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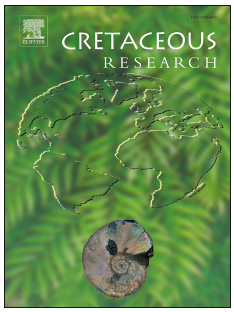

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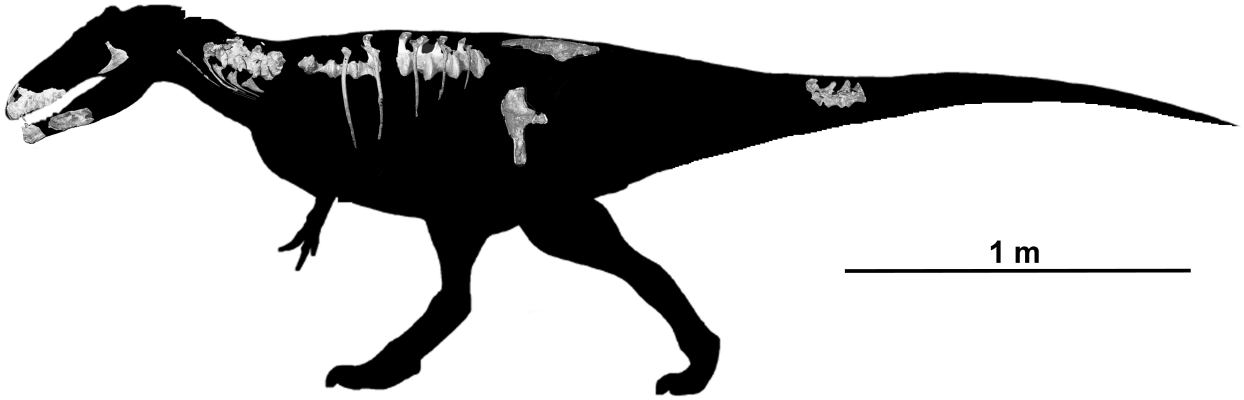

An Early Cretaceous, medium-sized carcharodontosaurid theropod (Dinosauria, Saurischia) from the Mulichinco Formation (upper Valanginian), Neuquén Province, Patagonia, Argentina

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Abstract

A new carcharodontosaurid taxon, *Lajasvenator ascheriae* gen. et sp. nov. is described. The new taxon is based on two specimens: MLL-PV-Pv-005 is a partial skeleton represented by a portion of the snout, partially articulated presacral vertebral series, four articulated caudal vertebra and fragments of the pelvic girdle; MLL-PV-Pv-007 includes the anterior ends of both dentaries, a quadratojugal, and fragments of cervical vertebrae, ribs and a possible tarsal bone. *Lajasvenator* is unique in having anterior projections on cervical prezygapophyses, lip-like crests on the lateral surfaces of cervical postzygapophyses, and bilobed anterior processes on cervical ribs. *Lajasvenator* material was collected from the terrestrial sandstones of the Valanginian Mulichinco Formation. It is the oldest carcharodontosaurid record from South America. This medium sized theropod was found associated with remains of the dicraeosaurid sauropod *Pilmatueia*, indeterminate diplodocid remains, and a yet unidentified iguanodontian-like ornithopod.

Keywords: *Lajasvenator*; Carcharodontosauridae; Theropoda; Valanginian; Patagonia

1. Introduction

During the second half of the 20th Century, knowledge about South American dinosaur faunas was primarily built upon a wealth of discoveries from the Mesozoic outcrops of Argentina (see Coria, 2016; Ezcurra and Novas, 2016; Salgado and Calvo, 2016, and references therein). Notwithstanding, most dinosaur taxa are known from the latest levels of the Cretaceous, given the scarcity of Lower Cretaceous outcrops.

In a global context, fossil-bearing localities from the lowest levels of the Cretaceous -- the Berrasian and Valanginian -- are either scarce or have uncertain stratigraphic identification (Weishampel et al., 2004). A handful of Valanginian dinosaur species are known from Asia, Australia and Europe, although the phylogenetic status of many of these species is currently uncertain (Broom, 1904; Buffetaut et al., 2009a and b; Carpenter and Ishida, 2010; Christiansen and Bonde, 2003; Galton, 2009; Harrison and Walker, 1973; de Klerk et al., 2000; Norman, 2010, 2012; Pereda-Suberbiola et al., 2012; Rauhut and Xu, 2005; Taylor and Naish, 2007; You et al., 2005).

In Argentina, the Valanginian is well exposed in the Neuquén Basin, where it is represented by marine and terrestrial deposits of the Mulichinco and Bajada Colorada formations (Gulisano et al., 1984; Zavala, 1999, 2000), which are considered to be synchronous, at least at some of their levels. The Mulichinco Formation includes older beds composed mostly of marine deposits, whereas the upper terrestrial sediments are unconformably overlain by the marine sediments of the Agrio Formation (upper Valanginian–lower Barremian) (Zavala et al., 2005).

Since 2009, annual expeditions have collected fossil vertebrates at the locality of Pilmatué, located 9 km northeast from Las Lajas, Neuquén Province. Here, the terrestrial levels of the Mulichinco Formation are extensively exposed over many square kilometers. Through the years, numerous dinosaur remains have been collected, including articulated or semiarticulated skeletons of dicraeosaurid sauropods, ornithopods and theropod dinosaurs (Coria et al., 2010, 2012, 2017, 2019; Paulina Carabajal et

al., 2018), many of which are associated with fossil plants (Martinez et al., 2012; Gnaedinger et al., 2017). Furthermore, recent collections of vertebrate fossils from the synchronous Bajada Colorada Formation produced what could be a similar dinosaur association (Gallina et al., 2014, 2019; Canale et al., 2017), suggesting that the fossils from both formations could represent the same ecosystem.

During the 2010 field season at Pilmatué locality, a partial, semiarticulated skeleton of a medium sized theropod (MLL-Pv-005) was collected (Fig.1). A second, less complete specimen (MLL-Pv-007) was recovered 50 meters southeast from the same stratigraphic level during the 2012 field season, which although very incomplete, it preserved the proximal end of a cervical rib that is undistinguishable from the seventh cervical rib of the specimen MLL-Pv-005. A new theropod taxon – *Lajasvenator ascheriae* gen. et sp. nov. – is based on these materials, which constitutes the first theropod remains reported for the Valanginian Cretaceous of Patagonia (Coria et al., 2010) and the first described Theropoda taxon from the Mulichinco Formation (Fig.1).

Lajasvenator shows clear features that link it with the Carcharodontosauridae, a clade of meat-eating dinosaurs commonly known by large, heavily built, Late Cretaceous forms like *Giganotosaurus*, *Carcharodontosaurus*, *Mapusaurus* and *Tyrannotitan* (Coria and Salgado, 1995; Coria and Currie, 2006; Novas et al., 2005; Sereno et al., 1995). However, little is known from the early stages of the evolution of the clade, which could be represented by medium size species like the one here described. *Lajasvenator* is the oldest Cretaceous carcharodontosaurid from South America and a key element to understand the evolutionary history of this clade, which could be older than thought for this continent.

2. Institutional abbreviations:

IVPP, Institute od Vertebrate Paleontology and Paleoanthropology, Beijing, China; MCF-PVPH, Museo Municipal Carmen Funes, Vertebrate Paleontology, Plaza Huincul, Neuquén Province, Argentina; MLL-PV, Museo Municipal de Las Lajas, Las Lajas, Neuquén Province, Argentina; MPCA PV, Museo

Provincial Carlos Ameghino, Vertebrate Paleontology, Cipolletti, Río Negro Province, Argentina; MUCPv-CH, Museo de la Universidad Nacional del Comahue, El Chocón Collection, Neuquén City, Argentina; USNM, United States National Museum, Washington DC, USA.

3. Systematic Paleontology

Theropoda Marsh, 1881

Tetanurae Gauthier, 1986

Allosauroidea Currie and Zhao, 1993

Carcharodontosauridae Stromer, 1931

Lajasvenator ascheriae gen. et sp. nov.

Etymology: *Lajas*, referring the city of Las Lajas, within the jurisdiction of which the specimen was found; *venator*, Latin, hunter; *ascheriae*, after Susana Ascheri, for her kindness in allowing us to work on her land.

Holotype: MLL-PV-005, an incomplete but partially articulated skeleton that includes a partial skull represented by the almost complete left premaxilla with one tooth, anterior portion of the right premaxilla with two teeth, most of the main body of the left maxilla, anterior section of the main body of the right maxilla, distal half of the left dentary, posterior ramus of the left splenial, complete last four cervical vertebrae (articulated with each other and their cervical ribs), almost complete first dorsal vertebra, a series of nine articulated dorsal centra (the centra are incomplete at the anterior and posterior ends of the series), fragment of sacrum with three incomplete

vertebrae attached to a fragmentary ilium, a series of four articulated mid caudal vertebrae (two of which are complete), five almost complete posterior dorsal ribs with heads, three dorsal rib shaft fragments, four fragments of possible gastralia, incomplete right ilium, and proximal end of the right pubis.

Referred material: MLL-PV-007, a right quadratojugal, symphysial ends of both dentaries, fragmentary series of four cervical transverse processes, proximal end of seventh right cervical rib, proximal half of a left, anterior dorsal rib, and a possible distal tarsal.

Locality and horizon: Pilmatué Locality, 9 km northeast of Las Lajas, Neuquén Province, Patagonia, Argentina. Mulichinco Formation (upper Valanginian, Lower Cretaceous). GPS positions: MLL-PV-005, S38^{o} 29’ 59.5”, W70^{o} 15’ 51.1”, Elevation 732 masl; MLL-PV-007, S38^{o} 29’ 59.6”, W70^{o} 15’ 48.0”, same elevation as MLL-PV-005. (Figs. 2 and 3).

Diagnosis: medium-sized theropod with the following autapomorphies: anterior projection on cervical prezygapophyses, lip-like crest on lateral surface of cervical postzygapophyses, and cervical ribs with bilobed anterior process. The phylogenetic analysis shows that *Lajasvenator* has the following unique combination of features: premaxilla ventral to external naris has a height/length ratio less than 0.5 (character 2); paradental plates with striated or ridged surfaces (character 140); relatively small premaxillary teeth (character 152); cervical vertebrae with a distinct rim on each anterior articular surface (character 175) (all characters are also present in some megalosaurs); and ilium with straight dorsal margin (also in some basal theropods).

4. Description

The holotype (MLL-PV-005) consists in an adult individual based on the complete fusion of neural arches with their respective central along the preserved vertebral elements. The partial skull was lying on its left side and was upside down in relation to the hips and posterior dorsal

vertebrae. The neck was twisted downwards so that the distal elements of the cervical vertebrae and their ribs were recovered in articulation. The hips and posterior part of the abdomen were lying on the right side when the animal was buried, and most of the left side of this region was destroyed by erosion. This suggests that the animal was articulated when buried, and was in a modified death pose. It was collected from a heavily indurated, coarse-grained sandstone layer, and had been eroding for a long time before it was discovered and excavated.

Premaxilla. The left premaxilla is complete, whereas the right one lacks the supranarial process and the posterior end (Fig. 4). Both premaxillae were recovered in contact but were not fused with each other, or with the maxillae.

The external surface of the left premaxilla is somewhat weathered, but that of the right premaxilla is relatively smooth other than pitting for nutrient foramina (Fig. 4A). The subnarial body of the premaxilla is somewhat taller (43 mm) than long (41 mm anteroposteriorly, 43 mm obliquely between the front and back of the alveolar margin). There are four alveoli in each premaxilla. The last alveolus is positioned under the front of the external naris. The supranarial process arches high above the external naris and the posterior end is 90 mm above the alveolar margin of the maxilla. The external naris was clearly large (about 30 by 60 mm) with a posterodorsally inclined axis. On the left side, the premaxilla has a tapering, elongate posterodorsal, subnarial process, which is more clearly seen in medial view. It separates the maxilla from the narial margin and probably contacted the subnarial process of the nasal.

Maxilla. The anteroventral region of the left maxilla is preserved with the first seven alveoli (Table 1) (Fig. 4). The external surface of the bone is heavily weathered in most places. In areas where the outer surface is well-preserved, there are anteroventrally trending canals and deeply rugose texture that are characteristic of carcharodontosaurids like *Giganotosaurus* (MUCPv-CH-01) and *Mapusaurus* (MCF-PVPH-108), and abelisaurids like *Aucasaurus* (MCF-

PVPH-236). The anterior ramus is as long as it is deep, and extends beneath the posterior region of the external naris. Neither the posterodorsal (lacrimal) process nor the interfenestral region is preserved. However, depressions in the dorsal surface of the palatal shelf show that there were pneumatic excavations in the anterior ramus. A curved edge on the medial surface of the anterior border of the antorbital fossa presumably marks the position of the promaxillary fenestra. However, because the posteromedial margin of the promaxillary fenestra is not preserved, it is impossible to know if the fenestra was exposed in lateral view. The ventral margins of the antorbital fossa and fenestra seem to coincide in the posterior region of the preserved part of the left maxilla. The interdental plates are texturally distinct from the medial alveolar margin, and have patterns of vertical ridges and grooves. The first interdental plate is small and low (9 mm), but subsequent ones increase progressively in height. The tallest plate (25 mm) is between the fourth and fifth alveoli. Posterior to this one, they are fused into a continuous plate that decreases steadily in height. The fused interdental plates resemble those of *Acrocanthosaurus* (Eddy and Clark, 2011), *Carcharodontosaurus* (Stromer, 1931), *Eocarcharia* (Sereno and Brusatte, 2008), *Giganotosaurus* (MUCPv-CH-1), *Mapusaurus* (MCF-PVPH-108, Coria and Currie, 2006) and other carcharodontosaurids, but also abelisaurids (Lamanna et al., 2002; Sampson and Witmer, 2007), *Allosaurus* (Madsen, 1976), *Ceratosaurus* (Madsen and Welles, 2000), dromaeosaurids (Currie, 1995), *Torvosaurus* (Britt, 1991) and many other theropods.

Quadratojugal. MLL-Pv-007 includes a nearly complete right quadratojugal (Fig. 5).

It has an “L” shape, with dorsal and anterior rami forming a 90° angle. The dorsal ramus lacks the distal end, but it is more slender and thinner than that in *Allosaurus* (Madsen, 1976). The posterior side of the dorsal ramus has a shallow depression that would have formed the anterolateral border of a large quadratic fenestra. On the medial surface of the quadratojugal, below the quadratic fenestra, is a tall, rugose facet that would have contacted the lower end of the quadrate (Fig. 5C). The ventroposterior end of the quadratojugal is shallowly convex with a small

notch that would have exposed a small ventrolateral surface of the quadrate. The anterior ramus is wide at its base and tapers anteriorly to a single point that would have been wedged between two posterior prongs of the jugal as in *Acrocanthosaurus* (Currie and Carpenter, 2000) and *Sinraptor* (Currie and Zhao, 1993). However, unlike the latter, there was no contact for the third, medial quadratojugal process of the jugal. The sutures for the two prongs of the jugal clearly show that the upper prong was restricted to the front of the quadratojugal on the dorsal edge, whereas the lower prong would have been largely overlapped laterally by the quadratojugal but extended almost to the quadrate suture.

