizzo *et al*., 2005; Morello *et al*., 2012).

Data collection

To estimate the distribution and relative presence (RP) of each species in the region we based the study on information obtained from four complementary methods. The RP was calculated as the number of localities where the species is present divided by the total number of localities.

1. Field surveys: Track transects were conducted on internal trails along the MS – Iberá Wetlands ecotone (Puerto Valle ranch) and in the locality of Garruchos (60,000 sampled meters). Tracks, burrows, feces, carapaces, and any other signs of presence were recorded (Zuleta *et al.*, 2010). We also incorporated field surveys conducted in Campo San Juan Natural Reserve in Misiones province (Homberg *et al*., 2012).

2. Participatory monitoring: A participatory monitoring program of fauna is conducted in association

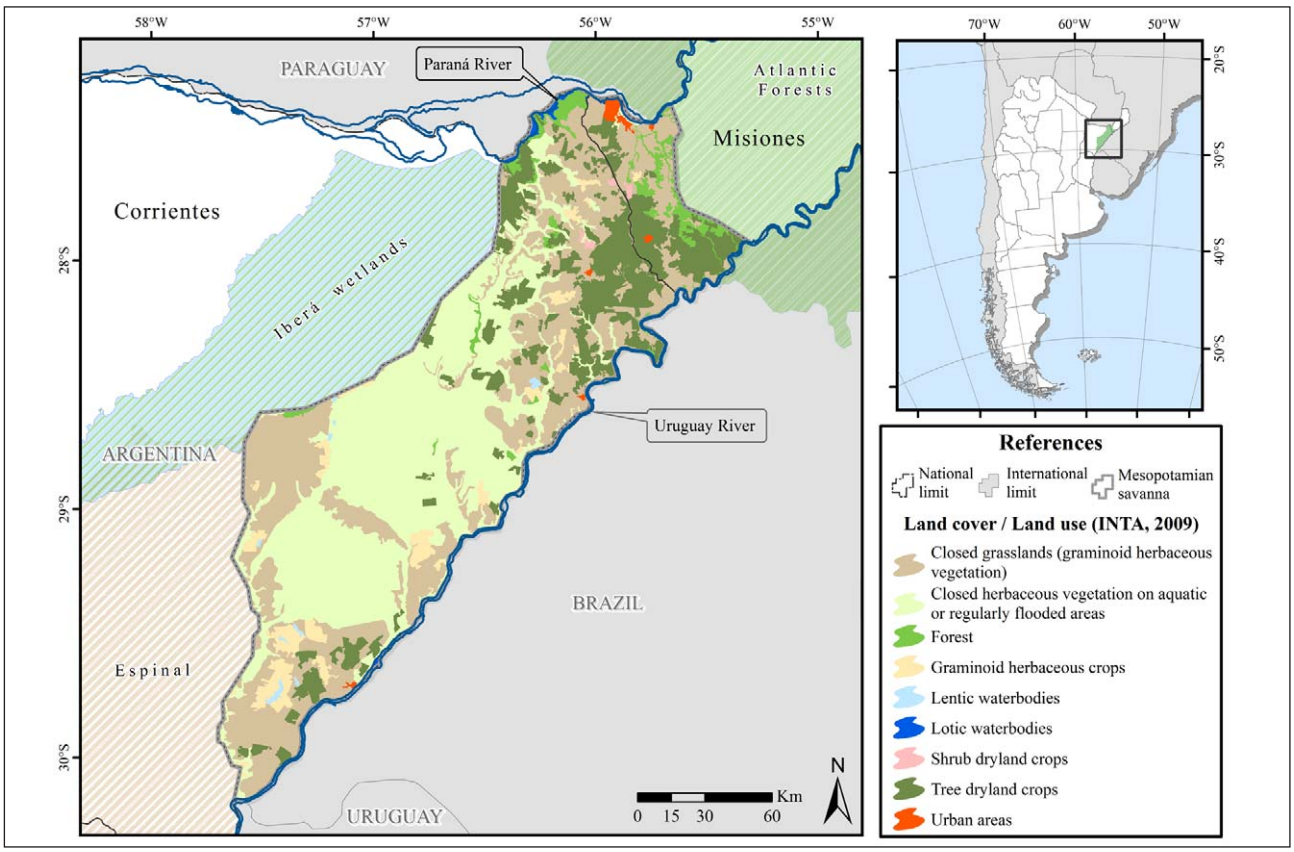

FIGURE 1. Location of the Southern Cone Mesopotamian savanna, Argentina, and its main land uses and land covers.

with forestry personnel, who are periodically trained and evaluated in the identification of species by fauna experts. Observers are fixed in some cases (fire control tower employees, N=13, sampling effort=8 hr/day) and mobile in others (brigade firefighters and supervisors, N=15, variable sampling effort). Participants register all occasional sightings during their daily duties in the field, recording the name of the species, their location, date, number of individuals, and physical condition. Here we present results from September 2006 until May 2012, with over 17,700 hr of sampling effort by observers.

3. *Interviews*: Semi-structured questionnaires were administered to local inhabitants between 2008 and 2012. Interviews were conducted with residents, farmers and field workers who mainly develop field activities in contact with local wildlife. For each species, interviewees were asked to categorize them as commonly or occasionally present (Stockill, 2006); all other relevant information provided was also considered. Correct identification of species was verified through morphological and behavioral descriptions, as well as photographs provided during the encounters; interviewees who failed to show reliable knowledge and identification capacity were not considered in further analyses (Bauni, 2011).

4. *Bibliographical review*: We conducted a bibliographical search of scientific articles, field guides, range maps, and scientific and technical reports to collect observations of xenarthrans. Online search was performed using Google and Google Scholar, and keywords in both Spanish and English (common and Latin names of the species and terms such as distribution, *Campos y Malezales*, Argentina, presence, locality). We also included national and international databases, namely SIB (*Sistema de Información de Biodiversidad de Argentina*, <http://www.sib.gov.ar/>) and GBIF (Global Biodiversity Information Facility, <http://www.gbif.org>).

