

NOTES ON GEOGRAPHIC DISTRIBUTION

Mammalia, Lagomorpha, Leporidae, *Lepus europaeus*, Pallas, 1778: Distribution extension, first confirmed record for Paraguay

Noé U. de la Sancha¹
Hugo Mantilla-Meluk¹
Fredy Ramirez²
Pastor Perez³
Nathalia Mujica³
Angelica Troche³
Marcela Gimenez³

¹ Texas Tech University, Department of Biological Sciences.
P.O. Box 43131, Lubbock Texas, USA. E-mail: delasancha@msn.com

² Fundacion Moises Bertoni Prócer Carlos Argüello N° 208, Asunción, Paraguay.

³ Universidad Nacional de Asunción, Facultad de Ciencias Exactas y Naturales, Departamento de Biología.
San Lorenzo, Paraguay.

If the native fauna of Paraguay is still poorly understood, as shown from recent new species records of marsupial and rodent species (de la Sancha et al. 2007, D'Elía et al. 2008, and de la Sancha et al., 2009), so are exotic species infiltrating the country. One good example of this is the European hare *Lepus europaeus*. In 1983, Grigera and Rapoport reported an anecdotal record in Paraguay (based on a personal communication by Dr. B. Aranda Centurión) of a few hares surrounding Fortín General Díaz (possibly in the Department of Alto Paraguay in the Dry Chaco). They had no real knowledge of the origin of the hares. Although no confirmed Paraguayan records of *L. eurpaeus* are reported by Grigera and Rapoport (1983), these authors extrapolated the possible presence of European hares in Paraguay based on known localities from Bolivia and Brazil at that time. Likewise, Rodriguez et al. (1997) mention that *Lepus* has established populations outside of Europe in Asia, Australia, New Zealand and Southern cone of South America including Paraguay, with no further details.

Although several authors describe distributions and trends for *Lepus* in the Southern Cone of South America (see Pine et al., 1979; Dietrich, 1984; Johnson et al., 1990; Jaksic, 1998; Jaksic et al., 2002; Novillo and Ojeda, 2008) actual locality

records are not particularly abundant. Most mention *L. europaeus* as a food item in carnivore diet studies (Jaksic et al. 1983; Branch et al. 1996; Pia et al. 2003; Diuk-Waser and Cassini 1998; Zapata et al. 1998; Rau and Jiménez 2002; Donadio et al. 2004; García and Kittlein 2004; and Zapata et al. 2005), avian scavenger diet studies (Travaini et al. 1998), in occasional records from faunal surveys (Aguilar et al., 2007; Cossio 2004; Dotta and Verdade 2007; and Aguiar et al. 2007) and/or in describing the ecology of *Lepus* itself (Auricchio et al. 1999; Campos et al. 2001; Cossíos, 2004; and Kufner et al. 2008).

Introduced hares in South America have been cited as *L. europaeus* and/or *L. capensis* Linnaeus, 1758. As clarified by Hoffman and Smith (2005), the species *europaeus* was earlier placed in *capensis* based on a cline of morphological characters mainly size as interpreted by Petter (1961). Hoffmann and Smith (2005) recognize *L. europaeus* and *L. capensis* as valid species. The type locality for *capensis* is Cape of Good Hope, South Africa, and Hoffmann and Smith (2005), restrict the distribution of *capensis* to the continent of Africa, the Arabian Peninsula northward through to Syria, as far as west and southern Iraq. Meanwhile, *europaeus*, with the type locality from Poland, is the species native to

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Europe extending into the western Siberian lowlands south to northern Israel, northern Syria, northern Iraq, into western Iran (Angermann, 1983). Hoffman and Smith (2005) suggest that it is *europaeus* which has been introduced to South America and other places in the world and not *capensis*. And as suggested by Grigera and Rapoport (1983), Lever (1985), and Jaksic et al. (2002), all introductions originated from native European stocks. Pending a revision of these species in South America we are assuming that the animals found there are *europaeus*.

