

ORNAMENTATION AND DEFENSE STRUCTURES OF THE PELVIC BUCKLER OF *EUTATUS PASCUALI* (XENARTHRA, DASYPODIDAE)

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Abstract. - *Eutatus pascuali* is a large armadillo characteristic of the Lower-Middle Pleistocene of Argentina. The number of published specimens is small and frequently they consist of isolated osteoderms and carapace fragments, in which the dorsal region is usually preserved. In this work we report the presence of modified thick spine-like osteoderms projected laterally on the lateral border of the pelvic buckler. This is a remarkable feature within the Euphractinae that contributes to the knowledge of the appearance of *E. pascuali*. The presence of spines projecting from the carapace, a convergent adaptation also observed in some Glyptodontinae, could have been developed as a defense against predators.

Keywords: Armadillo ▪ Osteoderms ▪ Euphractinae ▪ Pleistocene ▪ South America.

Resumen.- Estructuras de ornamentación y defensa del escudo pélvico de *Eutatus pascuali* (Xenarthra, Dasypodidae): *Eutatus pascuali* es un armadillo de gran tamaño característico del Pleistoceno Inferior-Medio de Argentina. El número de especímenes publicados es limitado y están frecuentemente representados por osteodermos aislados y fragmentos de coraza en los que se preserva frecuentemente la región dorsal. En este trabajo describimos la presencia de osteodermos modificados con puntas gruesas proyectadas lateralmente en el borde lateral del carapacho de *E. pascuali*. Esta es una característica única entre los Euphractinae y añade nuevo conocimiento morfológico sobre la apariencia de *E. pascuali*. La presencia de espinas que se proyectan desde el carapacho, una adaptación convergente también observada en algunos Glyptodontinae, podría haberse desarrollado como defensa frente a predadores.

Palabras clave: Armadillo ▪ Osteodermos ▪ Euphractinae ▪ Pleistoceno ▪ Sudamérica.

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INTRODUCTION

The genus *Eutatus* comprises large armadillos species compared to the mean size of the Dasypodidae (Scillato-Yané et al. 1995, Vizcaíno and Bargo 1993, Vizcaíno et al. 1995, 2003). In Argentina, during the Pleistocene, the genus is represented by three species, *Eutatus pascuali* Krmpotic, Carlini & Scillato-Yané, 2009 in the Lower-Middle Pleistocene, and *Eutatus crispianii* Brambilla and Ibarra, 2017 and *Eutatus seguini* Gervais, 1867 in the Upper Pleistocene. The genus has been recorded from southern Buenos Aires, Argentina (Krmpotic 2007, Krmpotic, Carlini et al. 2009) to Paraguay (Ríos et al. 2016), see Fig. 1.

Eutatus is usually represented by isolated osteoderms or even almost complete carapaces. The carapace consists of mobile bands of osteoderms that cover its first two-thirds (Brambilla & Ibarra 2017), then it also has a group of fixed osteoderms on the sides at the level of the scapula and finally fixed osteoderms cover the last third, forming a pelvic buckler (Krmpotic, Carlini et al. 2009).

The shape of the osteoderms and their ornamentation have been described and used with systematic purposes (Vizcaíno & Bargo 1993, Krmpotic, Carlini et al. 2009, Soibelzon et al. 2010, 2013, Brambilla & Ibarra 2017). The mobile osteoderms of *Eutatus* have an ornate caudal portion and a smooth unexposed cranial portion beneath the anterior band of osteoderms (Krmpotic, Ciancio et al. 2009). The external surface of the fixed and mobile osteoderms from the dorsal region of the carapace has a rough surface with a central figure that extends along the osteoderms, and smaller figures around that. Osteoderms are so important in the study of armadillos that not only the external ornamentation but also the internal structure have been subject of extensive morphological description with systematic and palaeobiological implications (Krmpotic, Carlini et al. 2009, Krmpotic, Ciancio et al. 2009, 2015).