Mapping

We used the coordinates for localities provided by the source of the data. If such data were not available, coordinates were obtained from the Global Gazetteer Version 2.2. (<http://www.fallingrain.com/world/index.html>), the Cartographic Directory of Spain (<http://www.dices.net/>), or derived from specific references (*e.g.*, route intersections, lagoons, distances from towns) using GoogleEarth. Imprecise data (*e.g.*, "north-east Corrientes", "south of the province") were not considered. For interviews, the coordinates of the centre of the property were recorded. All records were georeferenced using ArcGis 9.3 (Environmental Systems Research Institute, Inc., Redlands, USA). Potential distribution maps were extracted from IUCN (2013).

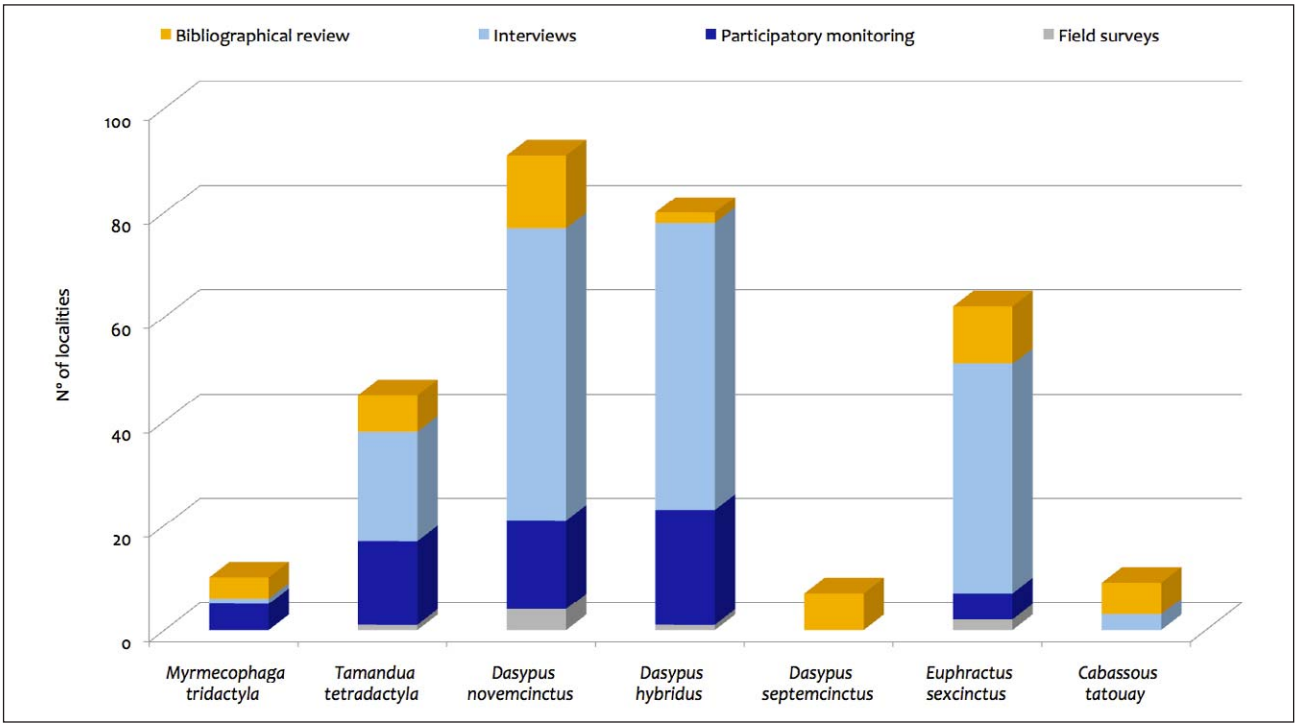

FIGURE 2. Number of localities in the Southern Cone Mesopotamian savanna per xenarthran species and source of information.

APPENDIX 1 contains a full list of records with their respective species, locality data, and sources of information.

RESULTS AND DISCUSSION

Summary of collected data

Based on all sources of information, we documented 304 records and 127 localities distributed across the entire ecoregion in the period 1979–2012. They represented a total of seven xenarthran species belonging to two orders. Six species were undoubtedly identified: *Myrmecophaga tridactyla*, *Tamandua tetradactyla*, *Dasypus novemcinctus*, *Euphractus sexcinctus*, *Cabassous tatouay* and *D. hybridus*. We considered *D. septemcinctus* as a seventh species due to the existence of records, but given the confusion between the latter and *D. hybridus* (see discussion below) and the possibility that all individuals of *D. septemcinctus* actually belong to *D. hybridus* (Abba *et al.*, 2012), we present the records of both species in the same map.

The most widespread species were the nine-banded (*D. novemcinctus*; 91 localities) and the southern lesser long-nosed armadillo (*D. hybridus*; 80 localities), followed by the yellow armadillo (*E. sexcinctus*; 62 localities) (**FIG. 2**).

The most frequently detected species in the bibliographical review, participatory monitoring and interviews were the nine-banded and lesser long-nosed armadillo, each with a similar number of records. Considering the field surveys alone, the nine-banded armadillo was the species with the highest number of records. Both the greater naked-tailed armadillo (*C. tatouay*) and the giant anteater were detected in a low proportion.

Interviews and occasional sightings of xenarthrans account for 54 and 25% of localities, respectively. Bibliography data, with 24 localities, represent 18% of recorded sites, whereas field surveys only account for 3% of total recorded localities (**TABLE 1**).

Species synopsis and regional conservation status

Below we describe each registered species, indicating its relative presence and national (NCS; Ojeda *et al.*, 2012) and international conservation status (ICS; IUCN, 2013).

Magnorder Xenarthra Cope, 1889

Order Pilosa Flower, 1883

Family Myrmecophagidae Gray, 1825

TABLE 1. Number of records of xenarthran species in the Southern Cone Mesopotamian savanna by source of information.