Vomers. The anterior parts of the vomers are fused to form a thick midline ridge (17 mm tall) on the roof of the mouth (Fig. 4D). They contact the premaxillae on the midline anteriorly, and are held in place posteriorly by the anteriorly tapering anteromedial processes of the maxillae. The width of the vomer is 12 mm and seems to be constant throughout the preserved part of the bone. This suggests that the narial region of the animal was narrow.

Dentary. Partial dentaries are preserved in the two known specimens of *Lajasvenator*. MLL-Pv-007 includes the anterior ends of both dentaries, although the right side is slightly more complete (Fig. 6).

The symphysial ends of *Lajasvenator* have the typical squared-off profile of carcharodontosaurids, and each has an anteroventral chin-like process (Brusatte and Sereno, 2007; Calvo and Coria, 2000; Currie and Carpenter, 2000; Eddy and Clarke, 2011). The lateral surfaces of the dentaries are lightly sculptured by grooves and foramina. The first three neurovascular foramina are close to the dorsolateral edge of the lateral surface, but are not within a neurovascular groove as they are in *Acrocanthosaurus* (Eddy and Clarke, 2011). However, there is an anteroposteriorly oriented groove on the ventral edge of the lateral side. It is suspected that the anterior end of the dorsal neurovascular groove may have been behind the fourth alveolus as it

is in *Giganotosaurus* (Calvo and Coria, 2000). In medial view, the proximal end of the Meckelian groove (Figs. 6D and E) reaches the level between the second and third dentary teeth. The first three interdental plates are triangular and did not contact each other (Fig. 6E). However, this may have been an age- or size-specific character because the anterior interdental plates of one of the smaller specimens of *Mapusaurus* (MCF-PVPH-108.125, Coria and Currie 2006, fig. 8D) and *Giganotosaurus* (MUCPv-CH-01) are also unfused. Only external sections of three dentary tooth crowns (second to fourth) are preserved with the right dentary, although the root of the first dentary tooth can be seen in the broken anterodorsal corner of the bone. Only part of the first tooth crown is represented on the left dentary, although at least two more alveoli are present with broken tooth roots.

MLL-Pv-005 includes the posteroventral end of the left dentary (Fig. 7). The fragment is a mediolaterally thin and dorsoventrally deep lamina that is invaded by a distinct oval anterior extension of the mandibular fenestra on the ventroposterior border. Below the mandibular fenestra, the ventral border of the dentary is gently convex, wrapping around the ventral edges of the splenial and probably the angular.

Splenial. Part of the posterior ramus of the left splenial of MLL-Pv-005 is preserved in articulation with the medial side of the dentary, which bears a forked end for the articulation with the angular (Fig. 8).

The long slender shape of the posteroventral process is similar to that of *Mapusaurus* (MCF-PVPH-108.179), which also forks (Coria and Currie 2006, fig. 9), although at a relatively more anterior level. The elongate, distally forked process is also found in *Acrocanthosaurus* (Eddy and Clarke, 2011). The posterodorsal process is rather square in contrast with the triangular process seen in most theropods.

Teeth. Alveoli in the holotype show that there were four premaxillary teeth and at least seven maxillary teeth (Table 1).

Three premaxillary teeth are preserved in their sockets; two in the right premaxilla, which occupy the third and fourth positions, and one in the left premaxilla that occupies the fourth position. Each is lateromedially compressed and gently curved. However, each of the three teeth is oval in basal outline.

Predepositional weathering has made details of the carinae and denticulation hard to see. The anterior carina of the third premaxillary tooth on the right side is offset to the medial side of the crown (so that the tooth is J-shaped in cross-section) and extends at least half the height of the crown. Under high magnification, barely discernible denticulation suggests there were 2.7 anterior denticles per millimeter in the apical third of the tooth. The posterior carina has about three low denticles per millimeter. The enamel of the crown is smooth, and lacks any longitudinal ridging, striations or crenulations. The alveoli suggest that the first premaxillary tooth was the smallest, followed by the second. The third premaxillary tooth was the largest, and the fourth is only slightly smaller. Alveolar size shows that the first maxillary tooth was about the size of the posterior premaxillary teeth, and that the fifth maxillary tooth would have been the largest tooth. Maxillary teeth must have been quite bladelike because the widths of the maxillary alveoli are only about 40% their anteroposterior lengths.

The dentary teeth of MLL-Pv-007 are poorly preserved (Fig. 6B and E). Nevertheless, a few of the serrations can be seen on the posterior carinae of the second and third, right dentary teeth. The third dentary tooth has a base that is longer anteroposteriorly than wide, and is apically curved.

Postcranial

248 The *Lajasvenator* vertebral column is incomplete and represented by articulated partial
249 series of five cervical, nine dorsal, three sacral and four caudal vertebrae (Table 2).

The most anterior are an articulated series of five vertebrae and ribs (Fig. 9). Based on comparisons with *Allosaurus* (Madsen, 1976) and *Neovenator* (Brusatte et al., 2008), they correspond to the 6^{th}, 7^{th}, 8^{th}, 9^{th} and 10^{th} presacral vertebrae (which are the last four cervicals and the first dorsal). The dorsal section is represented by an articulated series of the last nine vertebral centra. The sacrum is preserved partially from the second to the fourth sacral centra, whereas the tail is represented by four articulated mid-caudal vertebrae. None of the recovered ribs are fused to the vertebrae.

Cervical vertebrae: The four cervical centra have concave (anteroventrally and transversally) ventral surfaces between the parapophyses. They have hemispherical anterior intervertebral articulations, and strongly opisthocoelous posterior articular surfaces. Each of the preserved cervical vertebrae has epipophyses, but they are most prominent in the sixth cervical.

The most anterior element of the cervical series is identified as a sixth cervical vertebra (Fig. 10). It is largely destroyed by erosion, but still preserves most of the centrum and tips of both postzygapophyses. The centrum is longer than high and has deeply excavated lateral sides.

The parapophyses on the anteroventral margins of the centrum are well developed and extend ventrolaterally on short pedicles to a level lower than the anteromedial edge of the centrum (Fig. 10A and B). In anterior view (Fig. 10B), the broken surface anterior to the left parapophysis reveals that the interior of the centrum is camellate. Above each parapophysis there is an oval pleurocoel. The deeply concave posterior intervertebral articulation of the centrum is wider than high (Table 2). The postzygapophyses are posterodorsally oriented and have well-developed epipophyses represented as small horn-like processes that project posteriorly. The articular facets of the postzygapophyses face ventrolaterally. In dorsal view, the lateral edge of each postzygapophysis projects laterally as a pronounced wing-like process (lappet) with a convex outline. The dorsal surfaces of the postzygapophyses merge towards the midline and presumably there was a well-developed lamina that delimited a deep postspinal fossa that can be seen above the neural canal. There is no hyposphene.

The seventh cervical is virtually complete (Fig. 11). The centrum is slightly shorter than that of the sixth cervical (Table 2), but is wider at the midlength constriction. The pleurocoel above each parapophysis is subdivided by a thick septum into two openings. In anterior view, the prezygapophysial facets face dorsally and slightly anteromedially. The prezygodiapophysial lamina is well developed and extends anteriorly beyond the articular facet as a distinct anterior process. This seems to be an autapomorphic character.

On the left side, the wall of the supporting ridge has collapsed to expose the camellate condition of the prezygapophysis. The articular facet of the prezygapophysis extends both laterally and medially on distinct lappets. In anterior view, the prezygodiapophysial lamina merges ventromedially with the centroprezygapophyseal lamina. The prespinal fossa is deep and ventrally limited by intraprezygapophyseal laminae, which also roof deep anterior peduncular pleurocoels, one on each side of a midline lamina. In lateral view, the diapophysis is supported by the anterior and posterior centrodiapophysial laminae that separate the infraprezygapophysial, infradiapophysial and infrapostzygapophysial fossae. All three fossae are deep and probably extend into the inside of the bone through pneumatopores. In ventral view, there are distinct lateral and medial lappets that extend the articular surfaces of the postzygapophyses. In posterior view, the intrapostzygapophysial laminae form a V-shaped ventral boundary for the postspinal fossa, and roof over a pair of posterior peduncular pleurocoels. The interspinal ligament scarring covers distinct facets on the anterior and posterior surfaces of the neural spine. There is neither a hyposphene nor a hypantrum.

In most features, the eighth cervical vertebra is similar to the preceding vertebra although is slightly larger in most dimensions (Fig. 12). There are no peduncular pleurocoels. The anterior prong beneath the prezygapophyses is more pronounced and there is a conspicuous hemihyposphene beneath each postzygapophysis.

297 The ninth cervical centrum is marginally larger than its predecessor (Fig. 13). Like the other
298 preserved cervicals, it has a broad, relatively flat ventral surface that is nevertheless slightly concave
299 between the parapophyses, and slightly convex posteriorly. There is a low, barely conspicuous midline
300 ridge behind the level of the parapophyses. The hypantrum is well-developed between the
301 prezygapophyses, and the interspinous ligament scar extends from the hypantrum to almost the tip of the
302 neural spine.

303 There is neither a prespinal fossa, nor anterior peduncular pleurocoels. The prezygapophyses
304 only extend a short distance anterior to the transverse processes. The anterior edges of the
305 prezygapophyses are not well preserved, but seem to lack the distinctive anterior prongs seen on the two
306 preceding vertebrae. Posteriorly, the interspinous scar occupies most of the posterior surface of the neural
307 spine and there is no postspinal fossa. The postzygapophysis on the left side is damaged laterally, but the
308 one on the right side extends laterally with a distinct epipophysial process that is continuous with the
309 lateral lappet. The hyposphene articulations are no longer separate, but are connected near the neural
310 spine by a lamina that is ventrally depressed on the midline. There are no posterior peduncular
311 pleurocoels.

312 Only the anterior part of the first dorsal (presacral 10) is preserved, including most of the neural
313 arch (Fig. 14).

314 The postzygapophyses and the posterior half of the centrum are missing. The anterior
315 intervertebral articulation of the centrum is markedly less convex than it is in the preceding cervicals. The
316 parapophyses are midheight on the centrum, and unlike the situation in the cervicals, the ventral edge of
317 the anterior intervertebral articulation is below the rib articulations. There appears to have been a weak
318 hypapophysis on the midline, and it is strongly offset from the lateral sides of the centrum by deep
319 depressions. The hypapophysis extends posteriorly as a ventral, midline ridge. There is a large
320 pneumatopore behind the parapophysis. A ridge on the lateral side of the base of the neural spine extends

to the posterodorsal tip of the diapophysis. The latter seems to roof over a complex network of laminae and pneumatic sinuses that extend into the base of the neural spine.

The last nine dorsal vertebrae of MLL-Pv-005 are preserved in articulation, although their left sides, the neural arches, and some of the midsections (dorsals 15, 19, 23) of the centra were destroyed by erosion (Fig. 15).

The ends of the right diapophyses of the 18th to 22nd presacrals were preserved in position, although the shafts of transverse processes were all destroyed by erosion. They were, however, represented by impressions in the rock. The amphiplatyan centra of all of these dorsals are strongly waisted, similar to other small allosauroids (Malafaia et al., 2016). This is most extreme in presacrals 16 to 18 (Table 2) in which the ventral surfaces of the centra narrow into sharp medial ridges. None of these centra appear to have had pneumatopores. The transverse processes are elongate rectangles that project laterally, dorsally and slightly posteriorly. The ventral surfaces of the distal regions of at least the 19th to 21st transverse processes have what are presumed to be pneumatic fossae.

Parts of three fused sacral vertebrae were recovered with MLL-PV-005. The anterior and posterior vertebrae of the triad are incomplete. However, the arrangement of transverse processes and sacral ribs suggests that these are the second, third and fourth sacrals. The centrum of the third sacral is approximately 68 mm long, and is pierced on both sides by pneumatopores with diameters of more than a centimeter. The sacral rib attachments between the second/third, and third/fourth centra are fused to the centra, although the sutures are still visible. The transverse processes of the third and fourth sacral vertebrae sweep outwards and backwards. The neural arches are broken, but the bases are thin and bladelike.

Four articulated caudal vertebrae were recovered (one represented by only the postzygapophyses and part of the neural spine) (Fig. 16).

The three well-preserved caudals have conspicuous, wide transverse processes and must be from the middle of the tail. Transverse processes can go far back in caudals of carcharodontosaurids -- at least 30 in *Acrocanthosaurus* (Harris, 1998) – but the sizes of the transverse processes and the dimensions of the central suggest that the caudals of MLL-Pv-005 are probably from the region of the 15th to 20th caudals. Presumably the caudals between the sacrum and this section were present when the animal was buried because their alignment follows a natural curve from the hips that would be appropriate for a typical death pose with the tail curved forwards dorsal to the hips. However, the caudal vertebrae did not continue in the rock beyond this preserved section of four vertebrae. None of the preserved caudal centra has a ventral midline sulcus, nor is there any evidence of pleurocoels. The absence of a sulcus is characteristic of *Neovenator* and derived carcharodontosaurids (Brusatte et al., 2008), whereas it is present in *Veterupristisaurus* (Rauhut, 2011) and *Concavenator* (Ortega et al., 2010). The facets for the haemal arches seem to be equally developed on the front and back of each centrum. The neural arch is indistinguishably fused to the centrum in each of the caudals, and is taller than the height of the centrum (Table 2). The neural spine inclines dorsoposteriorly so that the distal (dorsal) end is positioned above the front of the succeeding vertebra. The midline ridge of the neural spine extends forward until it rises into a small but distinct spinous process (accessory neural spine) as in *Acrocanthosaurus* (Currie and Carpenter, 2000; Harris, 1998; Stovall and Langston, 1950), *Allosaurus* (Gilmore, 1920), *Dubreuillosaurus* (Allain, 2005), *Mapusaurus* (Coria and Currie, 2006), *Sinosauropteryx* (Currie and Chen, 2001) and a few other theropods. However, accessory neural spines have been reported in rauisuchians (Franca et al., 2011) and probably have little taxonomic utility. The prezygapophyses are relatively elongate, and extend somewhat more than a third of the length of the preceding centrum. Articular facets on the zygapophyses are nearly vertical in orientation. The transverse process of the second preserved caudal is split into a double process. It is assumed that this represents a pathological condition because the transverse processes of the following two vertebrae are more typical rectangular plates that are orientated laterally and slightly posteriorly.

