

The southernmost record of a *Neuryurini* Hoffstetter, 1958 (Mammalia, Xenarthra, Glyptodontidae)

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Abstract In this contribution we document the southernmost and probably the oldest record of the tribe *Neuryurini* (Glyptodontidae). The southernmost record of this tribe outside of Patagonia is *Neuryurus* sp. from Lujanian sediments (Luján Formation, late Pleistocene–early Holocene) at Quequén Grande River (Buenos Aires Province, Argentina). The first and only previous record of a specimen of the *Neuryurini* in Patagonia was reported from the upper levels of the Puerto Madryn Formation (Huayquerian SALMA, late Miocene), exposed in Península Valdés (Chubut Province, Argentina). The new specimen described here and assigned to an indeterminate *Neuryurini* was recovered at Estancia La Peninsular (Santa Cruz Province, Argentina). This locality has been recognized in geological

studies as part of the Santa Cruz Formation (Santacrucian SALMA, late early Miocene), but there have been no fossils described from this site until now. Therefore, the new specimen represents, with the two confirmed records of *Glyptodon* Owen and *Panochthus* Burmeister (both from the Quaternary), the only non-Propalaehoplophorinae glyptodontids reported for Santa Cruz Province.

Keywords Glyptodontidae · *Neuryurini* · Miocene · Patagonia · Argentina

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südosten beobachtete Fund dieser Tribe ausserhalb Patagonien ist *Neuryurus* sp. aus den Lujanian Sedimenten (Formation Luján, spät Pleistozän- früh Holozän), am Fluss Quequén Grande (Provinz Buenos Aires, Argentinien). Der erste und einzige frühere Fund von einem Exemplar von *Neuryurini* in Patagonien wurde in den höheren Schichten der Formation Puerto Madryn (Huayquerian SALMA, spät Miozän) gefunden, welcher auf der Halbinsel Valdés (Provinz Chubut, Argentinien) ausgestellt ist. Der neue Exemplar hierbei beschrieben, welcher einem noch unbestimmten *Neuryurini* zugewiesen ist, wurde auf dem Estancia La Peninsular (Provinz Santa Cruz, Argentinien) gefunden. Dieser Raum wurde, anhand von geologischen Untersuchungen, als Teil der Formation Santa Cruz (Santacrucian SALMA, spät-früh Miozän) erkannt. Bis jetzt wurden keine aus diesem Ort stammenden Fossilien beschrieben. Aus diesen Gründen bekundet dieser neue Exemplar, zusammen mit den zwei bestätigten Funden von *Glyptodon* Owen und *Panochthus* Burmeister (beide aus dem Quartär), der einzige berichtete non-Propalaeophorinae Glyptodontids in der Provinz Santa Cruz.

Schlüsselwörter Glyptodontidae · *Neuryurini* · Miozän · Patagonien · Argentinien

Abbreviations

CC	Museo Universitario “Florentino y Carlos Ameghino” Universidad Nacional de Rosario (ex Instituto de Fisiografía y Geología “Alfredo Castellanos”) (Santa Fe Province, Argentina)
FC-DPV	Facultad de Ciencias, Departamento de Paleontología (Montevideo, Uruguay)
MACN	Sección Paleontología Vertebrados, Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (Buenos Aires Province, Argentina)
MCNL	Museo de Ciencias Naturales de Lobería (Buenos Aires Province, Argentina)
MCNN	Museo Municipal de Ciencias Naturales de Necochea “Dr. José Escuadrone” (Buenos Aires Province, Argentina)
MLP	Museo de La Plata (Facultad de Ciencias Naturales y Museo Universidad Nacional de La Plata) (Buenos Aires Province, Argentina)
MPCNP	Museo Provincial de Ciencias Naturales de Paraná (Entre Ríos Province, Argentina)
MPM-PV	Museo Regional Provincial “Padre Manuel Jesús Molina” (Santa Cruz Province, Argentina)
MPEF	Museo Paleontológico “Egidio Feruglio” (Chubut Province, Argentina)
UAP	Museo David Rhys, Universidad Adventista del Plata (Entre Ríos Province, Argentina)
SALMA	South American Land Mammal Age

