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Updated distribution of the pink fairy armadillo *Chlamyphorus truncatus* (Xenarthra, Dasypodidae), the world's smallest armadillo

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Abstract The distribution and ecology of the pink fairy armadillo *Chlamyphorus truncatus*, the world's smallest armadillo, are poorly understood due largely to the strictly subterranean habits of this species. We compiled records from the literature, museum and private collections, information from rural people, and researchers to update the species' current distribution and conservation threats. Recent records suggest that populations of *C. truncatus* persist in localities along most of the species' historical range, including at least 12 sites with recurrent pink fairy armadillo records. We added new registers outside the historical distribution; south of Mendoza province, north of Río Negro province and south of Buenos Aires province, effectively extending the species range. The rate at which new records are accrued has increased, arguably reflecting a greater interest in the species and greater presence of field workers in the species range. The conservation of the pink fairy armadillo depends on the maintenance of the arid and semiarid habitats where this species occurs, with commercial agriculture, pesticides, extensive livestock farming, and predation by domestic dogs and cats, posing the threats of greatest concern.

Keywords: Argentina, *Chlamyphorus truncatus*, conservation, dryland, pichiciego, rare species, subterranean mammal

Distribución actualizada del pichiciego menor *Chlamyphorus truncatus* (Xenarthra, Dasypodidae), el armadillo más pequeño del mundo

Resumen La distribución y ecología del pichiciego menor, *Chlamyphorus truncatus*, el armadillo más pequeño del mundo, han sido poco estudiadas debido a los hábitos estrictamente subterráneos de la especie. Recogimos registros de la literatura, de museos y colecciones privadas e información provista por pobladores rurales e investigadores a los fines de actualizar la distribución actual de la especie y sus problemas de conservación. Los registros recientes sugieren que las poblaciones de *C. truncatus* persisten en localidades a lo largo del rango de distribución histórica, incluyendo al menos 12 sitios con registros recurrentes de la especie. Agregamos nuevos registros fuera de su distribución histórica, al sur de la provincia de Mendoza, al norte de Río Negro y al sur de la provincia de Buenos Aires, extendiendo así el rango de distribución. La tasa de acumulación de nuevos registros ha incrementado en los últimos tiempos, lo cual refleja un interés creciente por la especie y un aumento de trabajos de campo en su rango de distribución. La conservación del pichiciego menor depende del mantenimiento de los hábitas áridos y semiáridos que ocupa. Las amenazas más preocupantes para la especie son la agricultura y ganadería extensiva, el uso de pesticidas y la depredación por animales domésticos.

Palabras clave: Argentina, *Chlamyphorus truncatus*, conservación, especie rara, mamífero subterráneo, pichiciego, zonas áridas

Introduction

The pink fairy armadillo *Chlamyphorus truncatus* was described by Harlan (1835), who used its native name "pichiciago", mentioned by Mr. William Colesberry when presenting a specimen to the Philadelphia Museum. The pink fairy armadillo is a desert-adapted, strictly subterranean armadillo (Cei, 1967; Borghi *et al.*, 2002) endemic to central Argentina, where it inhabits sandy plains, dunes, and scrubby grasslands dominated by sparse shrubs of creosotebush (*Larrea* spp.) and by *Portulaca* plants in the wet season (spring and summer).

This species is the smallest living armadillo (Dasypodidae), and is amongst the least known subterranean mammals. It has minute eyes; its fine silky fur is yellowish white and its flexible dorsal shell of about 24 bands is attached to the body only by a thin dorsal membrane. A vertical plate at the rear of the carapace gives it a rather blunt end (to which the name *truncatus* refers), from which a spatula-shaped tail protrudes (Minoprio, 1945; Guiñazú Rawson de Arentsen, 1956).

Yepes (1928, 1929, 1931, 1932), Minoprio (1945), Guiñazú Rawson de Arentsen (1956), Cei (1967), and Meritt (1985) have reported on the natural history and geographical distribution of pink fairy armadillos. They have nocturnal and solitary habits and a diet largely composed of insects (mainly ants and beetles), worms, snails, and small amounts of roots and other plant parts (Minoprio, 1945; Guiñazú Rawson de Arentsen, 1956; Cei, 1967).