MLL-Pv-007 has only fragments of four vertebrae that were clearly articulated until they were mostly destroyed by erosion. They appear to be the ends of transverse processes from cervicals or anterior dorsals. The sizes of the processes and the degree of separation suggest they were from an animal about the same size as MLL-Pv-005.

The longest of the most anterior pair of preserved cervical ribs of MLL-Pv-005 consists of long and thin rods of bone, of which the one from the left side is 25,5 cm long. It probably represents most of the shaft of the fifth cervical rib. Nothing from the proximal end is preserved.

The next cervical ribs of the preserved series correspond to the sixth pair (Fig. 17).

The rib from the right side seems to be complete and is 26 cm long. It has a conspicuous, bilobed anterior process that is laterally compressed. In medial view, the articular facet of the capitulum is kidney-shaped and significantly larger than the facet of the tuberculum. Both capitulum and tuberculum are linked by a short lamina. The articular facets of the capitulum and tuberculum are separated by about 25 mm, and the anterolateral process extends about 18 mm in front of the capitulum. Although the anterolateral process is prominent, it is considered short because it does not extend anteriorly beyond the level of the lateral margin of the intervertebral articulation of the centrum. The shaft is proximally convex laterally and flattens distally. The shaft tapers distally until the diameter is less than 2 mm. On the mesial surface, ridges extend between the capitulum-anterior processes and the tuberculum-anterior process, but there is no evidence of pneumatopores in the depressions on either side of the body.

Each of the seventh pair of cervical ribs of MLL-Pv-005 was at least 25 cm long, based on the more complete right rib. The proximal end is dorsoventrally wider than any of the preceding ribs, and so is the bilobed anterolateral process. The capitulum and tuberculum articular facets are separated by 30 mm, and the anterolateral process extends 20 mm forward. Pneumatic recesses or pneumatopores excavate the base of the capitulum on the mesial surface. An incomplete right cervical rib of MLL-Pv-007

seems to be from a seventh cervical rib and shows a clear pneumatic recess behind the ridge joining the capitulum and tuberculum mesially. There is a pneumatopore anterior to that ridge.

The eighth cervical ribs are 22 cm long. The anterior process, which has fingerlike processes, projects 22 mm in front of the parapophyseal articulation. The capitulum and tuberculum articular facets are separated by 37 mm, and multiple pneumatopores penetrate the mesial depressions into the otherwise thick region between the two heads. The distal end of the shaft tapers to a diameter of 3 mm. The rib from the left side seems to have been broken and re-healed during life of the specimen.

The next pair of ribs is associated with the ninth cervical vertebra.. The distance between the articular facets of the capitulum and tuberculum is 31 mm on the left side, but is 43 mm on the right side. The ribs are 72 mm in length on the right side and 95 on the left side, but most of their shafts are missing. The anterior process of the right side projects 17 mm in front of the junction with the ventral head of the rib, and is bilobed anteriorly. There is a large pneumatopore on the inside of each of these ribs and another that faces anteriorly near the junction of the capitulum, tuberculum and anterior process.

Five of the last six dorsal ribs are preserved on the right side of MLL-Pv-005, and presumably represent presacral ribs 17, 18, 20, 21 and 22 (Fig. 18).

Presacral rib 17, which would be dorsal rib 8, is 35 cm long when measured along the outside curve between the tuberculum and distal end. The distal end tapers to 6 mm in diameter. Presacral rib 18 was broken but had healed while the animal was still alive. The distance between the capitulum and tuberculum measures about 8 cm. In spite of the fact that the adjacent vertebrae and ribs are in natural articulation, there is no sign of any part of rib 19. One can only assume that it was destroyed at the same time as most of the associated vertebra. Presacral ribs 20, 21 and 22 seem to be complete except possibly for their distal tips, and measure 25 cm, 21 cm and 17 cm respectively (capitulum to distal end in a straight line).

Up to a dozen fragments of ribs and several gastralia were recovered with ML-005, but provide little information. The thickest rib fragment, which is 20 cm long, has a minimum shaft diameter of 18 mm (mediolateral) by 14 mm (anteroposterior) and probably is from one of the first dorsal ribs.

Most of an anterior dorsal rib was recovered with MLL-Pv-007. It is about 24 cm long, and the minimum mediolateral shaft width is 21 mm. The separation between the capitular and tubercular articulations is 48 mm, which is close to what the separation is between the parapophysis and diapophysis of the first dorsal vertebra of MLL-Pv-005.

The right ilium is partially preserved, although it was split longitudinally by a crack that had been widened by erosion. Assuming that the two blocks that contained the ilium had not moved in relation to each other, then the distance between the ventral edge of the pubic peduncle and the top of the ilium is 220 mm. The upper edge of the bone is relatively straight in lateral view (Fig. 19).

As in most theropods, there are conspicuous but small vertical ridges (striations) on the medial surface near the edge of the bone (Fig.19B). A fragment of bone adhering to the medial surface is probably a remnant of the dorsal limit of the third sacral rib. None of the broken surfaces suggest that the bone was pneumatic as in *Mapusaurus* (Coria and Currie, 2006) or *Murusraptor* (Coria and Currie, 2016), although a relatively small portion of the ilium is preserved. A small fragment anteroventral to the main iliac fragment seems to be part of the preacetabular process, and suggests that it extended at least 17 cm in front of the anterior margin of the acetabulum, and well beyond the anterior edge of the pubic peduncle. The pubic peduncle is attached to the head of the pubis, but the contact is visible (especially on the lateral surface) which suggests that they were not coossified. The distal end of the peduncle is 86 mm long, and 41 mm wide. A lateral ridge starts on the edge of the acetabulum 34 mm above the pubic contact, and quickly expands the articular surface of the acetabulum to 54 mm. This is the base of the antitrochanteric shelf, which would have expanded even more broadly over the anterodorsal region of the femoral articulation.

439 The 18 cm long proximal fragment of the right pubis is attached to the pubic peduncle of the
440 ilium (Fig. 20).

441 It is evident from the orientations of its contacts with the ilium and ischium that the shaft of the
442 bone was almost perpendicular to the longitudinal axis of the ilium as in *Aerosteon* (Sereno et al., 2008),
443 *Murusraptor* (Coria and Currie, 2016) and *Concavenator* (Ortega et al., 2010). In this and other features,
444 it resembles the pubis of *Megaraptor* (Calvo et al., 2004) and *Murusraptor* (Coria and Currie, 2016). The
445 ischial peduncle is somewhat damaged, but clearly was low (41 mm) and short anteroposteriorly (48 mm
446 from the posterior margin of the pubic shaft). The pubis formed about 4 cm of the acetabular margin,
447 where it has a smooth dorsal surface that is 27 mm wide. The anteroposterior diameter of the pubic shaft
448 is 35 mm. The posterodorsal margin of the pubis below the ischial peduncle is similar to the typical
449 allosauroid condition and does not enclose an obturator foramen (Brusatte et al., 2008). On the medial
450 surface, the dorsal limit of the pubic apron is 107 mm from the contact with the ilium.

451 A small fragment of the ischium is attached to the ischial peduncle of the pubis. The puboischial
452 contact seems to have been vertical in orientation.

453 MLL-Pv-007 also includes fragments of the distal end of a metatarsal and other indeterminate
454 fragments. None of these provided any particularly useful information or measurements to this study.
455 However, there is also a complete basipodial element (Fig. 21).

456 In outline and most details, it most closely resembles either the radiale of *Allosaurus* (Gilmore 1920,
457 fig. 45) or the third right distal tarsal of *Sinraptor* (Currie and Zhao, 1993, fig. 24). The bone is 29 mm
458 long, 21 mm wide and up to 10 mm thick. Comparison of vertebral measurements suggests that
459 *Lajasvenator* was about half the size of either *Allosaurus* or *Sinraptor*. Given the variability in size of
460 theropod carpal and tarsal elements, the bone in question has roughly the right size to be either element (it
461 is 0.71 the size of USNM 4734, an *Allosaurus* radiale, and 0.38 the size of the *Sinraptor* distal tarsal 3 of
462 IVPP 10600).

5. Discussion

The phylogenetic relationships of *Lajasvenator* among theropods were analyzed using a character matrix composed of 367 cranial and postcranial features distributed among 67 theropod taxa. The character matrix used was based on that one proposed by Coria and Currie (2016), which in turn was taken, with some modifications, from previous contributions (Carrano et al., 2012; Zanno and Makovicky, 2013). That character set was extended with additional characters and taxa presented by Apesteguía et al., (2016) (see Supplementary Material A and B). The character matrix was analyzed using TNT version 1.5 (Goloboff and Catalano, 2016).

Preliminarily, the analysis resulted in 15200 MPTs with 1147 steps in length, with a CI = 0.372 and RI= 0.660. *Lajasvenator* is clearly nested in a basal position within Carcharodontosauridae, in an unsolved polytomy with *Concavenator* and *Eocarcharia* (Fig. 22) (Supplementary Material C).

Lajasvenator shares with *Concavenator* the presence of an accessory centrodiapophyseal lamina in each dorsal vertebra (character 182, unknown in *Eocarcharia*). On the other hand, *Lajasvenator* shares with giganotosaurines and *Carcharodontosaurus* a maxilla with a sculptured external surface (character 34). Like most carcharodontosaurids, there is an anteroventrally inclined anterior end of junction between medial wall and paradental plates in the maxilla (character 17, unknown in *Concavenator* and *Tyrannotitan*). *Lajasvenator* also shares several apomorphies with most allosauroids (except *Allosaurus*), including paradental plates that lack replacement grooves (character 138), camellate internal structure of pneumatic centra (character 160), cervical vertebrae that each have an anterior pleurocoel consisting of two openings oriented anteroventrally and posterodorsally (character 169), anteroposteriorly elongate cervical pleurocoels (character 170), and a pubic peduncle of the ilium that has a length to width ratio greater than 2 (character 272).

The presence of *Lajasvenator* in the Mulichinco Formation is significant because of the stratigraphic context of this unit. This new form represents the oldest record of Carcharodontosauridae in South America. The family has conspicuous diversity at younger levels of the Cretaceous, when it is represented by large-sized forms like *Giganotosaurus*, *Mapusaurus*, *Tyrannotitan* (Coria and Currie, 2006; Coria and Salgado, 1995; Novas et al, 2005) and indeterminate remains from Brazil (de Azevedo et al., 2013). *Taurovenator violantei* (Motta et al., 2016) is a recently described carcharodontosaurid taxon based on an isolated right postorbital. The autopomorphies proposed to support this taxon consist of the presence of a horn-like prominence on the orbital brow, and a deep excavation on the ventral surface of the postorbital. However, these features are present in *Mapusaurus* (MCF-PVPH-108.177) and, although less developed, are also in *Giganotosaurus* (MUCPv-CH-1). The holotype specimen MPCA PV 802 of *Taurovenator* also exhibits the ventrolateral curved lateral margin of the palpebral (Motta et al., 2016, figs. 4 and 5), a diagnostic feature proposed for *Mapusaurus roseae* (Coria and Currie, 2006). Considering that the holotype specimen of *Taurovenator* (MPCA PV 802) was collected at the same stratigraphic level as *Mapusaurus* (Huincul Formation), and that there are no further autopomorphies in that single postorbital, it seems more reasonably to consider *Taurovenator violantei* as junior synonym of *Mapusaurus roseae*.

Other Cretaceous carcharodontosaurid records are known from North America, Europe, Africa and Asia (*Acrocanthosaurus*, *Carcharodontosaurus*, *Concavenator*, *Eocarcharias*, *Sauroniops*, *Siamraptor* and *Shaochilong*) (Brusatte et al., 2009; Cau et al., 2013; Chokchaloemwong et al., 2019; D'Emic et al. 2012; Ortega et al., 2010; Sereno and Brusatte, 2008; Sereno et al., 1996). The Jurassic record of this clade is poorly represented by the African form *Veterupristisaurus milneri* from Tendaguru (Rauhut, 2011), although have been also referred to Carcharodontosauria some specimens collected from the Jurassic of Portugal (Malafaia et al., 2017, 2019), and possibly some teeth from the Middle–Upper Jurassic of the Shishugou Formation of China (Han et al., 2011), and from the Lower Saxony Basin of Germany (Gerke and Wings, 2016). Although no carcharodontosaurids have yet been recognized from the

Jurassic of South America, it is expected that this clade was present on this continent before the Cretaceous.

The faunal association of different dinosaur taxa collected from the Mulichinco Formation includes *Lajasvenator*, ornithopods, and diplodocid and dicraeosaurid sauropods (Coria et al., 2010, 2019; Gnaedinger et al., 2017). The association is, up to certain point, comparable with that known from the Jurassic of Tendaguru (Janensch, 1914; Rauhut, 2011; Remes, 2004). Although the available fossil evidence is not conclusive, it is conceivable that some Jurassic dinosaur associations may have survived into Early Cretaceous times. Such a Cretaceous association – formed by dicraeosaurids, diplodocids, carcharodontosaurid theropods and non-hadrosaurian ornithopods – has to date only been recognized in the Valanginian of Patagonia. An Early Cretaceous dinosaur association with strong Jurassic roots preceded the drastic faunal turnover represented by the extinction of these ancient linages and the diversification of titanosaur sauropods and abelisaur theropods occurred in the Turonian of South America (Coria and Salgado, 2005).

6. Concluding Remarks

The diversity of South American dinosaurs is increased by the first Valanginian record of a carcharodontosaurid theropod, Lajasvenator ascheriae.

Lajasvenator is also the oldest South American carcharodontosaurid record, suggesting that the evolutionary history of the clade likely has older roots than was thought.

Carcharodontosaurids are typically associated with large predator forms from the Upper Cretaceous Gondwanan beds, and in some way, were considered as ecological equivalents to the Laurasian tyrannosauroids. The new taxon, Lajasvenator ascheriae, is based on a medium-sized adult individual, indicating that Carcharodontosauride, as a group, is more diverse than previously considered.

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764

765

766 **FIGURE CAPTIONS**

767

768 Figure 1. Restoration of *Lajasvenator ascheriae* showing which bones have been collected.

769

770 Figure 2. Location map showing provenance of specimens MLL-PV-005 and MLL-PV-007 (after Coria et
771 al., 2019). Quarries indicated by the arrow.

772

773 Figure 3. Stratigraphical section and geological provenance of *Lajasvenator ascheriae* remains (modified
774 from Coria et al., 2019).

775

776 Figure 4. *Lajasvenator ascheriae*, Holotype, MLL-PV-005. Premaxillae and maxilla in A) left lateral, B)
777 right lateral, C) anterior and D) ventral views. Abbreviations: mx, maxilla; pmx, premaxilla; snp,
778 supranarial process; v, vomers. Scale bar: 10 cm.