In this paper we present the first confirmed record of *Lepus* in Eastern Paraguay (Figure 1), which corresponds to a specimen of *L. europaeus* found dead along a roadside at 26°58'3.608" S, 55°55'648" W (point 1, Figure 2), outside of the town of Fram, Department of Itapúa, in southwestern Paraguay. Pictures of the specimen were taken as vouchers since its skull was completely crushed and we had no collecting permits or means to effectively collect the skin (Figure 1). The extremely large lagomorph is unmistakably *L. europaeus*, and can be identified by its size (Table 1), large ears with black tips and a grayish-white fur inside, a yellowish-brown pelage with grayish-white venter, and a tail that is black on top and white on the bottom (Peterson 1966; Bansfields 1974; Dragg 1974).

All of these characteristics correspond well with Figure 1. Published measurements (in mm) for *L. europaeus* are as follows: Total length (TL): 600-750 (average 680); Ear length (EL), from

notch: 94-102 (average 98); Tail (T) 72-110 (average 95); and Hind foot (HF) 142-161 (average 151) (Peterson, 1966; Hall 1981); meanwhile, our specimen's measurements are TL 635, EL 120, T 87, and HF 147 (Table 1), which coincide well with those previously published for *L. europaeus*. Additionally, they are considerably larger than published measurements for *S. brasiliensis* (Linnaeus, 1758) (Redford and Eisenberg 1992, Emmons 1997), a native lagomorph (Myers et al. 2002), of considerably smaller size, with pure russet ears (which are relatively short for a rabbit) and a small inconspicuous tail (Emmons 1997).



Figure 1. First confirmed record of the invasive European hare for Paraguay. Size of the documented record overlap with ranges reported in the literature by Peterson, 1966; Hall and Kelson, 1959, and share the large black tips ears, the black topped and white-bottomed tail, long legs, and white venter characteristic of *L. europaeus*.

Table 1. Reported measurements in mm of *L. europaeus* and *S. brasiliensis*.

	Source	TL	EL	T	HF
<i>L. europaeus</i>	Photographed specimen, this work	635.0	120.0	87.0	147.0
	Peterson, 1966; Hall, 1981	600.0 - 750.0	94.0 - 102.0	72.0 - 110.0	142.0 - 161.0
<i>S. brasiliensis</i>	Redford and Eisenberg 1992	340.0 - 353.0	53.5 - 55.0	20.9	71.1 - 73.0
	Emmons 1997	268.0 - 395.0	40.0 - 61.0	10.0 - 35.0	64.0 - 85.0

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Pictures of the specimen were taken as vouchers since its skull was completely crushed (Figure 1).

We also reference two more visual records observed by Fredy Ramirez: First at the *Reserva Natural Privada Tapyta*, Departamento Caazapà, in the district of San Juan Nepomuceno (26°14'56.813" S, 55°44'19.791" W), on October 29, 2008 in a *Eucalyptus* sp. plantation (point 4, Figure 2), and second at the *Camino de Tavai Parque Nacional Caazapà*, Departamento Caazapà, in the district of Tavai (26°08'12.627" S, 55°26'48.905" W), on November 2, 2008 in a soy plantation (point 3, Figure 2). And finally, a third visual record from 2001 from the area around *Reserva Nacional San Rafael*, Itapua, at approximately 26°31' S, 55°52' W, (point 2, Figure 2) by Guillermo D'Elía (personal communication).