Source	Nº Localities	Percentage
Participatory monitoring	33	25
Interviews	71	54
Field surveys	4	3
Bibliographical review	23	18

Myrmecophaga tridactyla Linnaeus, 1758 (**Fig. 3**)

Common name: oso hormiguero, hormiguero gigante, yurumí (Spanish), giant anteater (English), tamanduá bandeira (Portuguese)

Relative presence: 7.9%

Conservation status: Vulnerable (NCS, ICS)

Comments: the giant anteater has been reported from 10 localities in the last decade. One of these records came from interviews, five from participatory monitoring and four from bibliography (two from Misiones and two from Corrientes province). Another bibliographical record, which did not have enough precision to be included in this study, indicates that an individual was observed in the department of Santo Tomé (Corrientes) in the 1980s (Chebez, 2008). Although the species is said to have a probability of occurrence of 0.2–0.6 in the MS ecoregion (Abba *et al.*, 2012), the IUCN has categorized the anteater as possibly extinct in this region (Superina *et al.*, 2010). The records reported in this paper may need verification from direct sampling methods, so as to clarify the anteater's uncertain status in the region. Meanwhile, "The Conservation Land Trust" foundation has a reintroduction program for this species in the provincial Park of Iberá wetlands, adjacent to MS ecoregion (Jiménez Pérez, 2006; Di Blanco *et al.*, 2012).

Tamandua tetradactyla Linnaeus, 1759 (**Fig. 4**)

Common name: oso melero, oso mielero (Spanish), southern tamandua (English), tamanduá-mirim (Portuguese)

Relative presence: 35.4%

Conservation status: Near Threatened (NCS), Least Concern (ICS)

Comments: this species was registered through interviews (21), participatory monitoring (16), bibliographic review (7), and field survey (1). All records were within the expected distribution according to the IUCN (2013). Although the number of localities was not high (45), the southern tamandua is widely distributed in north-east Corrientes, and MS is the southern limit of its known distribution in the province of Corrientes.

Records mainly belonged to patches of forest or riparian forests of the Uruguay and Paraná Rivers, where this species is able to feed on ants and termites, primarily extracted from arboreal nests (Abba *et al.*, 2012). Even though it is a fairly common species in the area, habitat loss implies a serious threat to this animal. In Uruguay the species has been negatively affected by advancing eucalyptus plantations (Miranda & Meritt, 2011). Considering the similar land-use changes in the MS ecoregion, this threat may also apply to

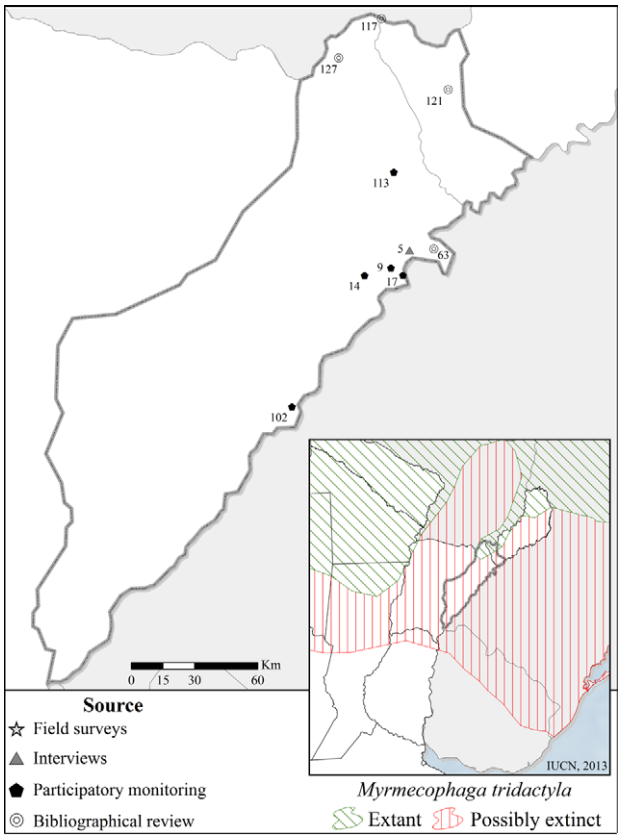

Figure 3. Localities with presence and potential distribution of *Myrmecophaga tridactyla* in the Southern Cone Mesopotamian savanna, Argentina.

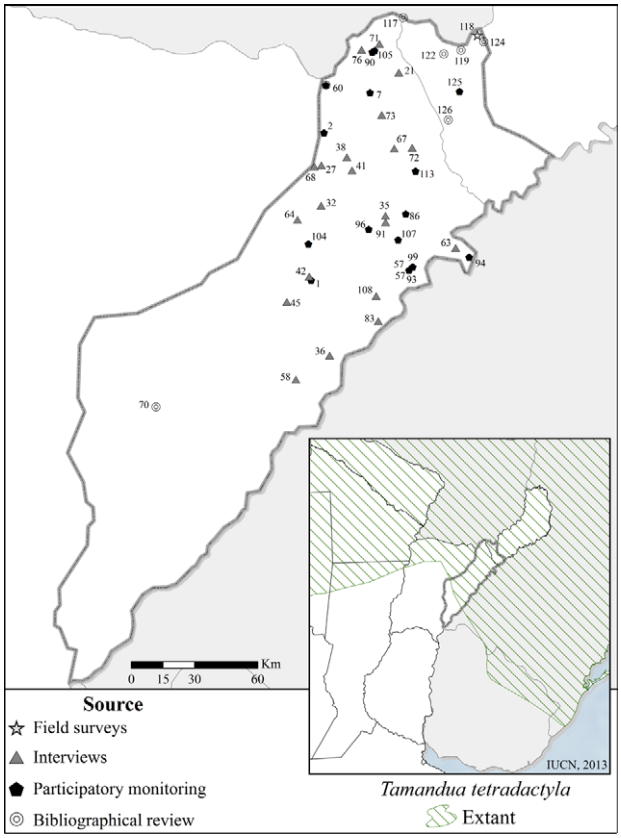

Figure 4. Localities with presence and potential distribution of *Tamandua tetradactyla* in the Southern Cone Mesopotamian savanna, Argentina.

Argentinean populations. Hunting is another potential threat for the southern tamandua, and many individuals are killed on roads, as observed during this work and reported from Brazil (*e.g.*, da Cunha *et al.*, 2010; da Rosa *et al.*, 2010) and Paraguay (Smith, 2012).