779

780 Figure 05. *Lajasvenator ascheriae*, MLL-Pv-007. Right quadratojugal in A) posterior, B) lateral, and C)
781 medial views. Abbreviations: ljs, suture for lower prong of jugal; qf, limits of border of quadratic fenestra
782 formed by quadratojugal; qs, quadrate suture; ujs, range of suture of upper prong of jugal. Scale bar: 10
783 cm.

784

785 Figure 6. *Lajasvenator ascheriae*, MLL-Pv-007. Anterior ends of dentaries. Left dentary in A) lateral and
786 D) medial views; right dentary in B) lateral, C) dorsal and E) medial views. Tooth crowns seen on the
787 right side in dt2 and dt3, wheras broken roots are visible in dt1 and dt4. On the left side, part of the crown
788 is visible in dt1, and broken roots can be seen in dt2 and dt3. Abbreviations: ch, chin-like process; dt1 to
789 dt4, dentary tooth positions; id, interdental plate; mg, Meckelian groove. Scale bar: 5 cm.

790

791 Figure 7. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Left dentary in lateral view. Abbreviation: mf,
792 mandibular fenestra. Scale bar: 10 cm.

793

Figure 8. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Left splenial in medial view. Abbreviation: aa, articulation for the angular. Scale bar: 10 cm.

Figure 9. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Last four cervical vertebrae, first dorsal vertebra, and ribs in articulation as found in left lateral view. Abbreviations: 6^{th} to 10^{th}, sixth to tenth cervical vertebrae; $r5^{th}$ to $r10^{th}$, fifth to tenth cervical ribs. Scale bar: 10 cm.

Figure 10. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Sixth cervical vertebra in A) left lateral, B) anterior, C) posterior, and D) ventral views. Abbreviations: c, anterior articular surface of centrum; pp, parapophysis. Scale bar: 10 cm.

Figure 11. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Seventh cervical vertebra in A-A') left lateral, B-B') anterior, C-C') posterior, D-D') dorsal, and E-E') ventral views. A-E, photographs; A'-E', line drawings. Abbreviations: dp, diapophysis; ep, epipophysis; ns, neural spine; pl, pleurocoel; prz, prezygapophysis; pz, postzygapophysis. Scale bar: 10 cm.

Figure 12. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Eight cervical vertebra in A-A') left lateral, B-B') anterior, C-C') posterior, E-E') dorsal, and D-D') ventral views. A-D, photographs; A'-D', line drawings. Abbreviations: as in Fig.11. Scale bar: 10 cm.

Figure 13. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Ninth cervical vertebra in A-A') left lateral, B-B') anterior, C-C') posterior, E-E') dorsal, and D-D') ventral views. A-D, photographs; A'-D', line drawings. Abbreviations: as in Fig.11. Scale bar: 10 cm.

Figure 14. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Tenth presacral vertebra (Dorsal 1) in A-A') left lateral, B-B') anterior, C-C') posterior, E-E') dorsal, and D-D') ventral views. A-D, photographs; A'-D', line drawings. Abbreviations: as in Fig.11. Scale bar: 10 cm.

Figure 15. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Articulated series of dorsal centra in right ventrolateral view. Abbreviations: 15^{th}, fifteenth presacral vertebra; 23^{th}, twentyeighth presacral vertebra; dp, diapophysis. Scale bar: 10 cm.

Figure 16. *Lajasvenator ascheriaee*, Holotype, MLL-Pv-005. Mid-caudal vertebrae in A) lateral, and B) ventral views. Abbreviations: c, vertebral centrum; prz, prezygapophysis; ns, neural spine; sp, spinous process; tp, transverse process. Scale bar: 10 cm.

Figure 17. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Left cervical ribs in lateral view. Abbreviations: 6cr-9cr, sixth to ninth cervical rib; bap, bilobed anterior process. Scale bar: 10 cm.

Figure 18. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Left dorsal ribs in lateral view. Abbreviations: 8dr-13dr, eighth to thirteenth dorsal rib. Scale bar: 10 cm.

Figure 19. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Pelvic elements in A) right lateral and B) right medial views. Abbreviations: ib, iliac blade; is, ischium; p, pubis; pa, pubic apron; ppc, pubic pedicel; prp; preacetabular process: sr, sacral rib. Scale bar: 10 cm.

Figure 20. *Lajasvenator ascheriae*, Holotype, MLL-Pv-005. Ilium and pubis articulation in A) right lateral, B) posterior, and C) right medial views. Abbreviations: ac, acetabulum; il, ilium; is, ischium; pa; pubic apron. Scale bar: 10 cm.

Fig. 21. *Lajasvenator ascheriae*, MLL-Pv-007. Possible carpal/tarsal in A) dorsal, B) ventral; C) anterior, and D) posterior views. Scale bar: 1 cm.

Fig. 22. Simplified cladogram depicting the phylogenetic relationships of *Lajasvenator ascheriae* within Carcharodontosauridae.

Tooth	DHmin	CHJM	CHPC	FABL	AntDent	PostDent	BW	BW/FABL	AL	AW	AW/AL
Pmx 1 R	?	?	?	?	?	?	?	?	9.1	7.1	0.78
Pmx 1 L	?	?	?	?	?	?	?	?	9.2	6.5	0.71
Pmx 2 L	?	?	?	?	?	?	?	?	11.4	5.7	0.50
Pmx 3 R	?	25.7	20.9	10.1	2.7	3	6.2	0.61	12	7.1	0.59
Pmx 4 R	?	10.2	?	5.8	?	?	4.7	0.81	10.3	6.1	0.59
Pmx 4 L	?	25plus	?	8.5	?	?	6.4	0.75	?	?	?
Mx 1 L	?	?	?	?	?	?	?	?	10.7	4.8	0.45
Mx 2 L	?	?	?	?	?	?	?	?	13.4	6	0.45
Mx 3 R	?	?	?	?	?	?	?	?	15.6	6	0.38
Mx 3 L	?	?	?	?	?	?	?	?	16.8	6.4	0.38
Mx 4 R	?	?	?	?	?	?	?	?	13plus	?	?
Mx 4 L	?	?	?	?	?	?	?	?	17.1	7.2	0.42
Mx 5 L	?	?	?	?	?	?	?	?	20.8	8.1	0.39
Mx 6 L	?	?	?	?	?	?	?	?	18.3	7.4	0.40
Mx 7 L	?	?	?	?	?	?	?	?	10plus	?	?
D 1 R	53.2	?	?	?	?	?	?	?	?	5.1	?
D 1 L	53.2	?	?	?	?	?	?	?	8.1	4.3	0.40
D 2 R	53.2	13plus	?	14.2	?	?	6.4	0.45	14.5	7.1	0.49
D 2 L	53.2	?	?	?	?	?	?	?	11.7	?	?
D 3 R	53.2	?	?	?	?	?	?	?	14.7	6.8	0.46
D 3 L	53.2	?	?	?	?	?	?	?	14.3	6.1	0.40
D 4 R	53.2	?	?	?	?	?	?	?	?	5.1plus	?
D 4 L	53.2	?	?	?	?	?	?	?	?	6plus	?

D 4 L	53,2	?	?	?	?	?	?	?	?	6plus	?

Table 1. Teeth and alveoli measurements of *Lajasvenator ascherieae*. Premaxillary and maxillary teeth from specimen MLL-Pv-005, Holotype; dentary teeth from specimen MLL-Pv-007. Abbreviations: ?, unknown; AL, anteroposterior length of alveolus; AW, transverse alveolus width; AntDent, number of anterior denticles per mm; BW, basal width of crown; D, dentary tooth; DHmin, minimum height of dentary; CHJM, crown height from the jaw margin, CHPC, crown height along posterior carina; FABL, fore-aft basal length; L, left; Mx, maxillary tooth; Pmx, premaxillary tooth; PostDent, number of posterior denticles per mm; R, right. All measurements in mm.

	clnas	clv	clwc	caww	cah	cpw	cph	cnw	th	nsh	nmdl	wap	wapz	llppz	watp	wapp
6	82	81	102	57	64	61.5	59.8	29	?	?	?	?	83est	?	?	60.6
7	66.8	72	90	63	36	62.3	47.8	30.5	126.5	66.5	29	74	71.6	109.6	128	66
8	65	69.5	103	48	43	65	47	32.1	129	68	30	68.8	69	86.4	134	71.3
9	62	65.1	92	59	40.5	68.5	48.9	34.2	128.3	64.7	21	70	74	66	144.4	66.6
10	?	?	?	59.5	44plus	?	?	?	124plus	69.2	17	73.7	?	?	150	59.4
15	47plus	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
16	70.5	71	?	61.5	59est	60.6	58est	14.4	?	?	?	?	?	?	?	?
17	71.4	64.9	?	63.4	53plus	53.6	56.3	15.5	?	?	?	?	?	?	?	?
18	72.6	65.6	?	49	52.3	55	60.6	15.3	?	?	?	?	?	?	164est	?
19	?	?	?	?	?	?	86	?	?	?	?	?	?	?	160est	?
20	68	68.7	?	53plus	88.3	65.7	77.2	16plus	?	?	?	?	?	?	160est	?
21	74.2	70.1	?	70	82.3	70.5	79.4	25	?	?	?	?	?	?	156	49
22	71.3	67.5	?	75.6	80.4	66plus	83	27.1	?	?	?	?	?	?	124plus	54.3
23	?	?	?	?	93.6	?	?	27	?	?	?	?	?	?	?	?
S2	?	59plus	?	?	?	?	?	32	?	?	?	?	?	?	?	?
S3	?	68	?	55	?	58	?	35	?	?	?	?	?	?	89	?
S4	?	35plus	?	58	?	58	?	?	?	?	?	?	?	?	60est	?
C15 ?	?	?	?	?	?	?	?	?	?	?	?	?	24.4	?	?	?
C16 ?	58plus	?	?	?	?	30.8	39.6	13	104	61	20.8	30.3	24.6	84	88est	?
C17 ?	65.5	66	?	31.6	34.7	33.6	41	14.2	99	58est	23	38	24.6	81	100	?
C18 ?	65.3	67	?	38.6	36	32.4	36	15.6	?	?	?	41	?	?	96.7	?

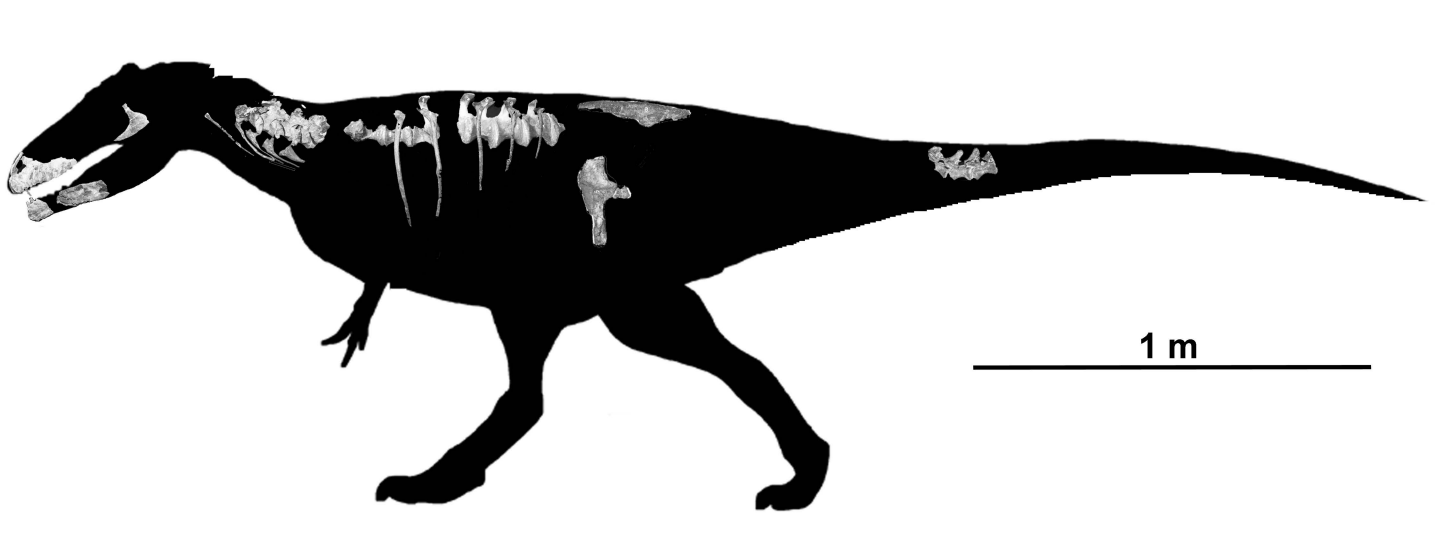
Table 2. *Lajasvenator ascherieae*, Holotype, specimen MLL-Pv-005. Table of vertebral measurements. Abbreviations; 6 to 23: presacral vertebrae 6th to 23rd; ?, unknown; C, caudal vertebrae; cah, centrum anterior height; caw, centrum anterior width; clnas, centrum length at neural arch suture; clv, centrum length at ventral side; clwc, centrum length with condyle; cnw, centrum narrowestr width; cph, centrum posterior height; cpw, centrum posterior width; est, estimated; lppz, length prezygapophyseis – postzygapophysis; nmdl, neural spine maximum distal

length; nsh, neural spine height above canal roof; S, sacral vertebrae; th, total height; wap, width across prezygapophyseis; wapp, width across parapophyses; wapz, width across postzygapophyses; watp, width across transverse processes. All measurements in mm.

A new genus and species of carcharodontosaurid theropod (*Lajasvenator ascheriae*) is described.

Lajasvenator is the oldest Cretaceous carcharodontosaurid record.