Introduction

The cingulatan family Glyptodontidae was one of the most conspicuous among the Cenozoic xenarthrans from South America, with an extensive latitudinal range from approximately 36°37' N (Carmen glyptodont fossil locality, northern Oklahoma, USA) (Czaplewski 2004) to 51°34' S (Killik Aike Norte, Santa Cruz Province, Argentina) (Scott 1903; Marshall 1976; Tauber et al. 2004). The earliest record of the Glyptodontidae comes from the late Eocene in Patagonia, Argentina, and belongs to the subfamily Glyptatelinae (Ameghino 1902; Kay et al. 1999; Carlini et al. 2005). From this initial record up to the “Friasian” SALMA (middle Miocene), Patagonia has preserved the best evidence for the radiation of the group (Pascual 1984; Pascual and Odreman Rivas 1973; Pascual et al. 1984), as part of a broader and well known radiation of the Cingulata (Scillato-Yané 1986). Moreover, Pascual and Odreman Rivas (1973) and Pascual et al. (1984) have suggested that major radiation and cladogenesis for the Cingulata took place in Patagonia. More recently, other possible evolutionary scenarios have been proposed for the radiation Cingulata, at lower latitudes (see Carlini et al. 2008).

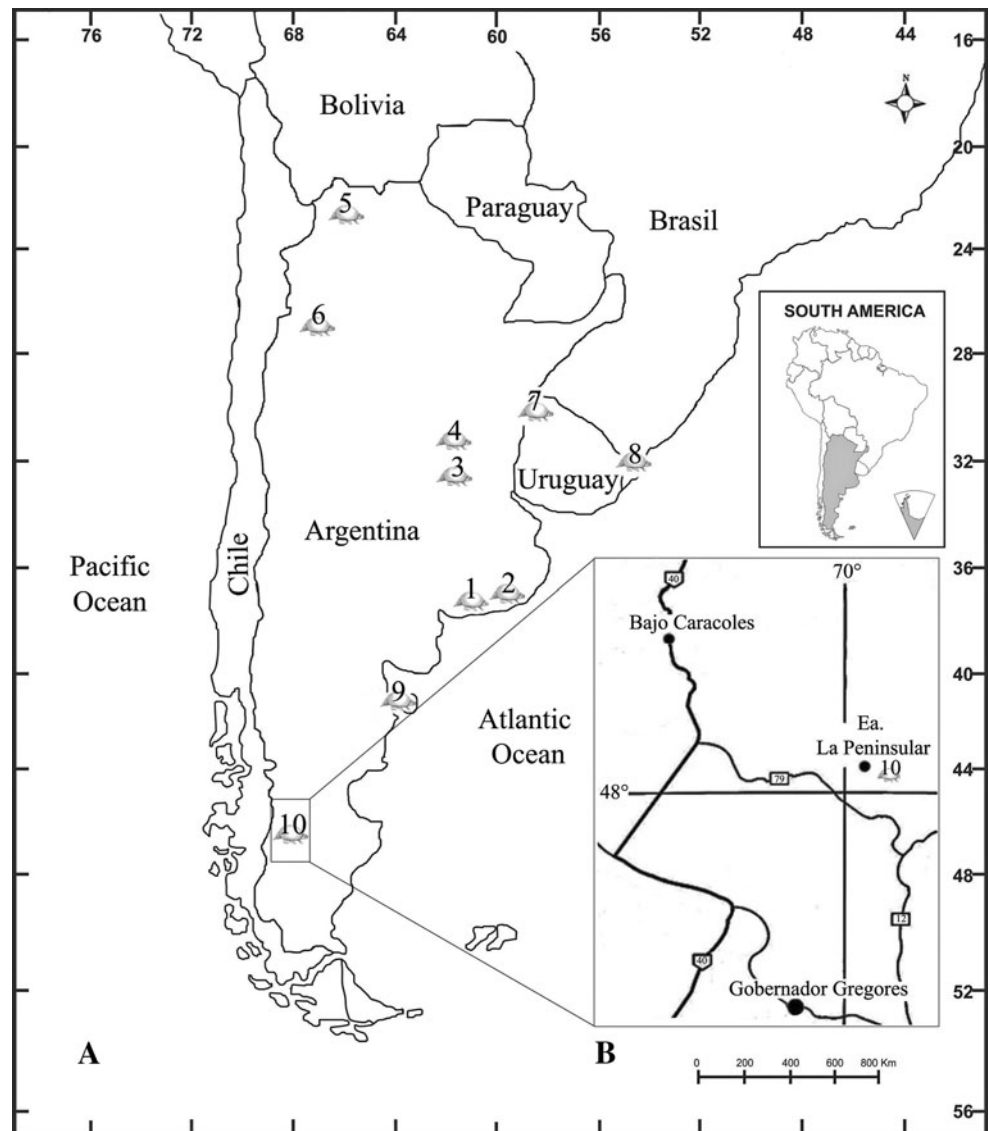
The glyptodontid tribe *Neuryurini* (?late Miocene–late Pleistocene) is one of the more poorly known groups of cingulatan. The best known taxa are *Neuryurus rudis* (Gervais) (early-middle Pleistocene, Ensenadan SALMA), *N. trabeculatus* (Zurita and Ferrero 2009) and *Neuryurus* sp. (late Pleistocene, Lujanian SALMA), from Argentina (see Ameghino 1889; Gervais 1878; Zurita and Ferrero 2009; Zurita et al. 2006). According to Hoffstetter (1958: 586), the *Neuryurini* are characterized by the following characters:... “*les plaques sont épaisses, souvent rectangulaires, unies par sutures indentées, mais lâches; la surface externe est uniformément perforée...Le bouclier céphalique rappelle quelque peu Panochthus Burmeister, 1866 par la présence de tubercules peu marqués.*”