Order Cingulata Illiger, 1811

Family Dasypodidae Gray, 1821

Subfamily Dasypodinae Gray, 1821

Tribe Dasypodini Gray, 1821

Dasypus novemcinctus Linnaeus, 1758 (**Fig. 5**)

Common name: mulita grande, tatú negro (Spanish), nine-banded armadillo (English), tatu-galinha (Portuguese)

Relative presence: 71.7%

Conservation status: Least Concern (NCS, ICS)

Comments: consistent with other authors (Parera & Erize, 2002; Zamorano & Scillato-Yané, 2008; Superina *et al.*, 2010), our results show that the nine-banded armadillo is the most widely distributed armadillo species and is present in numerous localities throughout the ecoregion. This species is known from a wide variety of habitats from the southern United States to northern Argentinean grasslands (McBee & Baker, 1982; Smith & Redford, 1990; Vizcaíno, 1995). Some authors have recently suggested that its range is expanding southwards (Fracassi *et al.*, 2010; Abba & Vizcaíno, 2011).

It is one of the most hunted armadillos for human consumption, tool manufacture, and ornamental use by the local community. Nevertheless, this does not seem to be a conservation concern in MS. This could be explained by its high adaptive capacity, its occurrence in diverse types of habitats and ability to produce quadruplets, resulting in a rapid rate of reproduction (Abba & Superina, 2010a).

According to Abba *et al.* (2012), until now a low probability of occurrence was given to this species in the ecoregion. Still, in this work we document a high number of records and localities, therefore suggesting that the abundance and distribution of the nine-banded armadillo could be greater than previously thought. These new records, especially those from direct observations, may be used in further niche distribution modelling of the species.

Dasypus hybridus Desmarest, 1804 (**Fig. 6**)

Common name: mulita orejuda, mulita pampeana (Spanish), southern lesser long-nosed armadillo (English)

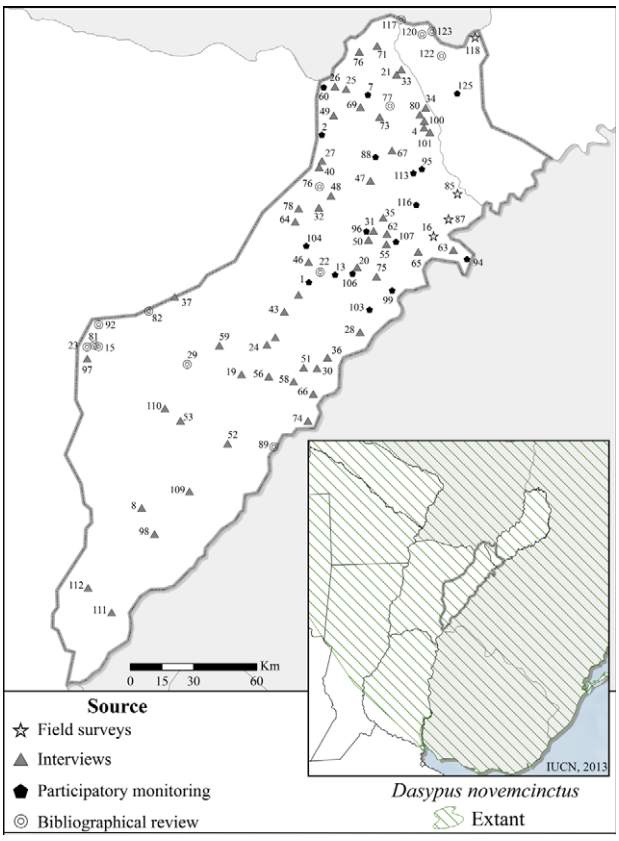

Figure 5. Localities with presence and potential distribution of *Dasypus novemcinctus* in the Southern Cone Mesopotamian savanna, Argentina.

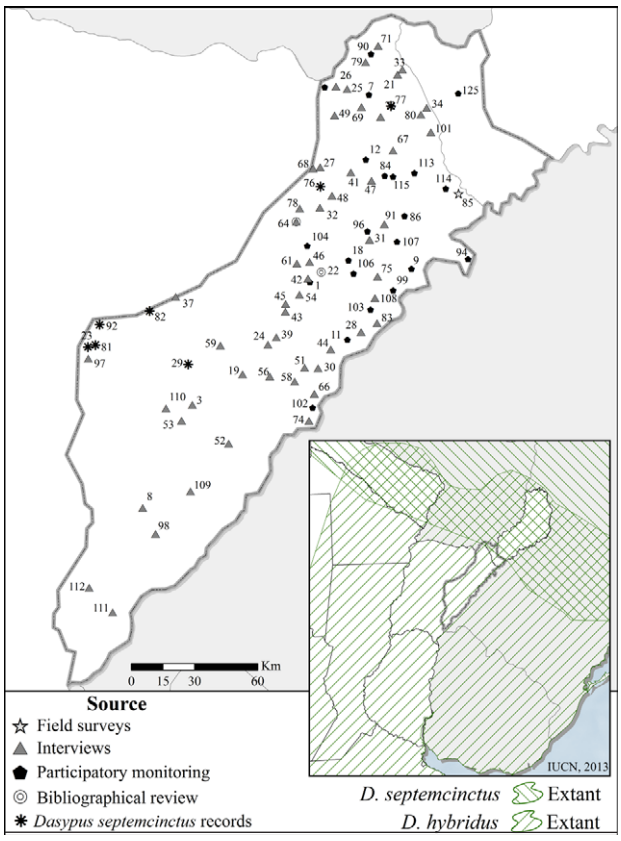

Figure 6. Localities with presence and potential distribution of *Dasypus hybridus* and *Dasypus septemcinctus* in the Southern Cone Mesopotamian savanna, Argentina.

Relative presence: 63%

Conservation status: Near Threatened (NCS, ICS)

Comments: the southern lesser long-nosed armadillo was represented in a higher number of localities and was found to be broadly distributed in the study area.

As far as its conservation is concerned, *D. hybridus* is susceptible to land use change and hunting (Fonseca & Aguiar, 2004), as well as urbanization and agricultural expansion (Abba & Superina, 2010b), which have probably caused a population decline (Fonseca & Aguiar, 2004). Given the current modifications of MS's landscape, which includes the replacement of grasslands for exotic plantations, this species should be monitored for potential population declines.