Lajasvenator represents the first Lower Cretaceous, South American carcharodontosaurid.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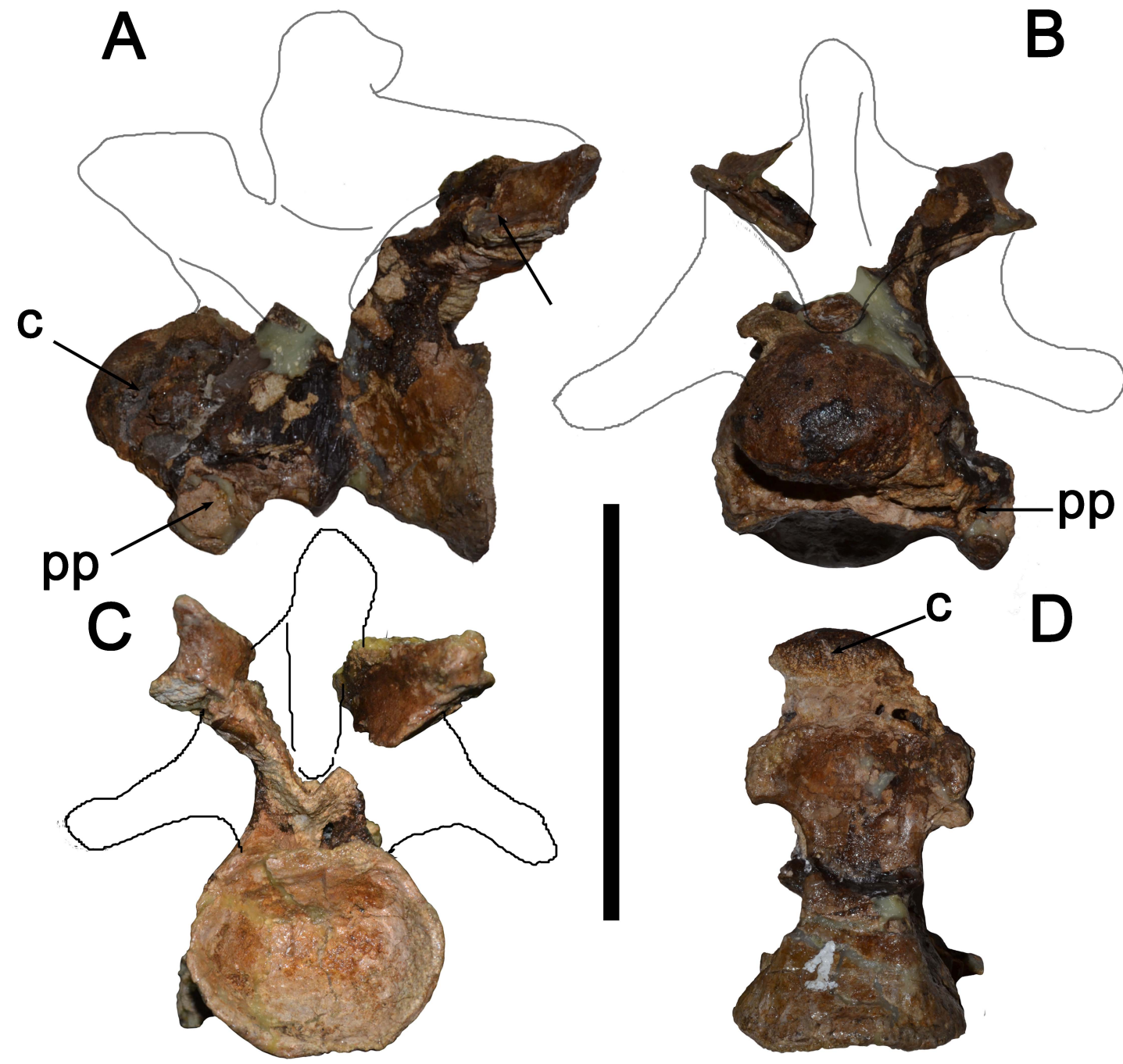
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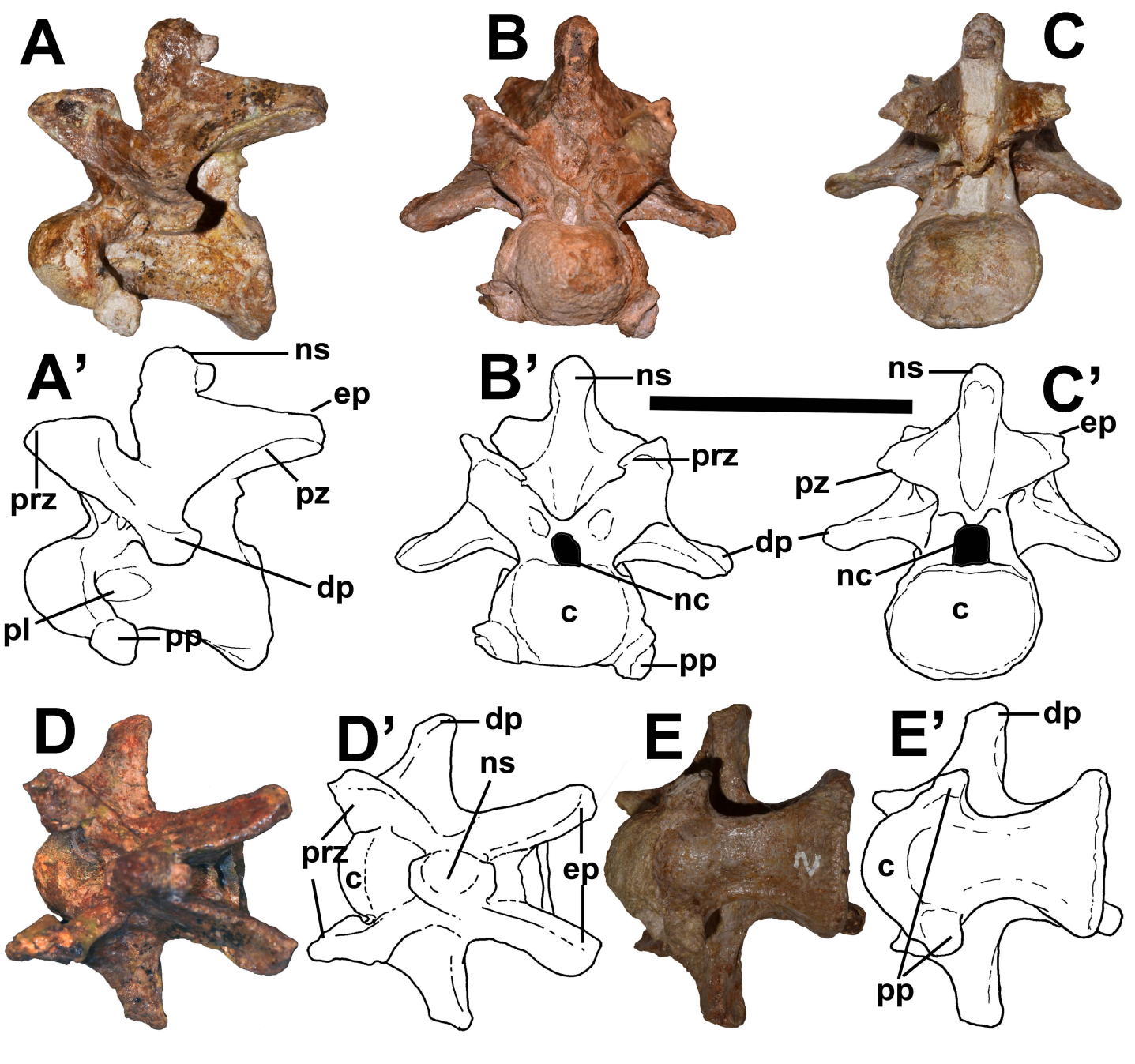
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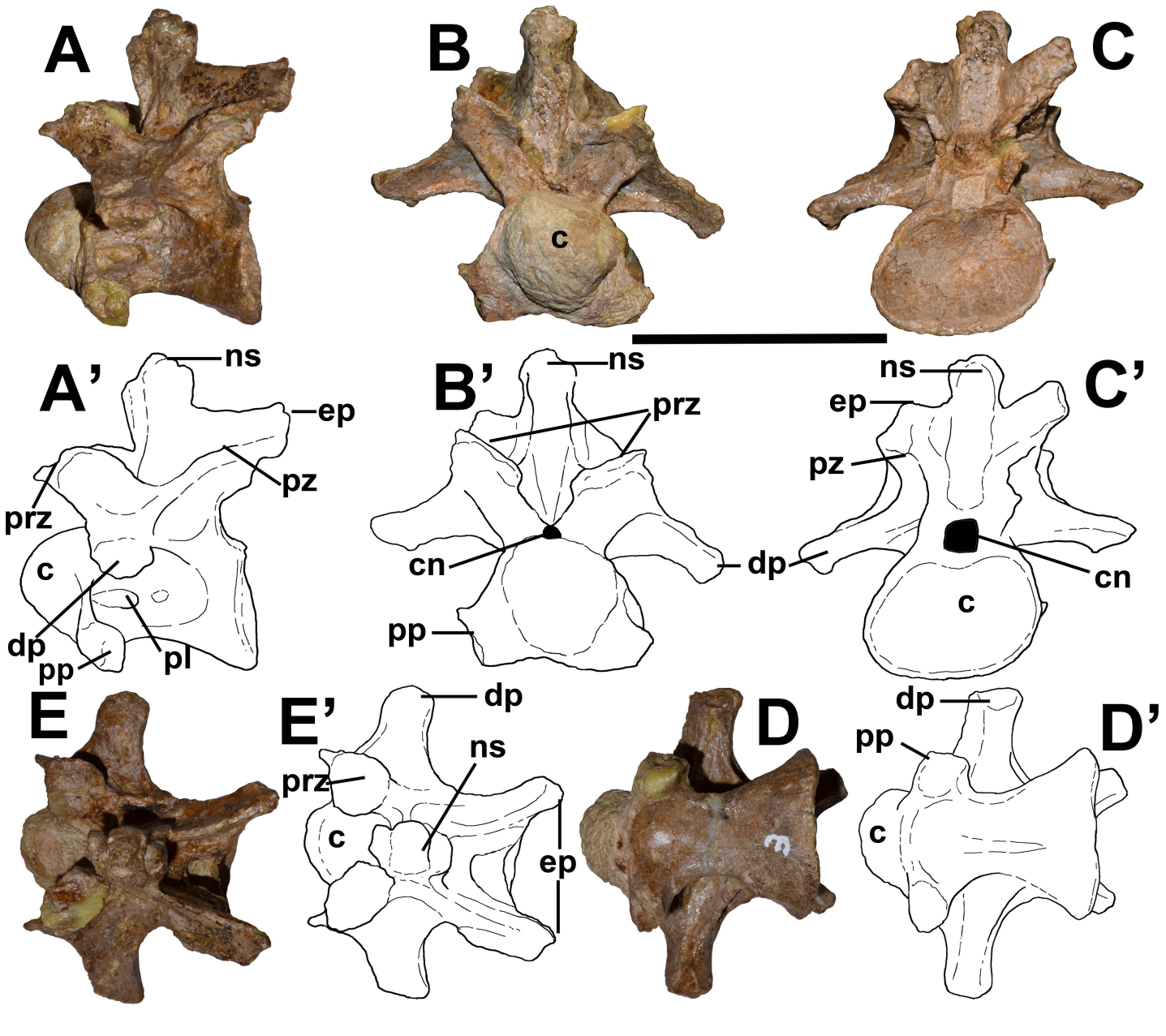
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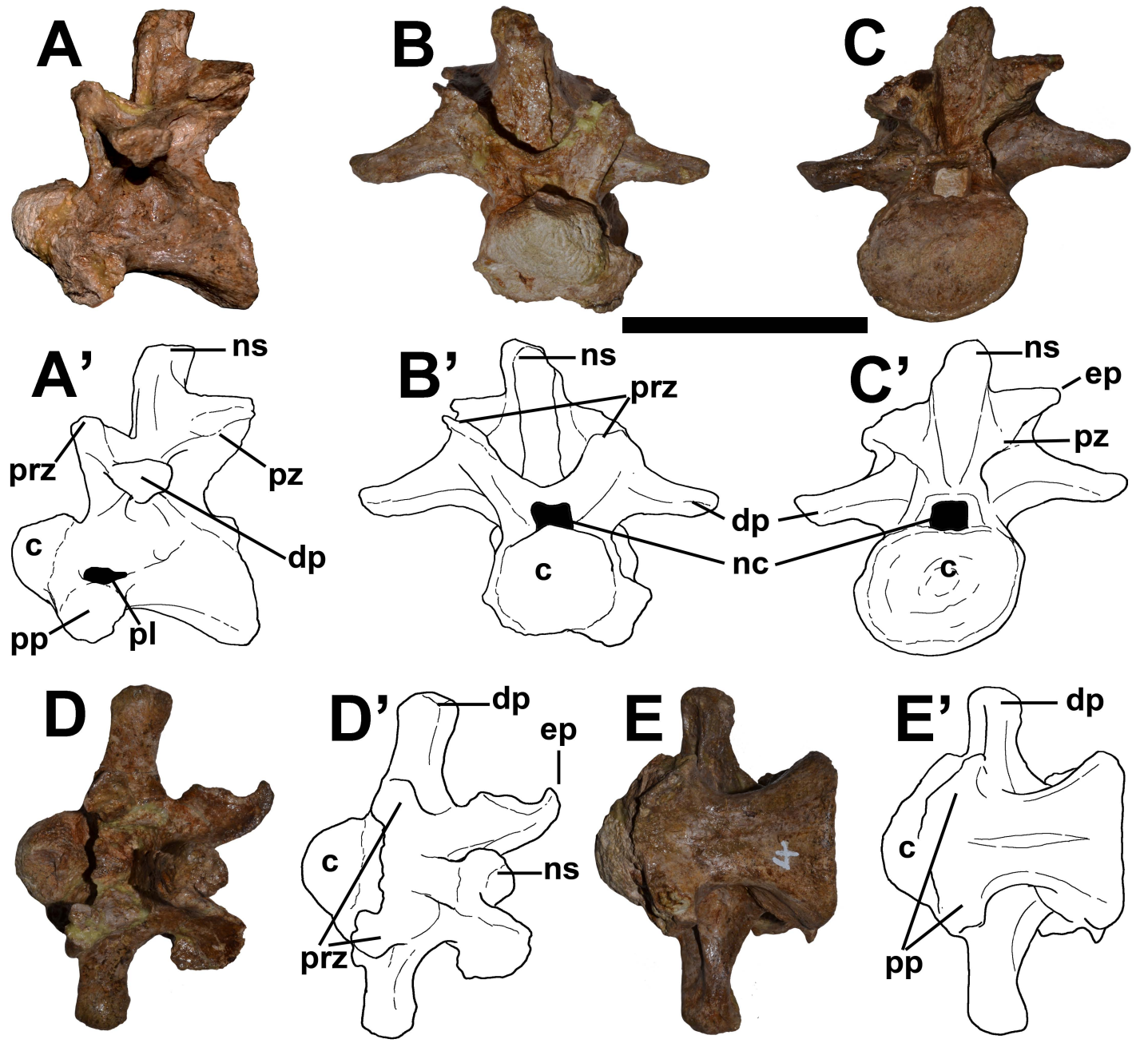
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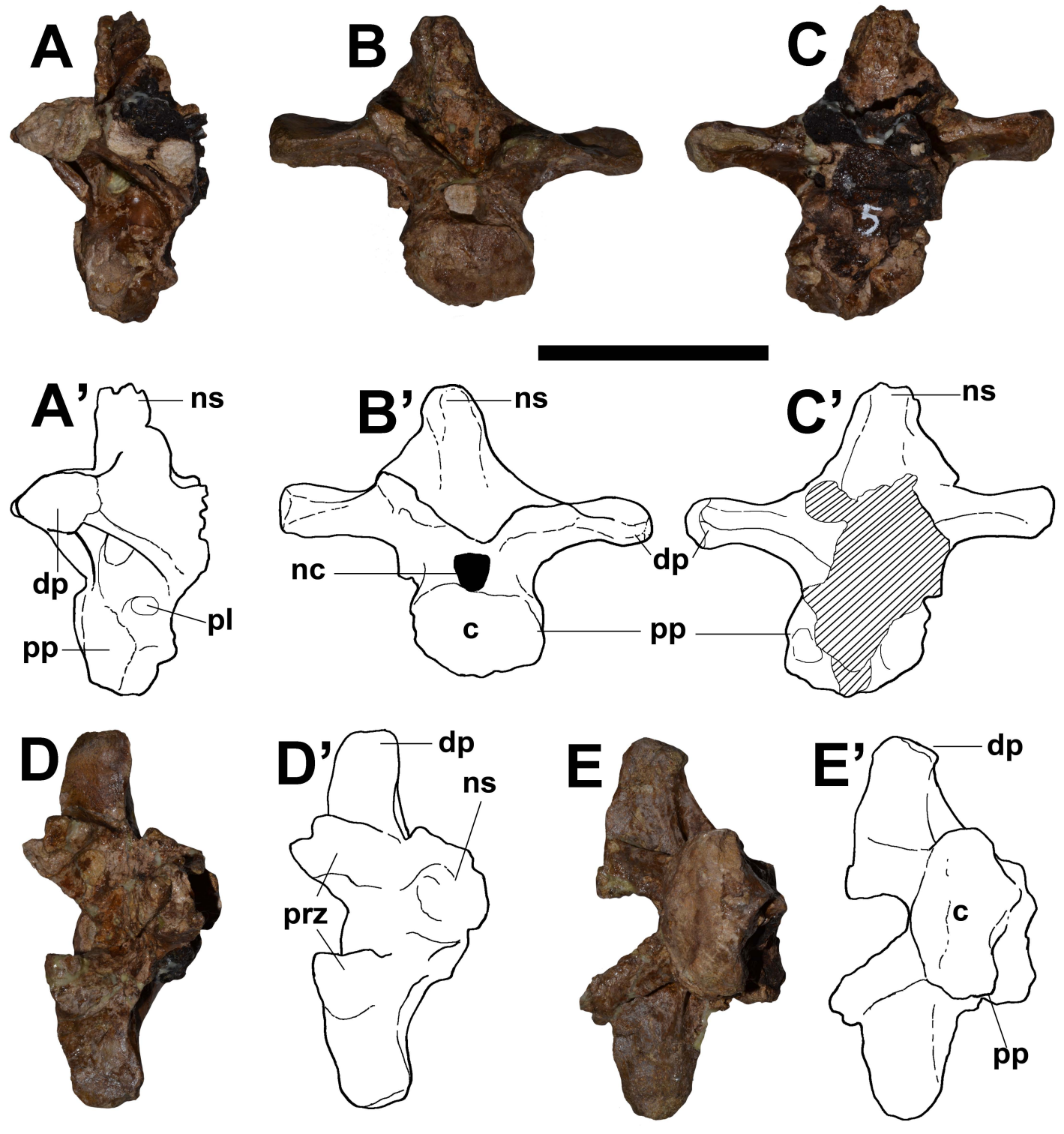
A
B
C
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A'
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dp
pl
pp
B'
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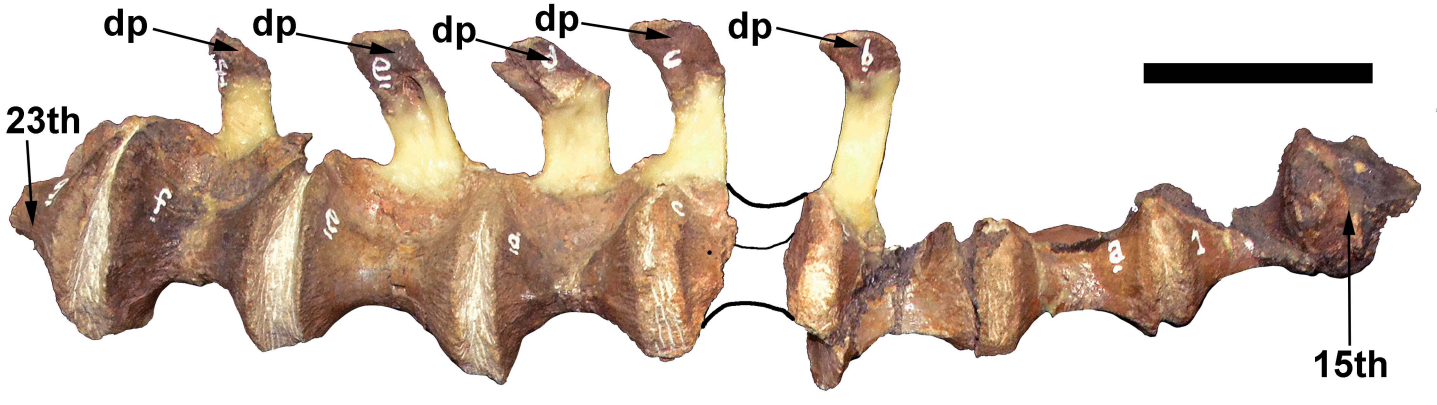
dp
pp
D
D'
dp
ns
prz
E
E'
dp
c
pp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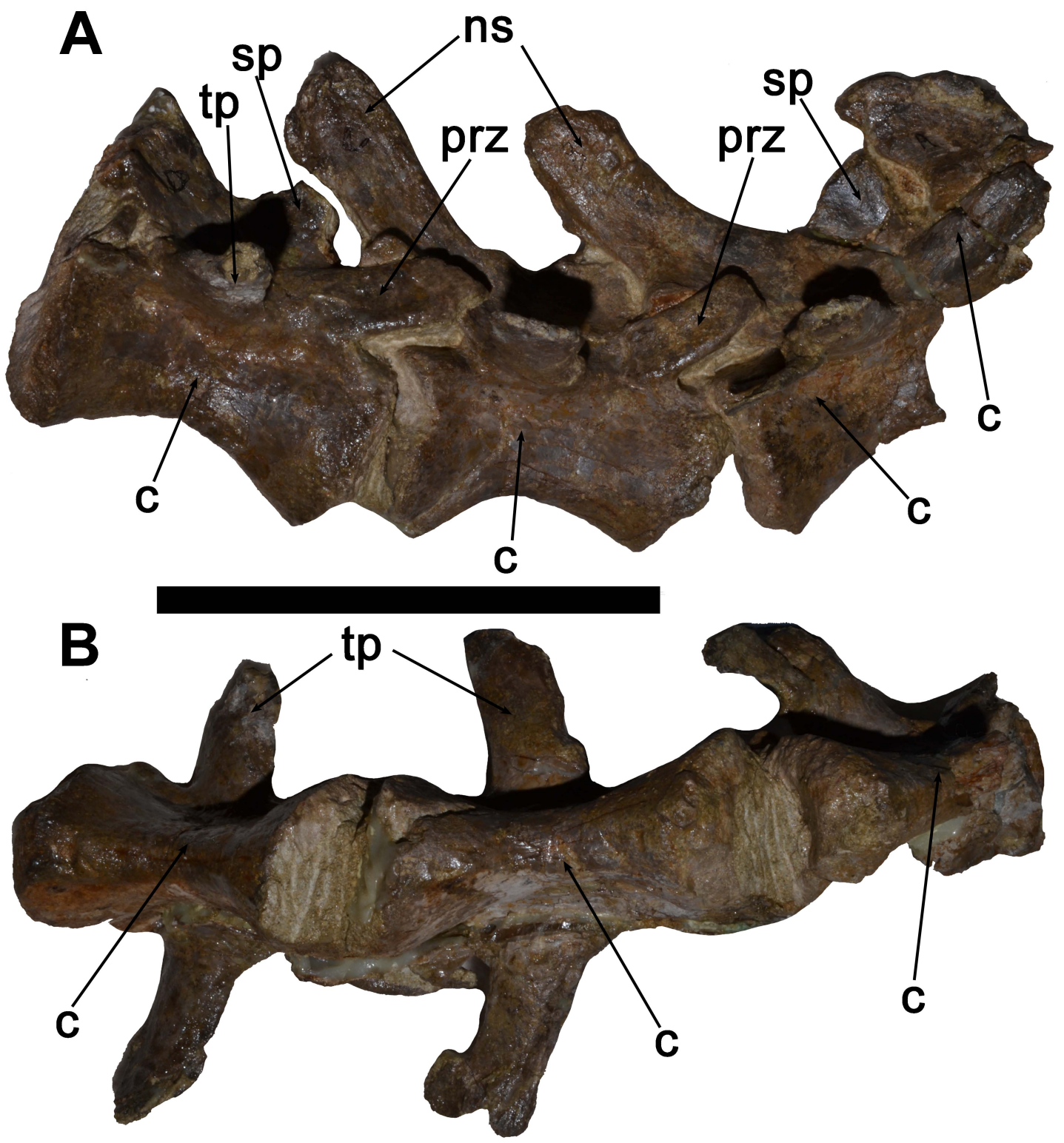
23th
15th