In this contribution we present the southernmost and probably the oldest record of a *Neuryurini* glyptodont. This is one of the rare records of a non-Propalaeophorinae glyptodontid from Patagonia.

The record of the *Neuryurini* in Patagonia

Dozo et al. (2002, 2008) reported the first and only *Neuryurini* from Patagonia represented by one isolated osteoderm and assigned by them to *Neuryurini* gen. et sp. indet. (MPEF-PV 2533) (Figs. 1a, 9 and 2c). This specimen comes from the upper levels of the Puerto Madryn Formation exposed in Península Valdés (specifically from

Fig. 1 a Geographic distribution of the Glyptodontidae Neuryurini. 1 *Neuryurus* sp. (Lobería, Buenos Aires Province), 2 *Neuryurus* sp. (Punta San Andrés, Buenos Aires Province), 3 *Neuryurus trabeculatus* (Arroyo Ensenada, Entre Ríos Province), 4 *Pseudoeryurus lelongianus* (Paraná, Entre Ríos Province), 5 *Neuryurus* sp. (Uquía, Jujuy Province), 6 *Urotherium* (Valle de Santa María, Catamarca Province), 7 *Neuryurus* cf. *N. rudis* (Artigas, Salto, and Tacuarembó departments, northern Uruguay), 8 *Neuryurus* sp. (Río Grande do Sul, southern Brazil), 9 Neuryurini gen. et sp. indet. (Punta Delgada, Península Valdés, Chubut Province), 10 Neuryurini gen. et sp. indet. (Estancia La Peninsular, Santa Cruz Province). **b** Detail of the location map of Estancia La Peninsular locality, Santa Cruz Province, Argentina



Rincón Chico near Punta Delgada, northeastern Chubut Province); associated fossil vertebrates indicate the Huayquerian SALMA (late Miocene) for these sediments. $^{40}\text{K}/^{39}\text{Ar}$ dates were obtained from a tuff in the upper part of the marine Rionegran, in Bahía Cracker (Chubut Province), with an age averaging 9.41 Ma (Zinsmeister et al. 1981). Recently Scasso et al. (2001) presented several dates obtained by $^{87}\text{Sr}/^{86}\text{Sr}$ from bivalves, giving an average age of 10.1 Ma. From a paleoenvironmental point of view, the fossiliferous levels represent the terminal regressive phase of the Tertiary Sea, and the transition to a continental environment (Dozo et al. 2008). Thus, this is the first evidence of late Miocene continental vertebrates south of Río Negro Province, and

until now the only report of the tribe Neuryurini in Patagonia.