Although *D. hybridus* has been considered a junior synonym of *D. septemcinctus*, they can be distinguished morphologically. Hamlett (1939) stated that *D. hybridus* has proportionately shorter ears and inhabits Paraguay, Argentina, Uruguay and southern Brazil, whilst *D. septemcinctus* has ears and tail of medium length and is distributed only in Brazil. Later, Wetzel and Mondolfi (1979) included MS in the distribution range of *D. septemcinctus*, although they did not present data points for the provinces of Corrientes and Misiones. These authors presented data for localities of *D. hybridus* around MS, therefore including the ecoregion in its distribution range. Moreover, they proposed the sympatry of these species. Other authors, such as Massoia *et al*. (2006), supported the possible presence of both species in the region, especially in the bordering area between Corrientes and Misiones, and cited two records for *D. septemcinctus* for Misiones. However, Abba *et al.* (2012) recognized the presence of *D. hybridus* in Argentina and suggested that records of *D. septemcinctus* are likely to belong to *D. hybridus*, as there are no reliable data of observed or collected specimens of *D. septemcinctus* in the area. The IUCN (2013) also acknowledges that the distribution of the seven-banded armadillo (*D. septemcinctus*) does not include the MS ecoregion, but it is present in Misiones province. Following Abba *et al*. (2012) we consider our records to be *D. hybridus*. Nevertheless, we present data of *D. septemcinctus* (7 bibliographical records) for those authors who have reported it, because we have no proof to assume otherwise.

Subfamily Euphractinae Winge, 1923

Tribe Euphractini Winge, 1923

Euphractus sexcinctus Linnaeus, 1758 (**Fig. 7**)

Common name: gualacate, tatú peludo (Spanish), six-banded armadillo, yellow armadillo (English), tatu-peba (Portuguese)

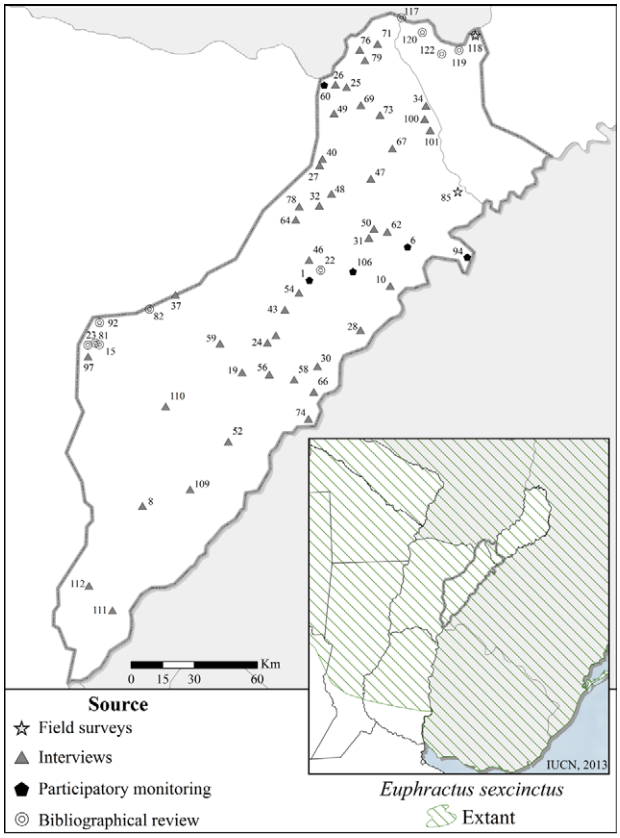

Figure 7. Localities with presence and potential distribution of *Euphractus sexcinctus* in the Southern Cone Mesopotamian savanna, Argentina.

Relative presence: 48.8%

Conservation status: Least Concern (NCS, ICS)

Comments: this species was registered through all available sources of information and local stakeholders characterize the species as abundant. Although it seems to be common in the whole Mesopotamian region, few occurrence points existed (Abba *et al.*, 2012) prior to this study.

This species is a common victim of roadkill, probably because of its diurnal behavior and its zig-zagging run that makes it difficult to avoid (Smith, 2007), and because it is hunted by local people. However, the populations of *E. sexcinctus* do not appear to be negatively affected in the ecoregion.

Subfamily Tolypeutinae Gray, 1865

Tribe Tolypeutini Gray, 1865

Cabassous tatouay Desmarest, 1804 (**Fig. 8**)

Common name: cabasú de orejas largas, tatú de rabo molle (Spanish), greater naked-tailed armadillo (English), tatu rabo-mole (Portuguese)

Relative presence: 7.1%

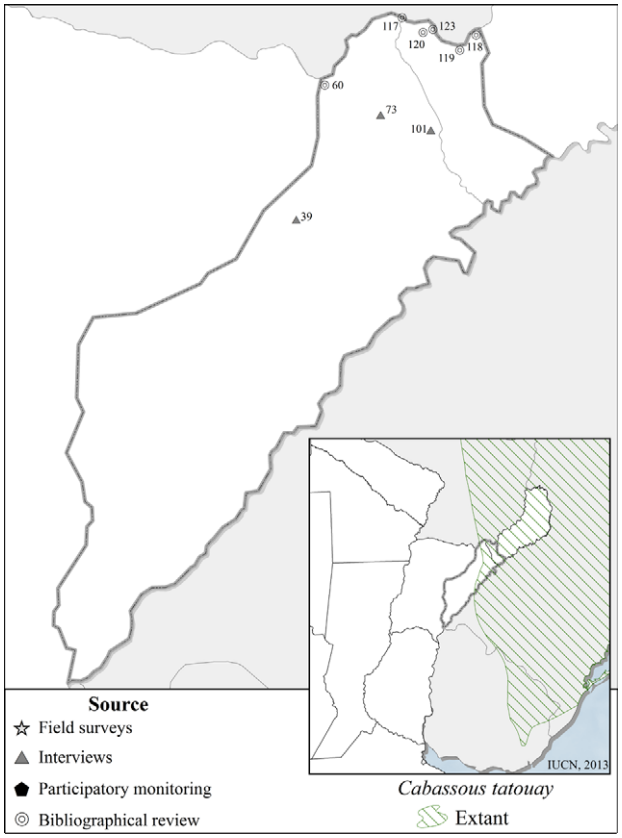

Figure 8. Localities with presence and potential distribution of *Cabassous tatouay* in the Southern Cone Mesopotamian savanna, Argentina.