A
ns
sp
tp
prz
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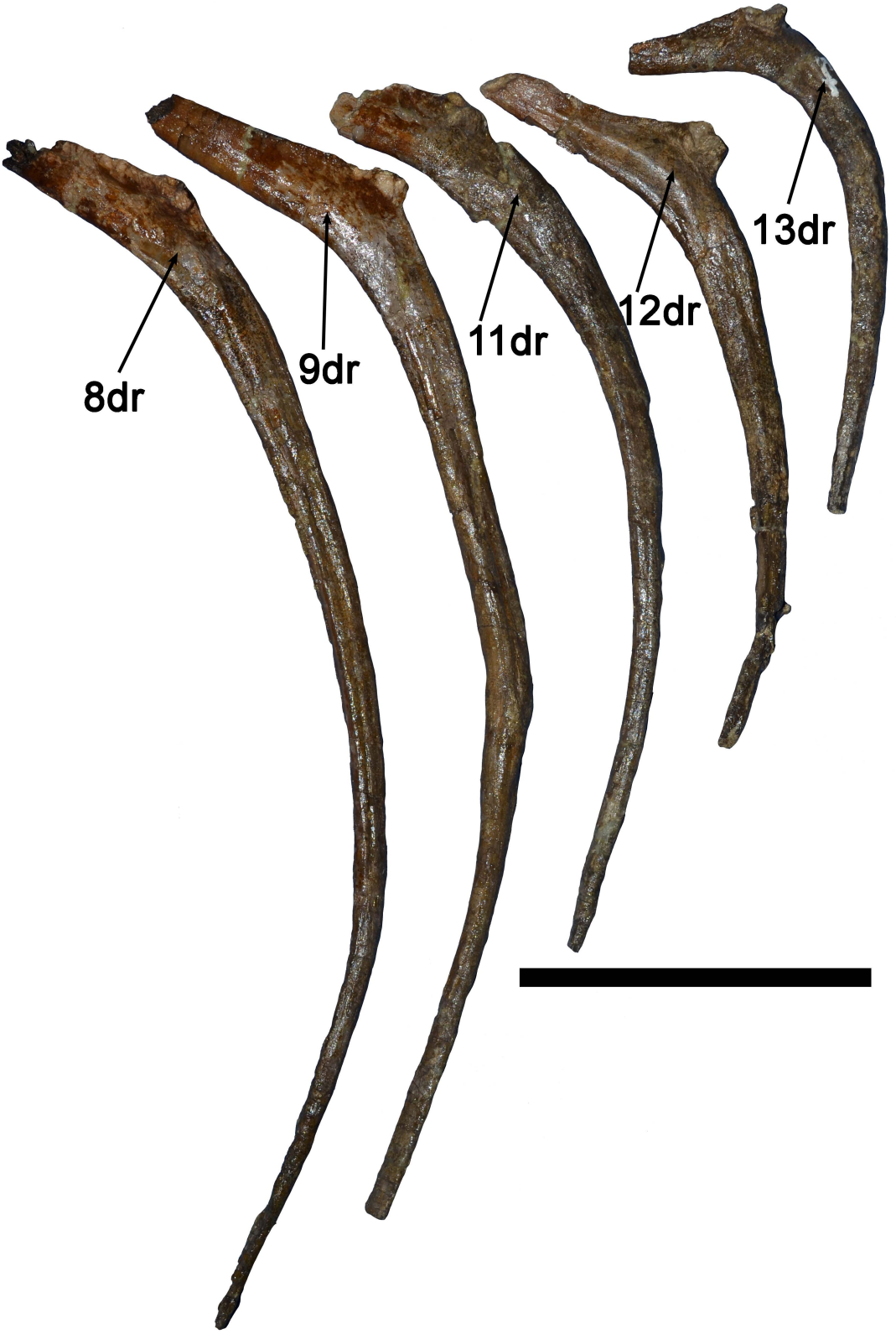
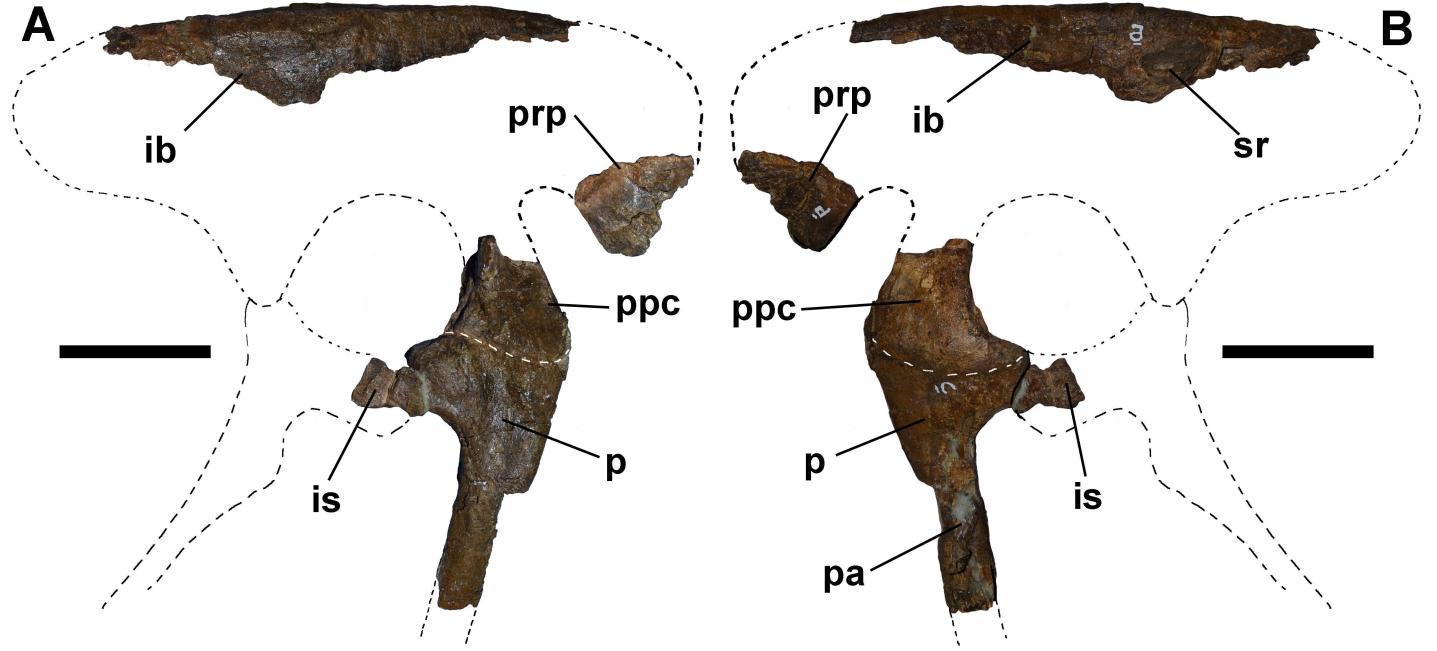
c
c
c