The conservation status of the pink fairy armadillo is uncertain. It is listed as Data Deficient by the IUCN Red List of Threatened Species (Superina *et al.*, 2009) but a decline in distribution and abundance is generally accepted (Lagiglia, 1956; Roig, 1995; Ojeda & Diaz, 1997; Diaz & Ojeda, 2000; Superina, 2006; Aguiar & Fonseca, 2008; Superina *et al.*, 2009). This perceived decline has been associated with farming activities, particularly large-scale plowing, as well as with predation by domestic dogs and cats (Minoprio, 1945; Lagiglia, 1956; Fonseca & Aguiar, 2004; Aguiar & Fonseca, 2008; Superina *et al.*, 2009; Abba & Superina, 2010).

Here we review the historical and current distribution of the pink fairy armadillo, and address the following questions: 1. Are there sites with recurrent records of the species, indicating long-term persistence?, and 2. Do the current location data show a reduction of its historical range?

Materials and Methods

We obtained data on distribution and collection date from the literature, museum and private collections, carcasses, and live animals observed or captured by rural people and field researchers. Specimen data were collated from the following collections: Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", Buenos Aires, Argentina (MACN); Instituto Argentino de Investigaciones de las Zonas Áridas, CCT CONICET Mendoza, Argentina (CMI); and Museo Municipal de Historia Natural, San Rafael, Mendoza, Argentina (MMHN).

In addition, informal, unstructured, and open-ended interviews were conducted throughout the species range, targeting key informants, including park rangers, field biologists, farm hands (locally referred as "*puesteros*"), and rural school students and teachers. Interviewees were asked for details of any observations of pink fairy armadillos, including location, habitat, date and natural history, and were confronted with photos of the species to confirm the correct identification (Rabinowitz, 2003). Whenever there was more than one record in a single location, independent of the time scale involved, we considered it to be a recurrent record. Records were grouped into four categories (date of last record for recurrent records): those without a precise date, prior to 1980 (i.e., historical distribution), between 1981 and 1993 (i.e., recent records), and from 1994 to present (i.e., current records). Only the records assigned to a precise location were plotted on the map. The historical distribution of the species is represented using the map in Yepes (1929).

Results

A total of 96 records were collected, of which 91 included date of collection or observation. Of these, 69 records had detailed locality information **(Table 1)**. Most records (58%) corresponded to museum collections, 26% to key informants, 14% were collated from the literature and from observed or captured live animals, and 1% from a field record of a carapace. Records came mainly from the provinces of Mendoza (54%), San Luis (10%), Buenos Aires (10%), La Pampa (9%), and San Juan (7%) **(Table 1).**

We added new registers to the historical distribution of the species, in the south of Mendoza, north of Río Negro and the south of Buenos Aires **(Fig. 1)**. We found 12 sites with recurrent pink fairy armadillo records **(Fig. 1 and Table 1)**: seven in Mendoza, three in Buenos Aires, one in La Pampa, and one in San Juan. Of the 91 records precisely dated, 45 were classified as historical (1896–1980), 14 as recent (1981–1993), and 32 as current (1994 to present). The rate at which these records were accrued was 0.5 records/year prior to 1980, 1.2 records/year between 1981 and 1993, and 1.9 records/year since 1994.

Several sites with recurrent records were registered across the range, but were more abundant in Mendoza and Buenos Aires provinces. Recurrent records from 1994 to date were found in Telteca, Divisadero, Ñacuñán, Monte Comán, El Nihuil,

Canalejas (Mendoza), Carro Quemado (La Pampa), Monte Hermoso, Sauce Grande and Chasicó (Buenos Aires), and Valle Fértil (San Juan) **(TABLE 1)**. Eight of these registers correspond to sites with recent (post–2000) records. **TABLE 1** indicates the differences between the first and the last register for all recurrent records.

