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Description and phylogenetic relationships of *Taniwhasaurus antarcticus* (Mosasauridae, Tylosaurinae) from the upper Campanian (Cretaceous) of Antarctica

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ABSTRACT

The Antarctic tylosaurine mosasaur *Taniwhasaurus antarcticus* (Upper Cretaceous, Campanian) is redescribed and rediagnosed based on the holotype. The reexamination of this specimen reveals that *T. antarcticus* is clearly distinguishable by a set of skull features from other species of the genus, including an almost straight fronto-parietal suture, the extreme reduction of the infrastapedial process of the quadrate, and the L-shaped coronoid. Phylogenetic analysis indicates that *T. antarcticus* and *T. oweni* are sister taxa, confirming their assignment to the same generic entity. The most striking feature of *T. antarcticus* is the configuration of the posterior terminus of the skull and its articulation with the quadrate. The posteroventral expansion of the supratemporal embraces medially the ventral half of the posterior border of the paroccipital process, preventing the quadrate head from extended posterior displacement. Although in *T. oweni* this region of the skull has not been preserved in natural position, the same configuration of the quadrate-supratemporal-squamosal and paroccipital process complex can be inferred based on the quadrate morphology.

1. Introduction

Mosasaur remains from Antarctica have been known for over a quarter century (Gasparini and del Valle, 1981). The first discoveries were isolated teeth and bones that could only be identified to higher taxonomic levels. Martin et al. (2002) identified, for the first time, mosasaurid remains from Antarctica at generic levels, revealing diverse assemblages composed of *Leiodon, Mosasaurus,* cf. *Moanasaurus, Plioplatecarpus*, as well as tylosaurine remains. Most of these specimens come from Maastrichtian levels of the López de Bertodano Formation (Martin, 2006). Novas et al. (2002) reported a well preserved specimen of a tylosaurine from the late Campanian levels of the Santa Marta Formation exposed at James Ross Island. The specimen was briefly described and referred to a new genus and species: *Lakumasaurus antarcticus.* However, re-examination of the Maastrichtian tylosaurine *Taniwhasaurus oweni* Hector (1874) from New Zealand (Martin and Fernández, 2005, 2007) indicated close similarities between both taxa. On this basis, Martin and Fernández (2005, 2007) synonymized *Lakumasaurus* Novas, Fernández, Gasparini, Lirio, Nuñez, 2002 with *Taniwhasaurus* Hector, 1874.

Except for the brief descriptions of Novas et al. (2002), Martin and Fernández (2007), and Martin et al. (2007), few anatomical details of *Taniwhasaurus antarcticus* have been published. The objective of the present contribution is to describe in detail the holotype of *Taniwhasaurus antarcticus* (Novas et al., 2002) and to determine its phylogenetic position within the Tylosaurinae.

2. Systematic palaeontology

Squamata Oppel, 1811
Mosasauridae Gervais, 1853
Tylosaurinae Williston, 1897
Taniwhasaurus Hector, 1874

Type Species. Taniwhasaurus oweni Hector, 1874

Emended diagnosis. Prefrontal forming part of the narial opening; broad overlap of prefrontal and postorbitofrontal above orbit, excluding frontal from orbital margin; frontal with relatively straight lateral sides; narial opening beginning between third and fourth maxillary tooth position; striated dentition; premaxilla with

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dorsal ridge; relatively short predental rostrum; dorsal quadrate deflected laterally; long, narrow dorsal margin of quadrate; suprastapedial with a large medial projection distinctly offset from the line of the suprastapedial process; suprastapedial process of quadrate long, deeply grooved, and directed ventromedially; infrastapedial process small; ventromedial suture of prefrontal sigmoidal rather than broadly convex; posterior extension of postorbitofrontal extends beyond the supratemporal fenestra.

Taniwhasaurus antarcticus (Novas, Fernández, Gasparini, Lirio, Nuñez, and Puertas, 2002)

Figs. 1–5

2002 *Lakumasaurus antarcticus* Novas, Fernández, Gasparini, Lirio, Nuñez, and Puertas, 2002, p. 245, figs.1–2 A,B (original description)

2005 *Taniwhasaurus antarcticus* Martin and Fernández, 2005, p. 244; Martin and Fernández, 2007, p. 207 (new combination)

Holotype. Instituto Antártico Argentino (IAA) 2000-JR-FSM-1, almost complete and articulated cranium, jaws, and teeth (Figs. 1, 2, 3, 4A, 5, 6), as well as rib fragments and isolated vertebrae from a single individual.

Locality and Horizon. Dinosaurio River, Santa Marta Cove, Northwestern James Ross Island (Lat. 63° 55′ S, Long. 57° 51′W); Antarctica, Herbert Sound Member (Gamma Member) of the Santa Marta Formation Upper Cretaceous, uppermost Campanian (Olivero, 1992; Olivero et al., 1986; Crame et al., 1991, 2004).