The new Neuryurini specimen

Systematic paleontology

Order Cingulata Illiger, 1811
 Superfamily Glyptodontoidea Gray, 1869
 Family Glyptodontidae Gray, 1869
 Subfamily Hoplophorinae Huxley, 1864
 Tribe Neuryurini Hoffstetter, 1958
Neuryurini gen. et sp. indet.
 Figure 2a, b

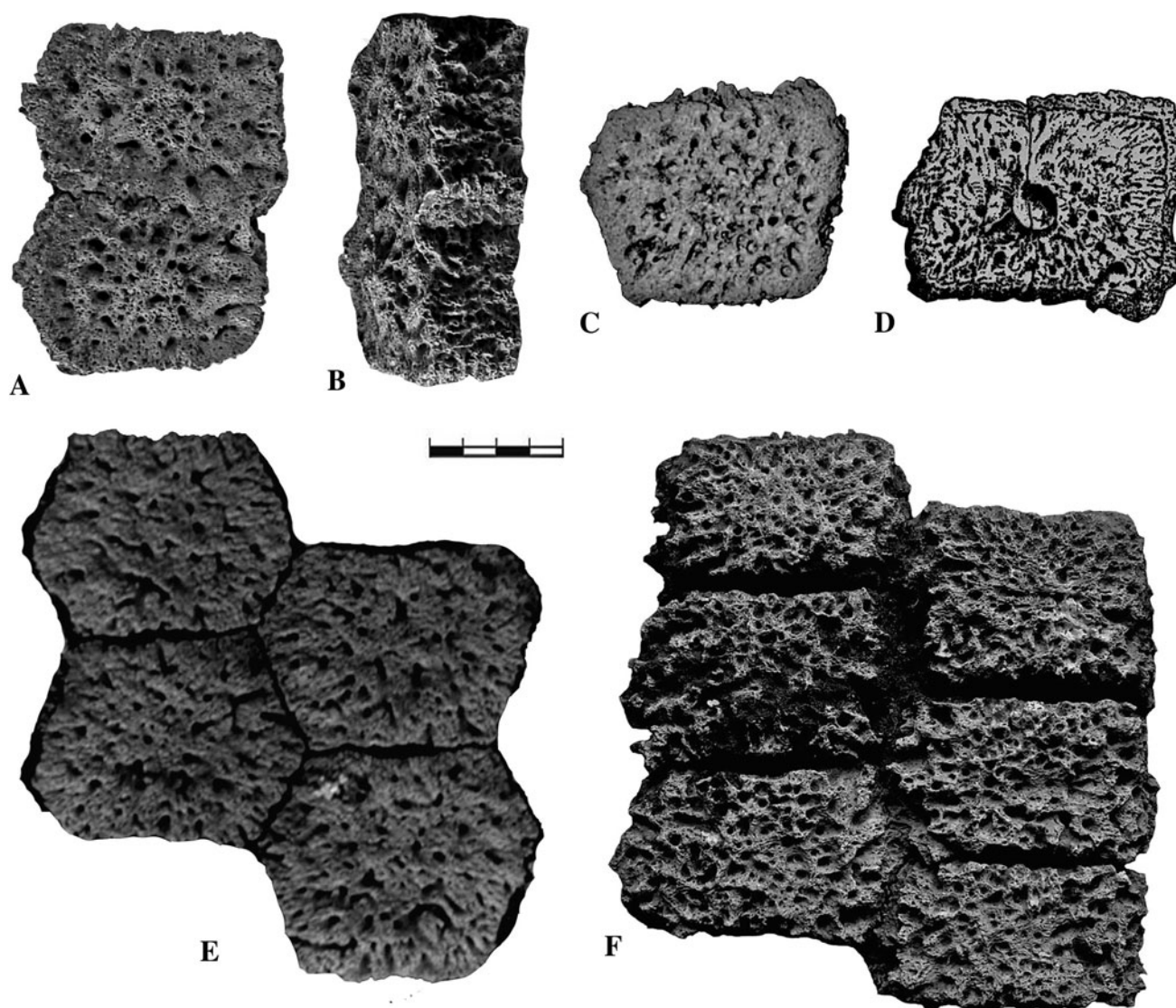


Fig. 2 *Neuryurini* gen. et sp. indet. (MPM-PV 1868). **a** Two osteoderms in dorsal view, **b** in dorso-lateral view. **c** *Neuryurini* gen. et sp. indet. (MPEF-PV 2533) (9 in Fig. 1a), one osteoderm in dorsal view. **d** *Pseudoeuryurus lelongianus* (MACN 599) (figure

modified from Ameghino 1889), one osteoderm in dorsal view. **e** *Neuryurus* sp. (MCNL 6.6), four osteoderms in dorsal view. **f** *Neuryurus trabeculatus* (UAP 1510), six osteoderms in dorsal view. Scale bar 2 cm

Referred material MPM-PV 1868, two associated osteoderms from the dorsal carapace.