Osteoderms from dorsal areas are frequent when the carapace is preserved, while specimens preserving those from lateral or edges of the carapace are very scarce. In this paper we describe the morphology of the osteoderms of the postero-lateral region of the pelvic buckler of *E. pascuali* and discuss the presence and function of spine-like osteoderms covering the margins of the carapace in this singular Euphractinae.

SYSTEMATIC PALAEOLOGY

Nomenclature: description of osteoderms and parts of carapace follows Krmpotic, Ciancio et al. (2009, 2015).

Abbreviations: MUFyCA: Museo Universitario Carlos y Florentino Ameghino (Rosario, Argentina); LPB: Colección Laboratorio de Paleontología y Biocronología (Instituto de Fisiografía y Geología (Universidad Nacional de Rosario, Rosario, Argentina); sonb: series of osteoderms near the lateral border.

Superorder Xenarthra Cope, 1889
Order Cingulata Illiger, 1811
Superfamily Dasypodoidea Gray, 1821
Family Dasypodidae Gray, 1821
Subfamily Euphractinae Pocock, 1924
Tribe Eutatini Bordas, 1933



Figure 1. Geographic provenance of the studied specimen (gray dot). The large gray area indicates the geographic distribution of the genus *Eutatus* with indication of the local records (black dots). Modified from Krmpotic, Carlini et al. (2009).

Genus *Eutatus* Gervais, 1867

Type species: *Eutatus seguini* Gervais, 1867

Eutatus pascuali Krmpotic, Carlini & Scillato-Yané, 2009

Fig. 2A-D

Material.- Right lateral portion of a pelvic buckler and 4 loose mobile osteoderms. The specimen (MUFyCA-131) was collected by Federico Henning in 1937 and was formerly part of the collection of the Instituto de Fisiografía y Geología (Universidad Nacional de Rosario).

Locality.- Playa de Olivos, Rio de la Plata, Buenos Aires, Argentina (Fig. 1).

Stratigraphic origin.- Ensenada Formation (Early-Middle Pleistocene).

Description.- Postero-lateral portion of the pelvic buckler composed of fixed osteoderms and part of the marginal shield formed by spine-like osteoderms (Fig. 2A-D). Osteoderms from the anterior rows, close to the osteoderms of movable bands, are rectangular with a wide main figure centred on the exposed surface. Four to six piliferous