bap
bap
9cr
8cr
7cr
6cr


8dr
9dr
11dr
12dr
13dr


A
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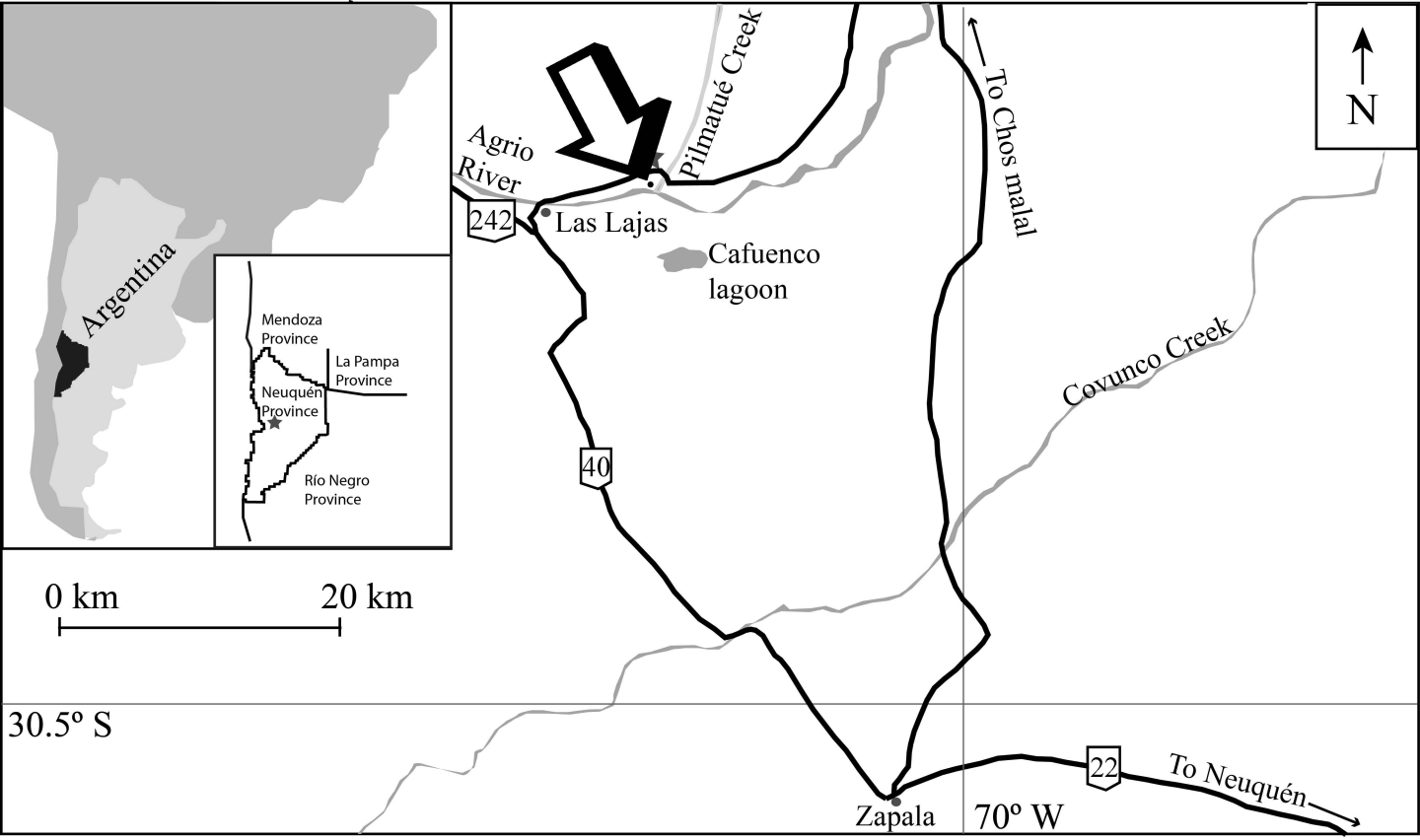
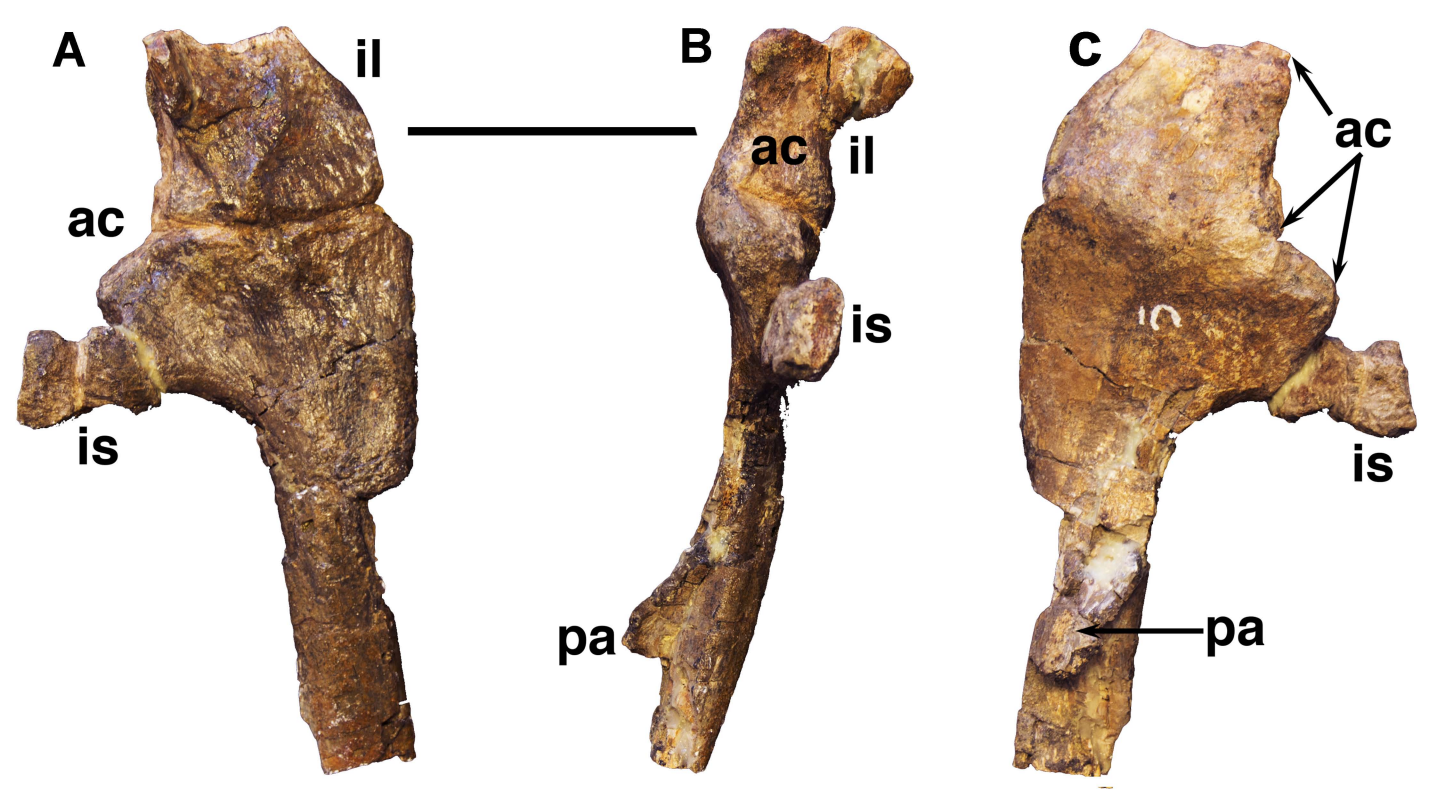
prp
ppc
p
is
B
prp
ib
sr
ppc
p
is
pa


Argentina
Mendoza Province
La Pampa Province
Neuquén Province
Río Negro Province
0 km
20 km
Agrio River
Pilmatué Creek
242
Las Lajas
Cafuenco lagoon
To Chos malal
N
Covunco Creek
40
30.5º S
22
To Neuquén
Zapala
70º W