Locality Estancia La Peninsular (47°43'35.2"S, 70°23'2.9"W) northwest of Santa Cruz Province, Argentina (Fig. 1b, 10).

Age and geological settings According to de Barrio et al. (1984) and Panza and Cobos (2001), a succession of badlands is exposed near Estancia La Peninsular. These include a lower section with white yellowish siltstones and claystones (pelitic subfacies), with fine intercalated sandstones (massive sands subfacies) and very fine to fine tuffites. There is a gray conglomerate bank 0.80 m thick at the top of the section, gray, with siliceous and tuffaceous

clasts, maximum diameter variable 1–4 cm. These strata are about 20 m thick, followed by about 10 m of claystone and siltstones, gray to yellowish.

The osteoderms were a surface find, recovered from the surface of eroded siltstone badlands during the course of prospecting for vertebrate fossils. While it is not possible to determine exactly where they derived from, there is no good reason to believe they did not erode from the adjacent sediments.

The sediments at Estancia La Peninsular were assigned by de Barrio et al. (1982, 1984) to the Santa Cruz Formation, Santacrucean SALMA (late early Miocene), an allocation also supported by Panza and Cobos (2001). Nevertheless, these authors did not report on any vertebrate

fossils collected at this particular locality, although many vertebrate fossils have been recovered from other, scattered sedimentary deposits in the region (Bown and Fleage 1993; de Barrio et al. 1984; Rae et al. 1996). Because the tribe Neuryurini has not been reported from any of the very extensive Santacrucian (late early Miocene) and “Friasian” (middle Miocene) deposits from the Santa Cruz, Chubut, Río Negro, or Neuquén provinces, there is also the possibility of younger sediments at La Peninsular that have not been recognized. Further geological and paleontological research in this area is clearly warranted.

Description

The material consists of two articulated osteoderms from the dorsal carapace, pentagonal in shape, and well preserved (Fig. 2a, b). The larger has a length of 41 mm, a width of 25.2 mm, and a thickness of 14.7 mm (including the central elevation). A comparison with the osteoderms of *Neuryurus* Ameghino suggests that these may correspond to the lateral region of the dorsal carapace (Fig. 2a, e, f). The exposed surface is characterized by a remarkable roughness (more than in *Neuryurus* and *Pseudoeryurus* Ameghino and much more than in *Urotherium* Castellanos) and in having numerous foramina. The central area, elevated and with smaller foramina, is surrounded by a row of foramina of greater diameter, as has been observed, to a lesser degree, in several osteoderms of *Neuryurus*. Unlike *P. lelongianus* Ameghino, this central region does not present a middle concavity (Fig. 2d). As in *Neuryurus*, most of the conduits penetrate in a nearly oblique angle. The articular area is denticular, and the sutures are visible, similar to that observed in *Neuryurus trabeculatus* (Fig. 2f).

In sum, the morphology of these osteoderms shows a considerable similarity with those of *Neuryurus* (e.g., MCNL 6.6, MCNN s/n, MLP 07-V-3-1, FC-DPV 901) and with the osteoderm presented by Dozo et al. (2008) (Fig. 2c), although in this case the exhibited surface has undergone some erosion (length 36.75 mm, width 28.95 mm, thickness 12.21 mm).

The record of extra-Patagonian Neuryurini

Based on the evidence discussed above, and accepting that *Pseudoeryurus* and *Urotherium* are Neuryurini, the first record of this tribe probably corresponds to *Pseudoeryurus lelongianus* Ameghino (Figs. 1a, 4 and 2d) and *Urotherium interundatum* (Ameghino) from the Mesopotamian (late Miocene–Pliocene), of the Mesopotamian region of Argentina (30°–33°S and 60°–58°W), and to *Urotherium simile* Castellanos from the Araucanian (late Miocene–Pliocene) of

the northwest of Argentina (28°–26°S and 68°–65°W) (see Ameghino 1885, 1889; Castellanos 1948) (Fig. 1a). In this context, the first record of a Neuryurini in the Pampean region corresponds to *Urotherium antiquus* (Ameghino), of the Montehermosan SALMA (late Miocene–Pliocene). The Neuryurini (*Urotherium* spp.) are also recorded in the Chapadmalalan and Marplatán SALMAs (Pliocene) of the Pampean region of Argentina, although they are very scarce (Scillato-Yané et al. 1995). From the late Pliocene to the late Pleistocene, the Neuryurini [*N. rudis*, *N. trabeculatus* (Fig. 1b, 3 and 2f) and *Neuryurus* sp. (Fig. 1b, 1 and 2e)] extended their distribution remarkably, with an area that ranges from 38°S to 28°S and from 60°W to approximately 53°W (Ameghino 1889; Ubilla et al. 2004; Zurita et al. 2009) (Fig. 1a).