Emended diagnosis. Medium-sized tylosaurine mosasaur differing from *T. oweni* (Hector), by having the quadrate shaft without medial quadrate process, dorsal aspect of the suprastapedial process unobservable from lateral view, infrastapedial process of quadrate extremely reduced to a bulge, straight posterior margin of frontal, and L-shaped coronoid (Martin and Fernández, 2007); and from the recently described species, *T. mikaensis* Caldwell et al. (2008), by teeth having compressed, asymmetrical, D-shaped cross-sectional outline, posterior carinae not well developed, facets absent, and postorbitofrontal margins straight, not inflated along length of squamosal ramus and at frontal-parietal suture.

2.1. Description

The cranium and lower jaws of the holotype were found articulated in situ. Vertebrae were recovered in a linear succession up to 20 m from the skull (Novas et al., 2002).

2.1.1. Cranium

Premaxilla. The fused premaxillae are almost complete and well preserved, except for the most posterior end of the internarial bar. In dorsal view the rostrum is V-shaped, whereas the rostrum is more flattened anteriorly and cylindrical on *Tylosaurus proriger*. The tip of the predental rostrum is rugose (Fig. 2A), more so than on other tylosaurines. Such rugosity normally indicates cartilaginous attachment. On the dorsal surface of the snout, a slight longitudinal ridge extends posteriorly at least to a position dorsal to the third maxillary tooth. The total length of this ridge can not be determined owing to poor preservation of the dorsal surface of the internarial bar but appears to have extended at least to a point dorsal to the fifth maxillary tooth. On the dorsal and lateral surfaces of the premaxillary predental rostrum, several well-developed foramina occur and are particularly well defined in the most anterior portion of the predental rostrum.

The suture between premaxilla and maxilla is better preserved on the left side, its most anterior terminus interdigitates in an inverted w-shape (Fig. 2B). This morphology has been described as diagnostic of *Hainosaurus* and some *Tylosaurus* specimens (Bardet, 1990; Lingham-Soliar, 1992; Lindgren and Everhart, 2000; Martin, 2007). Evidently, the character occurs prior to the early Campanian, and most subsequent tylosaurines possess an interdigitating premaxillary - maxillary suture. Interestingly, *T. oweni* appears to possess a much more simplified suture that rises vertically (Caldwell et al., 2005). The premaxillary - maxillary suture of *T. antarcticus* continues posteriorly to intersect the anterior border of the naris dorsal to the fourth maxillary tooth.

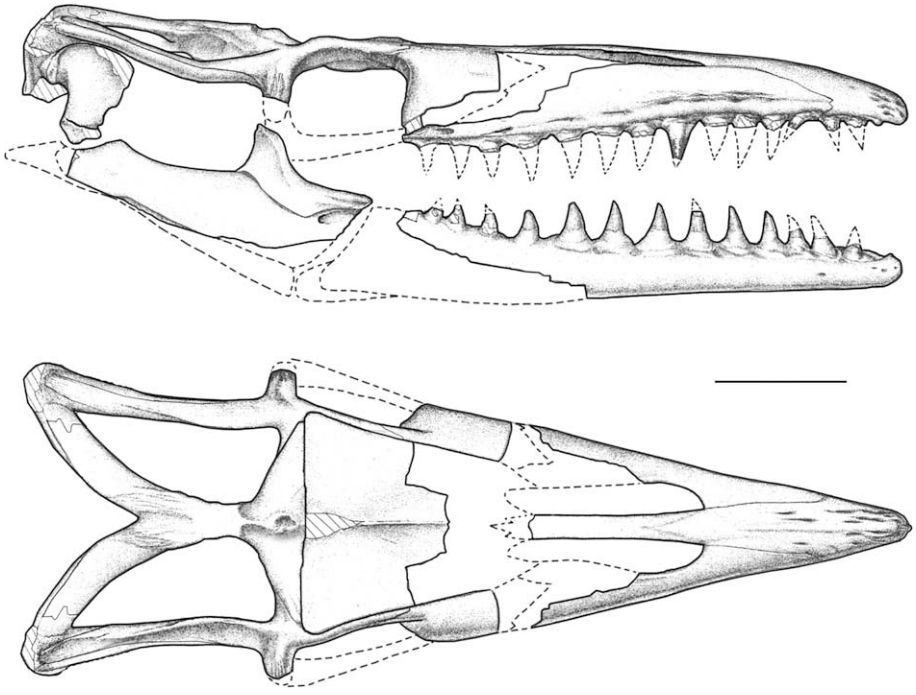

Fig. 1. Reconstruction of the skull of *Taniwhasaurus antarcticus* holotype IAA2000-JR-FSM-1, in lateral and dorsal views. Scale bar equals 10 cm.