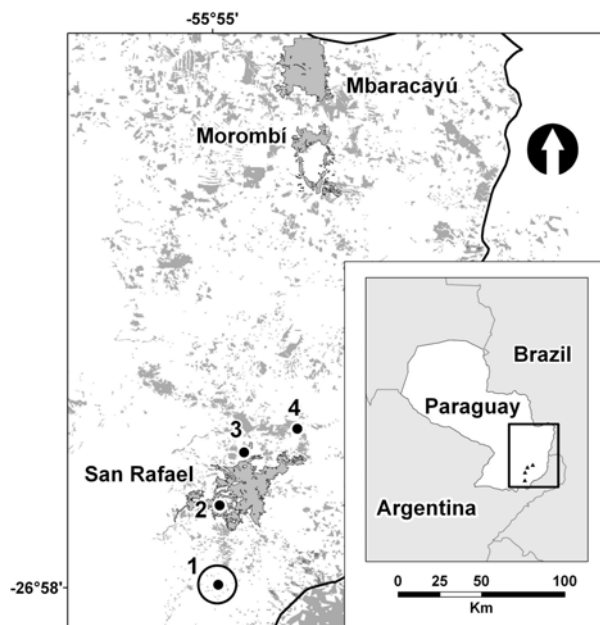


Figure 2. Map of eastern Paraguay showing the first confirmed record (encircled dot) and sightings (dots) of *L. europaeus* in the country, 1) 26°58'3" S, W 55°55'6" W; 2) *Reserva Nacional San Rafael*, Itapua, at approximately 26°31' S, 55°52' W; 3) *Reserva Natural Privada Tapyta*, Departamento Caazapà, 26°14'56" S, 55°44'19" W; 4) *Camino de Tavai Parque Nacional Caazapà*, Departamento Caazapà, 26°08'12" S, 55°26'48" W. Protected areas mentioned in the text are highlighted.

The only other Lagomorph reported in Paraguay is *Sylvilagus brasiliensis* (Linnaeus, 1758) (Myers et al. 2002), a considerably smaller, with pure russet ears (which are relatively short for a rabbit), and a small inconspicuous tail (Emmons 1997).

We hypothesize that the invasion of *L. europaeus* in southeastern Paraguay is a relatively recent event. Southeastern Paraguay has suffered one of the most extreme landscape transformations; as recent as 45 years ago eastern Paraguay was primarily covered by the Atlantic Forest (Fleytas 2007). Now, along the roadside where the specimen of *L. europaeus* was collected, one finds vast tracks of land dedicated to large-scale soy plantations and cattle-ranching. Although sightings of *L. europaeus* are common in the areas surrounding the *Reserva de Recursos Manejables San Rafael*, the species has never been formally reported although Morales et al., 2006 do report *L. capensis* (presumably *L. europaeus*) around *Parque Nacional San Rafael* with no particular locality or reference material.

To delineate the penetration of *L. europaeus* into Paraguay, no records or sightings have been found in its northern Oriental region near Brazil. Although there have been extensive mammal surveys, there are no official sightings or records of *Lepus* around *Reserva Mabaracayu*, Department of Canindeyu; *Lepus* was not included in the only available checklist of mammals for the reserve (Esquivel 2001). Likewise, no sightings or records are available for the *Estancia Golondrina y Reserva Natural Privada Morombi* in both the Departments of Canindeyu and Caaguazú (Figure 2); reinforcing the hypothesis that *Lepus* is to date limited to the southwestern corner of Paraguay.

The closest documented introduction locality is from the *Estancia La Hansa*, Cañada de Gómez, in the Province of Santa Fe, Argentina, which also is the earliest introduction locality of European hares species in that country (1888; Grigera and Rapoport 1983). Novillo and Ojeda, 2008 suggest that *L. europaeus* is found along the entire border of Paraguay and Argentina.

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With the massive deforestation of eastern Paraguay and extreme pressure from ranchers and hunters alike on felid and canid species there seems to be little left to control potentially quickly multiplying hare populations. This fact, coupled with the intensive and quick landscape changes from forest to soy plantations and other agricultural systems (Fleytas 2007, Huang et al., 2007) that could eventually provide endless

food sources for European hares, suggest the likelihood that this species will become widespread and common, and possibly a serious pest. This record highlights the scarcity of published documentation of exotic species in Paraguay and points out the urgent need to monitor and track the expansion and effects of invasive, non-native European hares and other invasive species in the region.

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