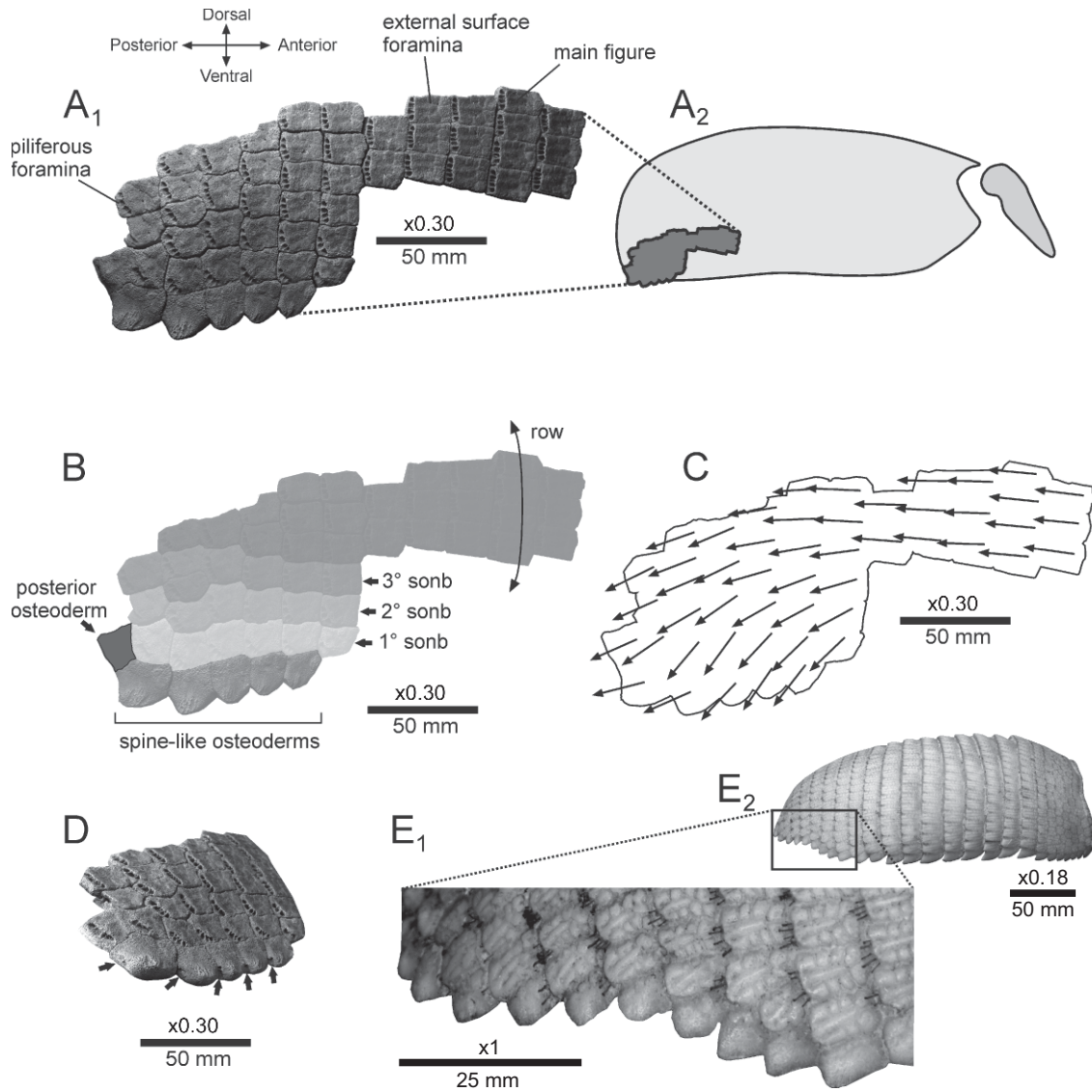


Figure 2. A-D: *Eutatus pascuali* (specimen MUFyCA-131). **A₁**: Lateral portion of the pelvic buckler; **A₂**: Scheme of the carapace (not in scale). **B**: Organization of the lateral region of the carapace. **C**: Scheme with the arrangement of the central figure of osteoderms; the origin of the vector-points to the anterior border of the central figure and the arrowhead point to the mid-point of the piliferous foramina. **D**: latero-caudal view, the arrows mark the piliferous foramina from spine-like osteoderms. **E₁**: detail of the border of the pelvic buckler for comparison; **E₂**: lateral view of the carapace of *Chaetophractus villosus* (specimen LPB-1142). – Osteoderms series near lateral border abbreviated as sonb.

foramina on the posterior border and fine external surface foramina are present on the osteoderms and these are diagnostic features of *E. pascuali*.

The osteoderms from the last rows of the pelvic buckler, located on the sides of the carapace, often have more quadrangular forms, with sinuous edges. In these osteoderms the main figures are displaced in ventral direction. The angle of the displacement of the main figure is more pronounced in the first series of osteoderms near lateral border (sonb) and it decreases in the second and third series near to the lateral border (Fig. 2A-C). The change of position of the main figure is also associated with a rotation of the piliferous foramina from the posterior region to a postero-lateral position in the osteoderms (Fig. 2A, C).

Five spine-like osteoderms are preserved on the lateral border of the carapace. The major axis of these modified osteoderms runs oblique to the major axis of the fixed dorsal

osteoderms, forming a serrate margin. The size of these modified osteoderms increases towards the posterior region, the last one being the greater (Fig. 2A₁). From a caudal view the spines are projected from the sides away the carapace with greater intensity in the last osteoderms (Fig. 2D) and the tip of the spines rise on the posterior angle of these modified osteoderms. The tips are blunt, porous, and have grooves that could have interacted with a horny sheath.