DISCUSSION

Populations of the pink fairy armadillo persist throughout most of its historical range, as indicated by the records we collated **(FIG. 1)**. The distribution of reports and recurrent records presented here reflects a close relationship between frequency of registers and presence of field researchers specifically interested in the species (V. Roig, C. E. Borghi, and M. Superina in Mendoza, C. E. Borghi in San Juan). Due to their nocturnal and subterranean habits, these animals are extremely difficult to observe; consequently, there is a paucity of population data, and the conservation status of extant populations remains unknown. Nevertheless, the rate at which records are collated has increased over the last century, with the current accrual rate being the highest. This may be due to various reasons, such as the existence of more roads/trails, greater vehicle access, or more people working in rural environments (e.g., rangers, NGO personnel, rural school teachers). Thus, even though the populations of the species might be declining, greater field activities in the species range

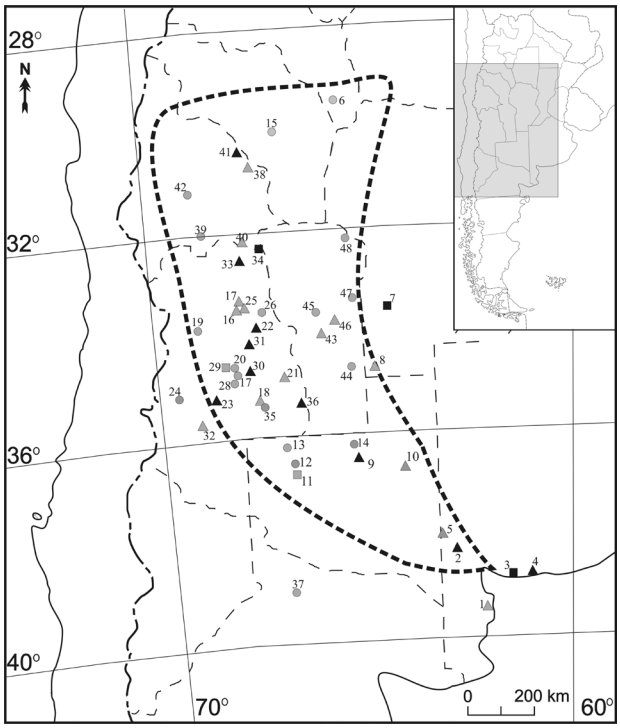

FIGURE 1. Updated distribution of *Chlamyphorus truncatus*. Records were grouped into three categories: ● prior to 1980; ■ between 1981 and 1993; and ▲ from 1994 to date. Grey symbols indicate only one record and black symbols indicate recurrent records in the same location. Numbers correspond to location reference numbers **(SEE TABLE 1).** Dashed line: Distribution of *C. truncatus* redrawn from Yepes (1929), indicated for comparative purposes.

TABLE 1. Locations of *Chlamyphorus truncatus* examined in this study, including province, locality, type of record and number of reference or source, years between recurrent records, location coordinates, and reference numbers (see Figure 1). Type of records: collection (C), reports from the literature (R), living or dead individuals found in the field or recorded during interviews during this study (L), mention in newspapers with a photograph (N).

Reference number	Province	Locality	Type of record (number of individuals–year)	Reference or source	Maximum interval between recurrent records (years)	Coordinate Locations
1	Buenos Aires	Bahía Unión	L (1–1995)	This study	---	39°33′S; 62°05′W
2	Buenos Aires	Laguna Chasicó	C (1–1929), L (1–2008)	Collection MACN & A. Abba pers. comm.	79	38°35′S; 63°09′W
3	Buenos Aires	Monte Hermoso	L (1–1960s, 1–1970s, 1–1990)	This study	30	38°58′S; 61°17′W
4	Buenos Aires	Sauce Grande	C (1–1978), L (1–1995, 1–n.d.)	1 in the Private Collection of C. Sillero & this study	17	38°59′S; 61°10′W
5	Buenos Aires	La Colorada Chica	R (1–2009),	Morici (2011)	---	38°59′S; 61°10′W
6	Catamarca	La Guardia	C (1–1918)	Collection MACN	---	29°34′S; 65°26′W
7	Córdoba	La Nacional	C (1–1994)	Collection MACN	---	34°46′S; 64°51′W
8	Córdoba	Vicuña Mackenna	L (1–1980s)	This study	---	33°54′S; 64°23′W
9	La Pampa	Carro Quemado	C (1–1971); L (2–2008)	Collection MACN & A. Abba pers. comm.	37	36°30′S; 65°20′W
10	La Pampa	Parque Luro	R (1–1997)	Massoia & Tiranti (1997)	---	36°55′S; 64°14′W
11	La Pampa	Paso del Algarrobo	L (1–1993)	C. Sillero, this study	---	36°42′S; 66°54′W