Conservation status: Vulnerable (NCS), Least Concern (ICS)

Comments: the low number of localities with records for this species could be explained by the fact that these armadillos are highly fossorial (Abba & Superina, 2010c), as well as that the MS ecoregion is the southern range limit of this species in Argentina (IUCN, 2013). Our results are aligned to those from Abba *et al.* (2012) who estimated a low probability of occurrence for this species in the region. Although this species has experienced habitat loss in much of its range, it has the ability to tolerate modified habitats to a certain degree (Abba & Superina, 2010c).

Conclusions

In this paper we describe the xenarthran species assemblage of the Southern Cone Mesopotamian savanna ecoregion, a poorly studied area of Argentina. We conclude that the nine-banded armadillo, the yellow armadillo, and the southern tamandua are reliably present in the ecoregion. The southern lesser long-nosed armadillo is also present across the ecoregion; however, taxonomic confusion with the seven-banded armadillo (*D. septemcinctus*) raises doubts about the presence of both species in the ecoregion. Further research is needed to provide insight into their taxonomy and to allow estimating their current distribution in MS. The giant anteater and greater naked-tailed armadillo seem to be rare in the area and occurrences are reported from a low number of localities. Additional information is required on these taxa in order to accurately assess their distribution and conservation status (Abba *et al*., 2012). As far as the giant anteater is concerned, this study could be contradicting the "possibly extinct" status assigned to the species in Corrientes province (Chebez & Cirignoli, 2008).

In general, species recorded in this study are consistent with those reported by Abba *et al*. (2006). Specific field studies on xenarthrans should help bridge the information gap identified in this work, particularly considering that they are vulnerable to the existing land-use change of the MS ecoregion.

Of the four methods used for data collection, 80% of the data originate from interviews with stakeholders and from the Participatory Monitoring Program. This reveals the importance of involving members of the local community, as they are normally aware of the faunal resources around them and can obtain information that cannot easily be acquired by systematic research. This information, if proved reliable, allows scientists to complement their records. At the same time, we believe including the community can help raise awareness of environmental issues and get the population involved in biodiversity conservation.

The current advancement of agriculture and silviculture production in the MS ecoregion derive in a decrease of suitable habitat for xenarthrans and in the reduction of environmental heterogeneity (Krapovickas & Di Giacomo, 1998), which in combination with the scarce protection of the area suggest that remaining natural habitat should be considered a priority for conservation. The ongoing transformation of natural grasslands indicates there is an urgent need to balance production with conservation through the implementation of additional protected areas (Bosso *et al*., 2003) and environmental management.

Acknowledgements

We thank Agustín Abba for providing data and very suitable comments. We are also thankful to Mariano Arias and Germán Lanusse, who actively contributed in data collection and computerization; and to Sergio Bogan for his accurate observations on species identification and taxonomy. We also extend our appreciation to Adrián Giacchino for giving us access to the collections databases of the Fundación Azara, to Jacob Cecile for his English revision of the manuscript, and to José Volante from INTA for providing Argentina's land cover map. A special note of thanks must also go to everyone involved in the Participatory Monitoring Program of Fauna who has been working with us for more than six years. Logistical and financial support was provided by Maimónides University, Bosques del Plata S.A., Pomera Maderas S.A, and Entidad Binacional Yacyretá.

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Received: 1 August 2013; Accepted: 22 November 2013

Appendix 1

Records with their respective species and source of information, province, political department, georeference (expressed in decimal degrees, WGS 84 reference system) and citation for bibliographic records. Source: PM: Participatory monitoring; I: Interviews; BR: Bibliographical review; F: Field surveys. Species: Ct: *Cabassous tatouay*; Dh: *Dasypus hybridus*; Dn: *Dasypus novemcinctus*; Ds: *Dasypus septemcinctus*; Es: *Euphractus sexcinctus*; Mt: *Myrmecophaga tridactyla*; Tt: *Tamandua tetradactyla*. Province: C: Corrientes; M: Misiones. Department: ST: Santo Tomé; GA: General Alvear; IT: Ituzaingó; SMA: San Martín: ME: Mercedes; PDL: Paso de los Libres; CAP: Capital; CAN: Candelaria; AP: Apóstoles.

ID	Source	Locality	Coordinates	Department	Province	Mt	Tt	Dn	Dh	Ds	Es	Ct	References
1	PM	Aguapey	28°27′S, 56°27′W	GA	C		X	X	X		X		
2	PM	Aguara Cuá	27°49′S, 56°24′W	IT	C		X	X					
3	I	Alderete	28°59′S, 57°2′W	SMA	C				X				
4	I	Alvarenga	27°47′S, 55°54′W	IT	C			X					
5	I	Arbelaiz Tito	28°19′S, 55°53′W	ST	C	X							
6	PM	Argilaga	28°18′S, 55°59′W	ST	C						X		
7	PM	Aurora Celeste	27°39′S, 56°11′W	IT	C		X	X	X				
8	I	Báez	29°25′S, 57°16′W	PDL	C			X	X		X		
9	PM	Boquerón	28°23′S, 55°58′W	ST	C	X	X		X				
10	I	Camella	28°28′S, 56°4′W	ST	C						X		
11	PM	Capara	28°42′S, 56°16′W	ST	C				X				
12	PM	Carambola	27°55′S, 56°11′W	ST	C				X				
13	PM	Casualidad	28°25′S, 56°20′W	ST	C			X					
14	PM	Cerrillos	28°25′S, 56°6′W	ST	C	X							
15	BR	Chacra Sr. Noalles	28°44′S, 57°29′W	ME	C			X			X		Fabri *et al.*, 2003; Parera, 2004
16	FS	Ciriaco centro	28°15′S, 55°51′W	ST	C			X					
17	PM	Don Hilario	28°25′S, 55°54′W	ST	C	X							
18	PM	Don Paulino	28°21′S, 56°16′W	ST	C				X				
19	I	Ea. 9 Lagunas	28°51′S, 56°47′W	SMA	C			X	X		X		Fabri *et al.*, 2003; Parera, 2004
20	I	Ea. Andresito	28°23′S, 56°13′W	ST	C			X					
21	I	Ea. Angelita	27°33′S, 56°2′W	IT	C		X	X	X				
22	BR	Ea. Casualidad	28°24′S, 56°24′W	ST	C			X	X		X		Fabri *et al.*, 2003
23	BR	Ea. Cerro Verde	28°44′S, 57°32′W	ME	C			X		X	X		Fabri *et al.*, 2003; Parera, 2004
24	I	Ea. Cunumí	28°43′S, 56°40′W	GA	C			X	X		X		
25	I	Ea. Don Andres	27°37′S, 56°17′W	IT	C			X	X		X		
26	I	Ea. Doña Argentina	27°37′S, 56°20′W	IT	C			X	X		X		
27	I	Ea. El Ceibo	27°57′S, 56°25′W	ST	C		X	X	X		X		
28	I	Ea. El Ceibo (2)	28°40′S, 56°12′W	ST	C			X	X		X		