Discussion and conclusions

The phylogeny, taxonomy, and paleobiogeography of glyptodonts, especially for those from the southernmost region of South America are still poorly understood (Carlini et al. 2008; Croft et al. 2007; Fernicola 2008). Nevertheless, the significant record during most of the time interval from late early Miocene to middle Miocene permits a reasonable understanding of some lineages of the Glyptodontidae.

The Glyptodontidae are first recorded from Paleogene outcrops of Gran Barranca (central Patagonia) with records of the Glyptatelineae from levels tentatively assigned to the Tinguirirican SALMA (late Eocene–early Oligocene) (Carlini et al. 2005) and the Propalaeohoplophorinae from Deseadan SALMA (early Oligocene) (Scillato-Yané 1977).

The Neogene started with a high diversity of Propalaeohoplophorinae during the Santacrucian SALMA (late early Miocene) (McKenna and Bell 1997; Scillato-Yané 1986). In that context recently Croft et al. (2007) mentioned that the Propalaeohoplophorinae are of uncertain monophyly and Fernicola (2006, 2008) has proposed that they are a natural group.

During the “Friasian” SALMA (Friasian *s.s.*, Collocurran *s.s.*, and Mayoan), other new lineages of Glyptodontidae evolution appeared, principally represented by Palaeohoplophorini (Hoplophorinae) (Ameghino 1904; Kraglievich 1930), Glyptodontidae incertae sedis (Scillato-Yané and Carlini 1998; Zurita 2007), and a probably new glyptodont Propalaeohoplophorinae (González Ruiz et al. 2010), with the Propalaeohoplophorinae also recorded (Kraglievich 1930; Roth 1899).

Later, the Chasicóan, Huayquerian, and Montehermosan SALMAs (late Miocene–early Pliocene) marked the disappearance of the Pan-Santacrucian elements, still present in the Chasicóan (late Miocene) (see Bondesio et al. 1980;

Pascual and Ortiz Jaureguizar 1990; Scillato-Yané 1977, 1979). In this time range, the Glyptodontidae underwent an important radiation with the diversification of Hoplophorinae (Palaeohoplophorini, Hoplophorini, and Plohophorini), Doedicurinae, and Glyptodontinae (Scillato-Yané 1986).

In this scenario, the first possible Neuryurini appeared in the fossil record during this time with several taxa, *Pseudoeuryurus lelongianus* Ameghino (Ameghino 1889), *Urotherium antiquus*, *U. interundatus*, and *U. simile* Castellanos (Castellanos 1926), recorded between 26°S and 33°S. Recently, Dozo et al. (2008) presented the southernmost record of a Neuryurini, coming from the Puerto Madryn Formation (late Miocene), northeastern coast of Chubut Province. During the Pleistocene, the Neuryurini (*Neuryurus* spp.) extended their geographic distribution to the north and east but were always restricted to the south end of South America.

Therefore, the new specimen described in the present work is the southernmost Neuryurini discovered up to now (47°43'35.2''S), and together with the three mentioned records of Quaternary Glyptodontidae, one of *Glyptodon clavipes* and two of *Panochtus* sp. (Ameghino 1900–1902; Parodi 1930; Tauber and Palacios 2007; Tauber pers. com. to LRGR 2009), documents the most extreme austral distribution of non-Propalaeohoplophorinae glyptodonts. If the Santacrucian SALMA of this new specimen is confirmed, it will be the oldest record of a Neuryurini and could reveal a greater Glyptodontidae diversification than supposed, since the only recorded Patagonian glyptodonts for this time period (late early Miocene) are the Propalaeohoplophorinae. This would corroborate the hypothesis of Fernicola (2008) who has suggested an early first splitting within the Glyptodontidae during the Colhuehuapian SALMA, or even before, during the Deseadan SALMA. Finally, and based on the current evidence, the Hoplophorinae Neuryurini appears to be a group of Glyptodontidae restricted to the southern part of South America.

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