TABLE 1 CONTINUED ON NEXT PAGE

TABLE 1, CONTINUED FROM PREVIOUS PAGE

Reference number	Province	Locality	Type of record (number of individuals–year)	Reference or source	Maximum interval between recurrent records (years)	Coordinate Locations
12	La Pampa	Santa Isabel	C (1–1980)	Collection MMHN	---	36°32′S; 66°54′W
13	La Pampa	Colonia Butaló	C (1–1977)	Collection MMHN	---	36°12′S; 67°04′W
14	La Pampa	Victorica	C (1–1929)	Collection MACN	---	36°13′S; 65°26′W
15	La Rioja	Patquia	C (1–1931)	Collection MACN	---	30°03′S; 66°53′W
16	Mendoza	Pichi Ciego	L (1–1996)	This study	---	33°23′S; 68°04′W
17	Mendoza	Alto del Algarrobal	C (1–1971)	Collection MMHN	---	34°37′S; 68°10′W
18	Mendoza	Carmensa	L (1–2000)	This study	---	35°08′S; 67°39′W
19	Mendoza	San Carlos	C (1–1978)	Collection MMHN	---	33°46′S; 69°02′W
20	Mendoza	Colonia Tabanera	C (1–1976)	Collection MMHN	---	34°31′S; 68°13′W
21	Mendoza	Corral de Lorca	R (1–2000s)	Superina (2006)	---	34°41′S; 67°04′W
22	Mendoza	El Divisadero	C (2–1989), L (1–2001)	Collection CMI & this study	12	33°45′S; 67°40′W
23	Mendoza	El Nihuil	C(1–1976), R (1–2000s)	Collection MMHN & Superina (2006)	24	35°03′S; 68°38′W
24	Mendoza	El Sosneado	C (1–1971)	Collection MMHN	---	35°04′S; 69°34′W
25	Mendoza	Santa Rosa	L (1–1999)	This study	---	33°16′S; 68°05′W
26	Mendoza	La Paz	C (1–1906)	Collection MACN	---	33°27′S; 67°32′W
27	Mendoza	Las Catitas	L (1–2002)	C. Borghi, this study	---	33°18′S; 68°02′W
28	Mendoza	Las Malvinas	C (1–1977)	Collection MMHN	---	34°50′S; 68°14′W
29	Mendoza	Las Paredes, El Usillal	C (1–1990)	Collection MMHN	---	34°29′S; 68°25′W
30	Mendoza	Monte Comán	R (3–2004, 2005, 2006)	Superina (2006)	2	34°35′S; 67°51′W
31	Mendoza	Ñacuñán	C (2–1980s, 1–1988), R (1–2000s, 1–2006), L (1–2000)	Collection (CMI), Superina (2006) & this study (L)	20	34°02′S; 67°56′W
32	Mendoza	Puesto Cortez	L (1–2009)	This study	---	35°36′S; 69°02′W
33	Mendoza	Reserva Telteca	C (1–1993), L (1–1997)	Collection IADIZA & this study	4	32°21′S; 67°59′W
34	Mendoza	San Miguel	C (2–1987)	Collection IADIZA	0	32°21′S; 67°24′W
35	Mendoza	San Pedro del Atuel	C (1–1980)	Collection MMHN	---	35°09′S; 67°38′W
36	Mendoza	Canalejas	L (1–2009), N (1–2011)	This study & Newspaper: "Diario San Rafael, 29/07/2011"	2	35°12′S; 66°32′W
37	Río Negro	Villa Regina	C (1–1957)	Collection MACN	---	39°04′S; 67°04′W
38	San Juan	Agua Cercada	L (1–2008)	This study	---	30°46′S; 67°22′W
39	San Juan	Cochagual	C (1–1915)	Collection MACN	---	31°55′S; 68°23′W
40	San Juan	Encón	L (1–2000s)	This study	---	32°10′S; 67°43′W
41	San Juan	San Agustín de Valle Fertil	L (1–2008), L & N (1–2010)	This study & Newspaper: "Diario de Cuyo, 07/03/2010"	2	30°38′S; 67°27′W
42	San Juan	Zonda	R (1–1920)	Yepes (1928)	---	31°28′S; 68°45′W
43	San Luis	Altos Negros	L (1–1996)	This study	---	34°08′S; 66°06′W
44	San Luis	Buena Esperanza	R (1–1967)	Rood (1970)	---	34°45′S; 65°14′W
45	San Luis	Chischaca	C (1–1926)	Collection MACN	---	33°52′S; 66°14′W
46	San Luis	Nueva Escocia to Batavia (20 km south Nueva Escocia)	L (1–1996)	This study	---	32°22′S; 68°02′W
47	San Luis	Pedernera, Bagual	C (1–1914)	Collection MACN	---	33°47′S; 65°17′W
48	San Luis	Pisco Yacú	C (1–1931)	Collection MACN	---	32°20′S; 65°12′W