Appendix continued on next page

ID	Source	Locality	Coordinates	Department	Province	Mt	Tt	Dn	Dh	Ds	Es	Ct	References
29	BR	Ea. El Espinillo	28°48′S, 57°3′W	SMA	C			X		X			Fabri *et al.*, 2003; Parera, 2004
30	I	Ea. El Fosforito	28°49′S, 56°25′W	GA	C			X	X		X		
31	I	Ea. El Jazmín	28°16′S, 56°10′W	ST	C			X	X		X		
32	I	Ea. El Mensajero	28°8′S, 56°25′W	ST	C		X	X	X		X		
33	I	Ea. El Naranjito	27°32′S, 56°1′W	IT	C			X	X				
34	I	Ea. El Pindó	27°42′S, 55°54′W	IT	C			X	X		X		
35	I	Ea. El Recreo	28°10′S, 56°6′W	ST	C		X	X					
36	I	Ea. El relincho	28°46′S, 56°22′W	GA	C		X	X					
37	I	Ea. Iberá	28°31′S, 57°7′W	SMA	C			X	X		X		
38	I	Ea. La Aurora	27°55′S, 56°17′W	ST	C		X						
39	I	Ea. La Chela	28°41′S, 56°37′W	GA	C			X	X		X		
40	I	Ea. La Concepción	27°56′S, 56°24′W	ST	C			X			X		
41	I	Ea. La Higuera	27°59′S, 56°16′W	ST	C		X		X				
42	I	Ea. La Hortensia	28°26′S, 56°28′W	GA	C		X		X				
43	I	Ea. La Isabel	28°35′S, 56°35′W	GA	C			X	X		X		
44	I	Ea. La Isabelita	28°44′S, 56°21′W	ST	C				X				
45	I	Ea. La María	28°33′S, 56°35′W	GA	C		X		X				
46	I	Ea. La Morocha	28°22′S, 56°28′W	ST	C			X	X		X		
47	I	Ea. La Palmita	28°1′S, 56°10′W	ST	C			X	X		X		
48	I	Ea. La Paulita	28°5′S, 56°21′W	ST	C			X	X		X		
49	I	Ea. La Pelada	27°44′S, 56°21′W	IT	C			X	X		X		
50	I	Ea. La Susana	28°14′S, 56°9′W	ST	C			X			X		
51	I	Ea. La Viruta	28°49′S, 56°29′W	GA	C			X	X				
52	I	Ea. Las Marías	29°9′S, 56°51′W	SMA	C			X	X		X		Fabri *et al.*, 2003; Parera, 2004
53	I	Ea. Loma Alta	29°3′S, 57°5′W	SMA	C			X	X				Fabri *et al.*, 2003; Parera, 2004
54	I	Ea. Loma Porá	28°30′S, 56°31′W	GA	C			X	X		X		
55	I	Ea. Loma Verde	28°17′S, 56°5′W	ST	C			X					
56	I	Ea. Los Ranchos	28°51′S, 56°39′W	GA	C			X	X		X		
57	PM	Ea. Mainumbí	28°24′S, 55°59′W	ST	C		X						
58	I	Ea. Mbatoby	28°53′S, 56°32′W	GA	C		X	X	X		X		

Appendix continued on next page

ID	Source	Locality	Coordinates	Department	Province	Mt	Tt	Dn	Dh	Ds	Es	Ct	References
59	I	Ea. Pacheco	28°43′S, 56°54′W	SMA	C			X	X		X		Fabri *et al.*, 2003; Parera, 2004
60	BR	Ea. Puerto Valle	27°37′S, 56°23′W	IT	C		X					X	Fabri *et al.*, 2003; Parera, 2004
	PM	Ea. Puerto Valle	27°36′S, 56°24′W	IT	C		X	X	X		X		
61	I	Ea. Puesto Yacaré	28°22′S, 56°31′W	ST	C				X				
62	I	Ea. Quiebrayugo	28°14′S, 56°5′W	ST	C			X			X		
63	I	Ea. Rincón de Las Mercedes	28°18′S, 55°45′W	ST	C		X	X					
	BR	Ea. Rincón de Las Mercedes	28°19′S, 55°46′W	ST	C	X							Fabri *et al.*, 2003; Parera, 2004
64	BR	Ea. San Antonio	28°12′S, 56°31′W	ST	C				X				Tognelli *et al.*, 2011; Abba *et al.*, 2012
	I	Ea. San Antonio	28°10′S, 56°34′W	ST	C		X	X	X		X	X	
65	I	Ea. San Cristóbal	28°19′S, 55°56′W	ST	C			X					
66	I	Ea. San Fernando	28°56′S, 56°26′W	GA	C			X	X		X		
67	I	Ea. San Francisco	27°53′S, 56°4′W	ST	C		X	X	X		X		
68	I	Ea. San Juan	27°58′S, 56°27′W	ST	C		X		X				
69	I	Ea. San Juan Bautista	27°42′S, 56°13′W	IT	C			X	X		X		
70	BR	Ea. San Lorenzo	29°0′S, 57°13′W	SMA	C		X						Fabri *et al.*, 2003
71	I	Ea. San Luis	27°26′S, 56°8′W	IT	C		X	X	X		X		
72	I	Ea. San Martin	27°53′S, 55°58′W	IT	C		X						
73	I	Ea. San Miguelito	27°44′S, 56°7′W	IT	C		X	X	X		X	X	
74	I	Ea. Santa Ana	29°3′S, 56°28′W	GA	C			X	X		X		
75	I	Ea. Santa Bárbara	28°26′S, 56°8′W	ST	C			X	X				
76	I	Ea. Santa Teresita	27°28′S, 56°13′W	IT	C		X	X			X		
	BR	Ea. Santa Teresita	28°2′S, 56°25′W	ST	C			X		X			Fabri *et al.*, 2003; Parera, 2004
77	BR	Ea. Santo Domingo	27°42′S, 56°4′W	IT	C			X		X			Fabri *et al.*, 2003; Parera, 2004
78	I	Ea. Sta. M. del Aguapey	28°8′S, 56°31′W	ST	C			X	X		X		