The five spine-like osteoderms have 1 to 3 piliferous foramina at the posterior border (Fig. 2D). Only one osteoderm is preserved from the posterior margin of the carapace which has no spine-like shape (Fig. 2A₁,B); only a slight elevation is present on the center of the osteoderm near the posterior border. Its margin is blunt with presence of piliferous foramina (Fig. D).

Remarks.- The serrated pattern produced by modified, but not laterally projected osteoderms is present in other species of the subfamily Euphractinae, like *Chaetophractus villosus* (Desmarest, 1804), *Chaetophractus vellerosus* (Gray, 1865) and *Zaedyus pichiy* (Desmarest, 1804) (Chebez et al. 2014, Góis 2013, Soibelzon & Leon 2017, Superina & Abba 2014). In these species the modified osteoderms are present in the lateral and posterior margin of the pelvic buckler (Fig. 2F) while in *E. pascuali* the serrated pattern only appears in the lateral border of the pelvic buckler, but not in the posterior border, a condition also present in *Euphractus sexcinctus* (Linnaeus, 1758) (Redford & Wetzel 1985, Góis 2013).

DISCUSSION

The studied specimen shows part of the ornamentation of the lateral and posterior regions of the pelvic buckler, included the postero-lateral margins, a poorly known aspect in *Eutatus*.

The osteoderms delineating the margins of the pelvic buckler of *C. villosus* are flattened, the thickness is smaller towards the tips and they do not project towards the sides of the carapace (Fig. 2E). This feature of *C. villosus* allows the animal to attach to the soil as a defensive strategy against predator attacks (Chebez et al. 2014).

In *E. pascuali* the thickness of the modified osteoderms increases towards the tips and are projected to the sides of the carapace like in *Glyptodon reticulatus* and *Glyptodon munizi* (Zurita et al. 2010). We speculate that these structures in *E. pascuali* could likely have improved the protection of delicate areas of the posterior region. This extra-protection would be due to many diversified predators known during the Ensenadan times that include medium- to large-sized felids and canids like *Puma concolor* (Linnaeus, 1771), *Smilodon populator* Lund, 1842, *Panthera onca* (Linnaeus, 1758), *Theriodictis platensis* Mercerat, 1891, *Protocyon scagliorum* (Kraglievich, 1952), *Protocyon troglodytes* (Lund, 1838) and *Canis? gezi* Kraglievich, 1928 (Soibelzon & Prevosti 2007, Prevosti 2006, Chimento & Dondas 2017). The remarkable increase in the pressure exerted by the new predators that were the product of the Great American Biotic Interchange (Simpson 1950, 1953, Webb 1976, 1985, Cione et al., 2015) could have driven the development of this adaptation as was previously discussed for glyptodonts by Zurita et al. (2010).

It is interesting to note that burrow-builders like *C. villosus* (Desmarest, 1804) *C. vellerosus* (Gray, 1865) and *Z. pichiy* (Desmarest, 1804) do not possess osteoderms with projected tips on the sides. The presence of spines projected to the sides at the posterior border in *E. pascuali* could be in agreement with biomechanical evidence that suggest *Eutatus* would have had a restricted capacity for building burrows (Vizcaino et al. 2003).

The presence of abundant piliferous foramina in the posterior margin of the spine-like osteoderms are also a distinguishing feature of *E. pascuali*. Neither the modified conical osteoderms of *G. reticulatus* and *G. munizi* nor the osteoderms of the serrated border of *C. villosus* show piliferous foramina.

CONCLUSION

Changes in the configuration of the osteoderms on the lateral side of the pelvic buckler of *E. pascuali* were observed. These osteoderms describe a displacement of the main figure and the piliferous foramina to their lateral border. The specimen MUFyCA-131 reveals an unknown aspect of the morphology of *E. pascuali*: the existence of specialized spine-like osteoderms, possibly useful for the protection against predators.

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