might explain the higher number of pink fairy armadillo encounters observed in recent times. Recent recurrent records of the species (post–2000) suggest that, at least in some localities across the historical range, populations of *C. truncatus* still persist.

There are no recent records on the southern, northern, and eastern fringes of the species range, largely due to the paucity of field research undertaken in those areas since 1980. Thus, no assumptions can be made about the persistence of the species there. In contrast, we show new registers in areas outside the historical distribution described by Yepes (1929) **(Fig. 1)**.

Ultimately, the conservation of the pink fairy armadillo would depend on the persistence of arid and semiarid habitats where the species occurs. The main threats to pink fairy armadillos are related to degradation and loss of habitats due to land clearing for commercial agriculture and overgrazing (Morello, 1985; Ojeda *et al*., 2002; Tabeni & Ojeda, 2005; Vilela *et al*., 2009), with the rapid expansion of agriculture in the western and northern parts of the species' range being of greatest concern (Abba & Superina, 2010). Current development policy in this region includes a rapid increase in land devoted to vineyards, olive groves, and other intensive crops suited to sandy soils (Vilela *et al*., 2009). Additionally, predation by feral and farm dogs and cats has been suggested as a major direct threat to pink fairy armadillos (Minoprio, 1945; Lagiglia, 1956), but its real impact remains unknown. The presence of wild boar (*Sus scrofa*), an exotic species introduced to Argentina in the last century (Novillo & Ojeda, 2008; Cuevas *et al*., 2010), might also have a negative impact on pink fairy armadillos due to their disruptive foraging habits. Although there are recurrent records of pink fairy armadillos in Ñacuñán, Telteca, and other protected areas, it is uncertain whether there is a fully protected viable population in these reserves. Unfortunately, even in these protected areas the pink fairy armadillo is vulnerable to predation by the ever present dogs and cats.

Field studies are needed to better understand the ecology of this rare, little-known species, and the effects on its populations of agricultural activities, extensive livestock farming, interactions with wild boar, and predation by domestic predators. Also, as feeders of soil fauna and plant matter, it has been suggested that armadillos may be exposed to agricultural toxins and pesticides (Herbst *et al*., 1989). Although the effects of these compounds on pink fairy armadillos have not been evaluated, organophosphate insecticides are used in vineyards and olive crops to control leaf-cutting ants (M. Battistella, pers. comm.). Since pink fairy armadillos chiefly eat ants (Redford, 1985), the use of agricultural pesticides potentially poses one of the greatest threats to their persistence.

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