APPENDIX CONTINUED ON NEXT PAGE

ID	Source	Locality	Coordinates	Department	Province	Mt	Tt	Dn	Dh	Ds	Es	Ct	References
79	I	Ea. Susanita II	27°30′S, 56°12′W	IT	C				X		X		
80	I	Ea. Tabaí	27°44′S, 55°56′W	IT	C			X	X				
81	BR	Ea. Tupasyroga	28°43′S, 57°30′W	ME	C			X		X	X		Fabri *et al.*, 2003; Parera, 2004
82	BR	Ea. y Arrocera Iberá	28°35′S, 57°14′W	ME	C			X		X	X		Fabri *et al.*, 2003; Parera, 2004
83	I	Ejército Argentino	28°38′S, 56°8′W	ST	C		X		X				
84	PM	Fortaleza	28°0′S, 56°6′W	ST	C				X				
85	FS	Garruchos Norte	28°4′S, 55°44′W	ST	C			X	X		X		Zuleta *et al.*, 2010
86	PM	Garruchos	28°10′S, 56°0′W	IT	C		X		X				Zuleta *et al.*, 2010
87	FS	Garruchos Sur	28°11′S, 55°47′W	ST	C			X					Zuleta *et al.*, 2010
88	PM	Jesús Cué	27°55′S, 56°8′W	ST	C			X					
89	BR	La Cruz	29°10′S, 56°37′W	SM	C			X					Tognelli *et al.*, 2011; Abba *et al.*, 2012
90	PM	Ombú Chico	27°28′S, 56°10′W	IT	C		X		X				
91	I	Pancho Vargas	28°12′S, 56°6′W	ST	C		X		X				
92	BR	Paraje Uguay	28°38′S, 57°29′W	ME	C			X		X	X		Fabri *et al.*, 2003; Parera, 2004
93	PM	Pariopá	28°24′S, 55°59′W	ST	C		X						
94	PM	Península	28°21′S, 55°42′W	ST	C		X	X	X		X		
95	PM	Pl. Mesopotámicas	27°58′S, 55°55′W	ST	C			X					
96	PM	Rios Cué	28°14′S, 56°11′W	ST	C		X	X	X				
97	I	Rivarola	28°47′S, 57°32′W	ME	C			X	X		X		
98	I	Rodríguez	29°32′S, 57°13′W	PDL	C			X	X				
99	PM	San Agustín	28°29′S, 56°3′W	ST	C			X	X				
100	I	San Carlos	27°45′S, 55°54′W	IT	C			X			X		
101	I	San Carlos 3	27°48′S, 55°53′W	IT	C			X	X		X	X	
102	PM	San Cristóbal	28°59′S, 56°26′W	GA	C	X			X				
103	PM	San Isidro	28°34′S, 56°10′W	ST	C			X	X				
104	PM	San Javier	28°18′S, 56°28′W	ST	C		X	X	X				
105	PM	San Justo	27°28′S, 56°9′W	IT	C		X						
106	PM	San Miguel	28°25′S, 56°15′W	ST	C			X	X		X		
107	PM	Sangrador	28°17′S, 56°2′W	ST	C		X	X	X				
108	I	Santo Tomé	28°31′S, 56°9′W	ST	C		X		X				

Appendix continued on next page

ID	Source	Locality	Coordinates	Department	Province	Mt	Tt	Dn	Dh	Ds	Es	Ct	References
109	I	Santori	29º21'S, 57º2'W	PDL	C			X	X		X		
110	I	S/n 1	29º0'S, 57º9'W	SMA	C			X	X		X		Massoia *et al*., 2006
111	I	S/n 2	29º52'S, 57º25'W	PDL	C			X	X		X		
112	I	S/n 3	29º46'S, 57º32'W	PDL	C			X	X		X		
113	PM	Timbauva	27º59'S, 55º57'W	ST	C	X	X	X	X				
114	PM	Unión	28º3'S, 55º48'W	ST	C				X				
115	PM	Villa Corina	28º0'S, 56º3'W	ST	C				X				
116	PM	Yacoví	28º7'S, 55º56'W	ST	C			X					
117	BR	Boca del Aº Itaembé	27º19'S, 56º1'W	CAP	M	X	X	X			X	X	Massoia *et al*., 2006
118	BR	Campo / Puerto San Juan	27º22'S, 55º40'W	CAN	M						X	X	Massoia *et al*., 2006
	FS	Campo / Puerto San Juan	27º24'S, 55º40'W	CAN	M		X	X			X		Homberg *et al*., 2012
119	BR	Candelaria	27º28'S, 55º45'W	CAN	M		X				X	X	Massoia *et al*. 2006; Tognelli *et al*., 2011; Abba *et al*., 2012
120	BR	Cnia. Aeroparque	27º23'S, 55º55'W	CAP	M			X			X	X	Massoia *et al*., 2006
121	BR	Fachinal (?)	27º37'S, 55º42'W	CA	M	X							Massoia *et al*., 2006
122	BR	Garupá	27º29'S, 55º50'W	CAP	M		X	X			X		Massoia *et al*., 2006
123	BR	Posadas	27º22'S, 55º52'W	CA	M			X				X	GBIF, 2013
124	BR	RN12, altura de Campo San Juan	27º25'S, 55º38'W	CAN	M		X						Massoia *et al*., 2006
125	PM	San Andrés	27º38'S, 55º45'W	CA	M		X	X	X				
126	BR	San José	27º46'S, 55º48'W	AP	M		X						Massoia *et al*., 2006
127	BR	Área de Ituzaingó	27°30'S, 56°14'W	IT	C	X							Pérez Jimeno & Llarín Amaya, 2009