A
il
ac
is
B
ac
il
is
pa
C
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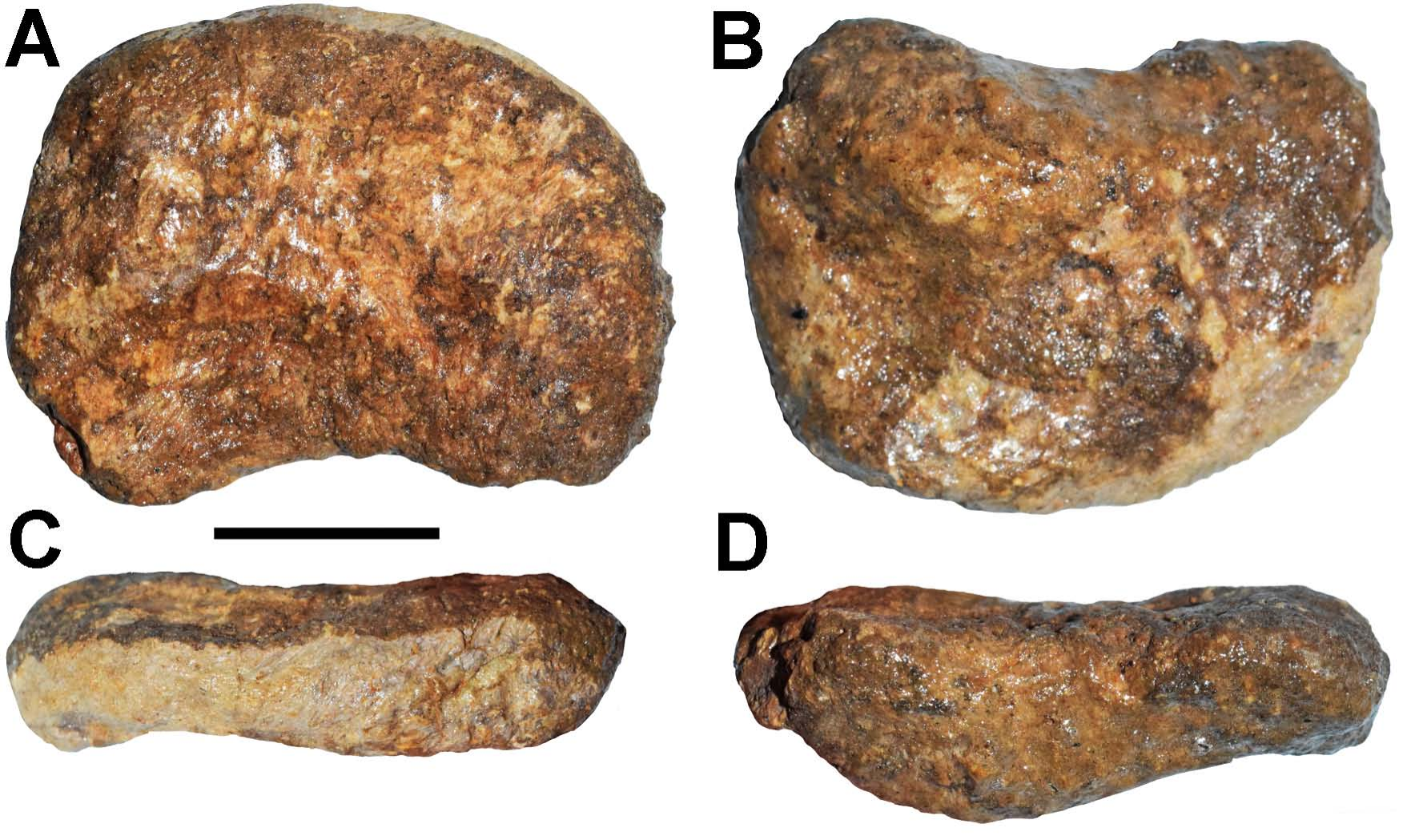
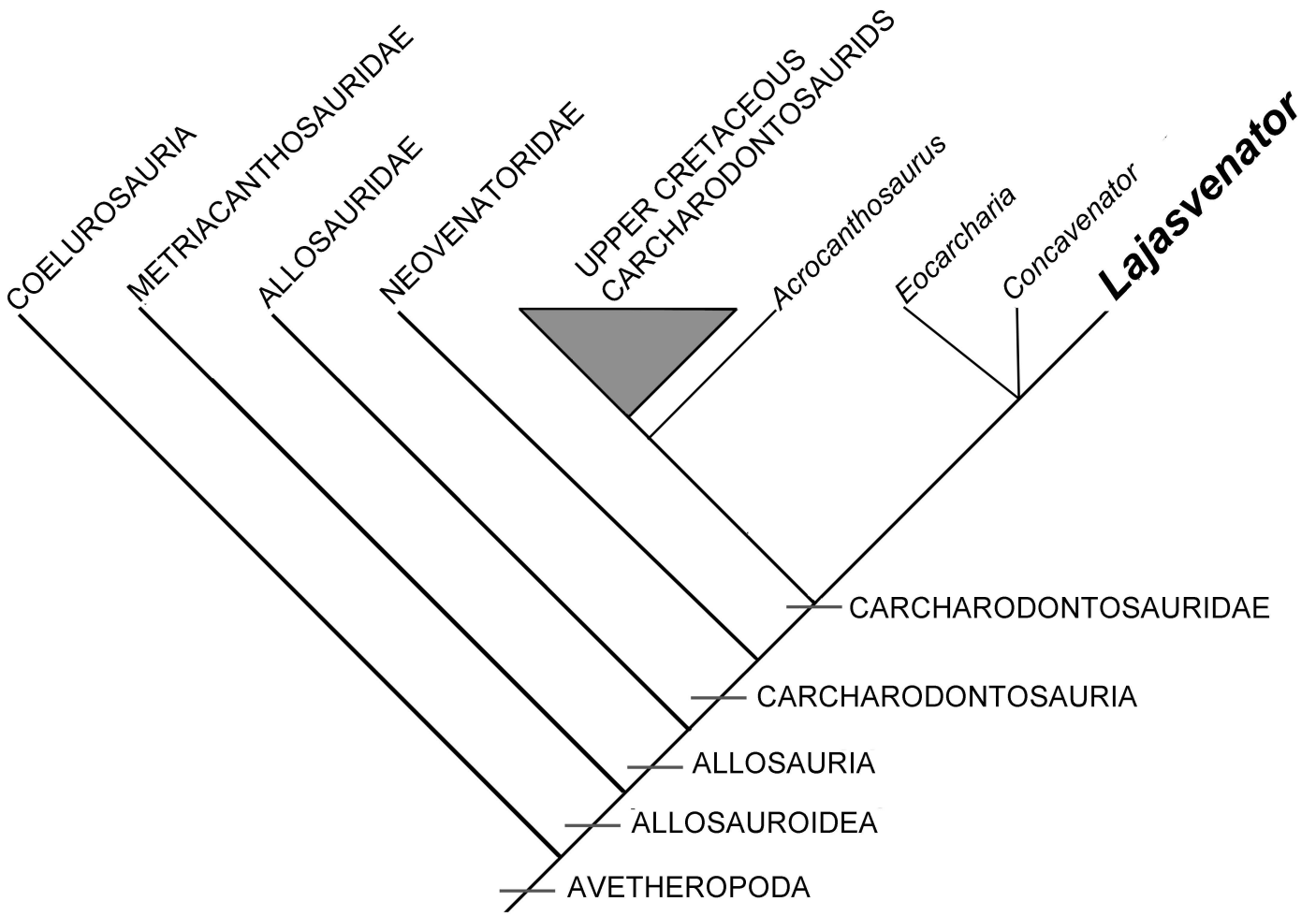
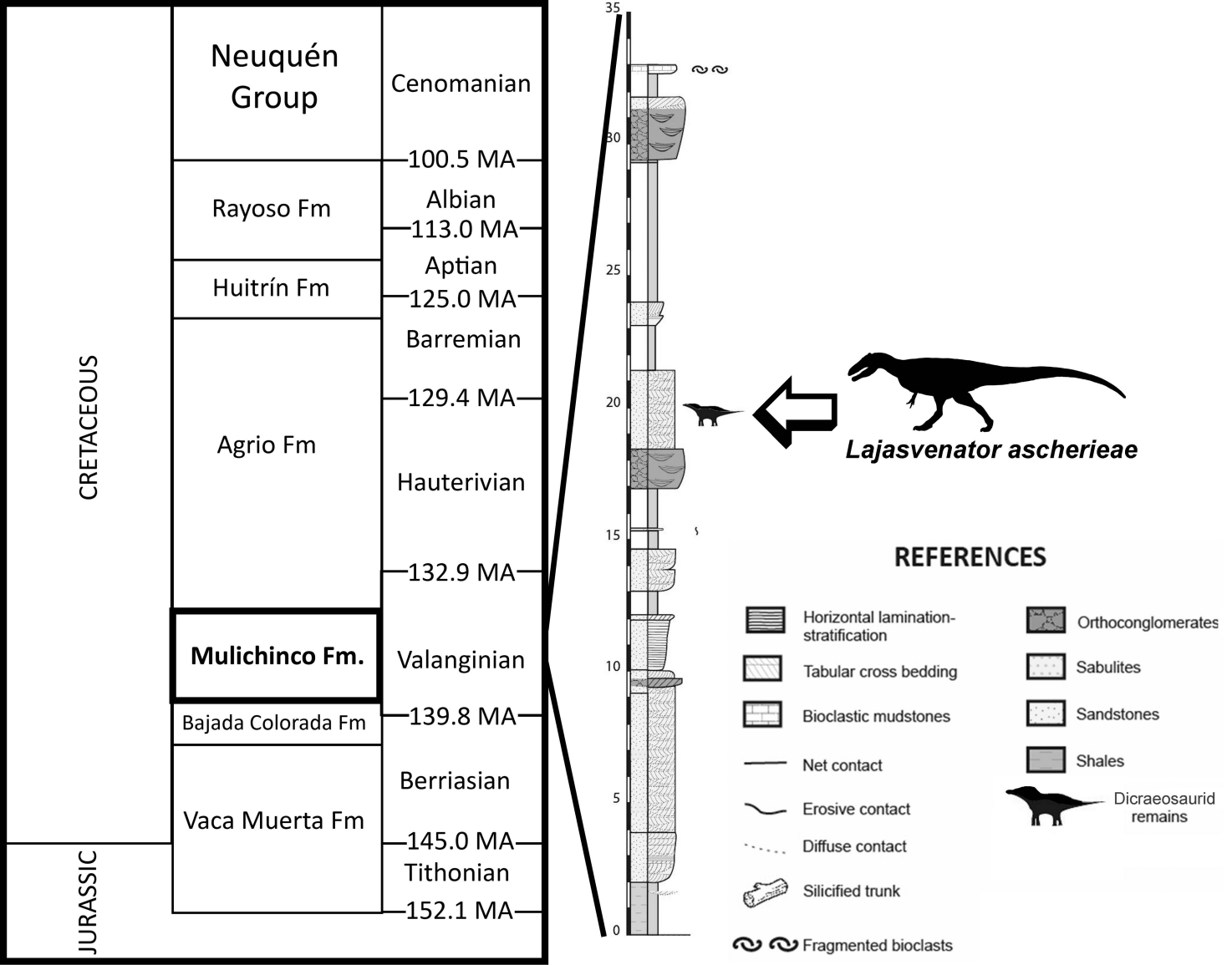
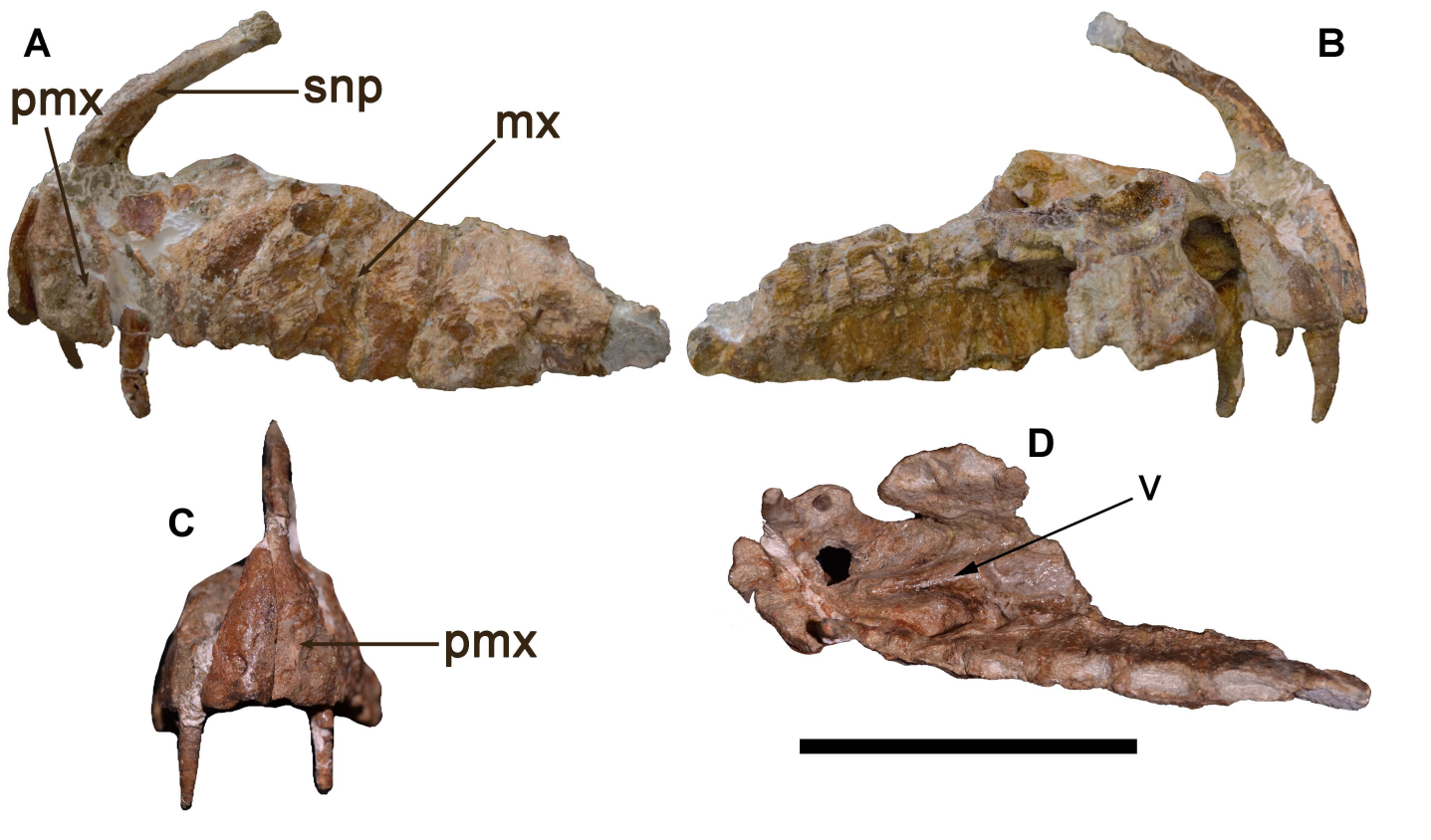
is
pa

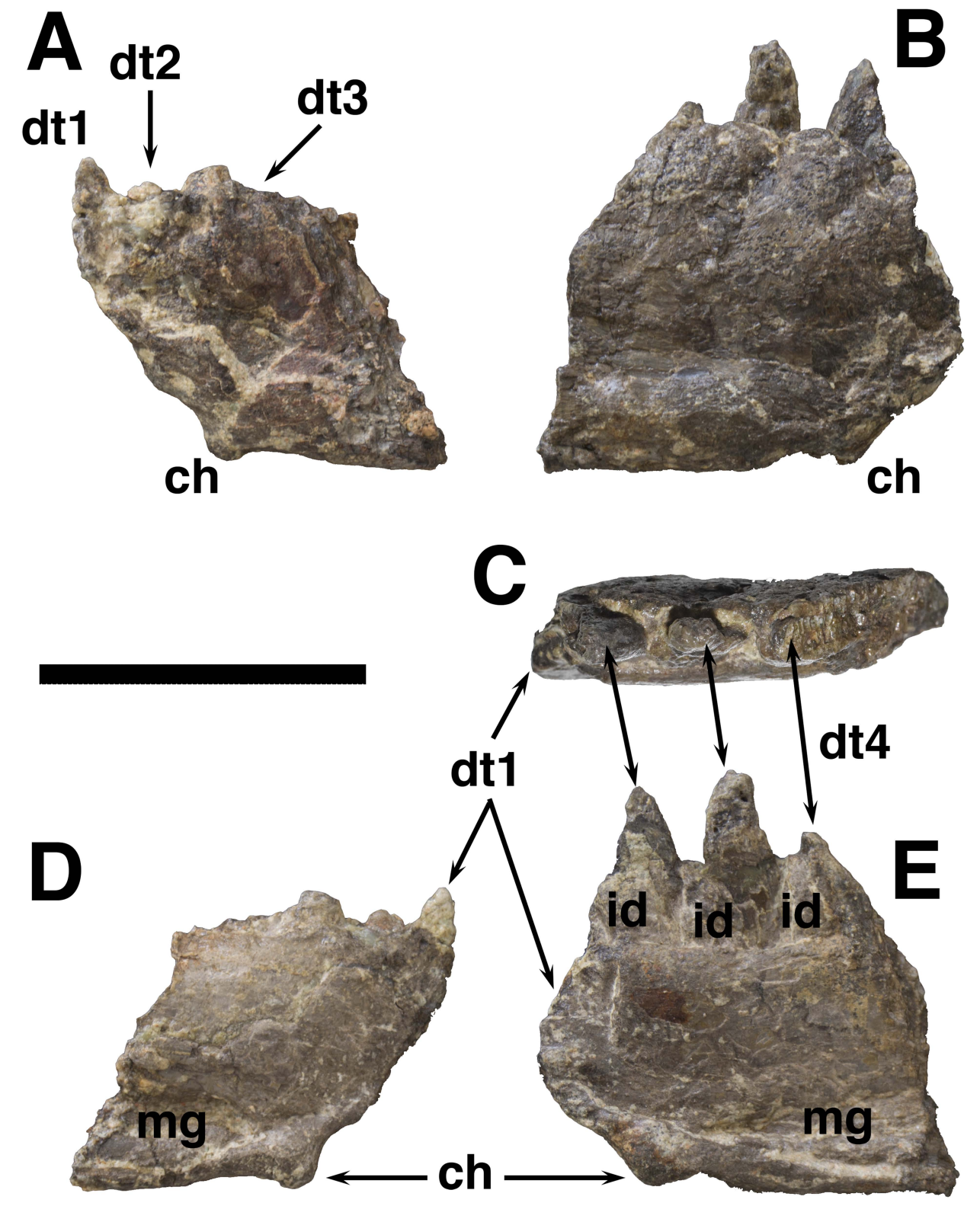

A
B
C
D


COELUROSAURIA
METRIACANTHOSAURIDAE
ALLOSAURIDAE
NEOVENATORIDAE
UPPER CRETACEOUS
CARCHARODONTOSAURIDS
Acrocanthosaurus
Eocarcharia
Concavenator
Lajasvenator
CARCHARODONTOSAURIDAE
CARCHARODONTOSAURIA
ALLOSAURIA
ALLOSAUROIDEA
AVETHEROPODA


CRETACEOUS
JURASSIC
Neuquén Group
Cenomanian
100.5 MA
Rayoso Fm
Albian
113.0 MA
Huitrín Fm
Aptian
125.0 MA
Barremian
129.4 MA
Agrio Fm
Hauterivian
132.9 MA
Mulichinco Fm.
Valanginian
Bajada Colorada Fm
139.8 MA
Berriasian
Vaca Muerta Fm
145.0 MA
Tithonian
152.1 MA
35
30
25
20
15
10
5
0
Lajasvenator ascherieae
REFERENCES
Horizontal lamination-stratification
Tabular cross bedding
Bioclastic mudstones
Net contact
Erosive contact
Diffuse contact
Silicified trunk
Fragmented bioclasts
Orthoconglomerates
Sabulites
Sandstones
Shales
Dicraeosaurid remains

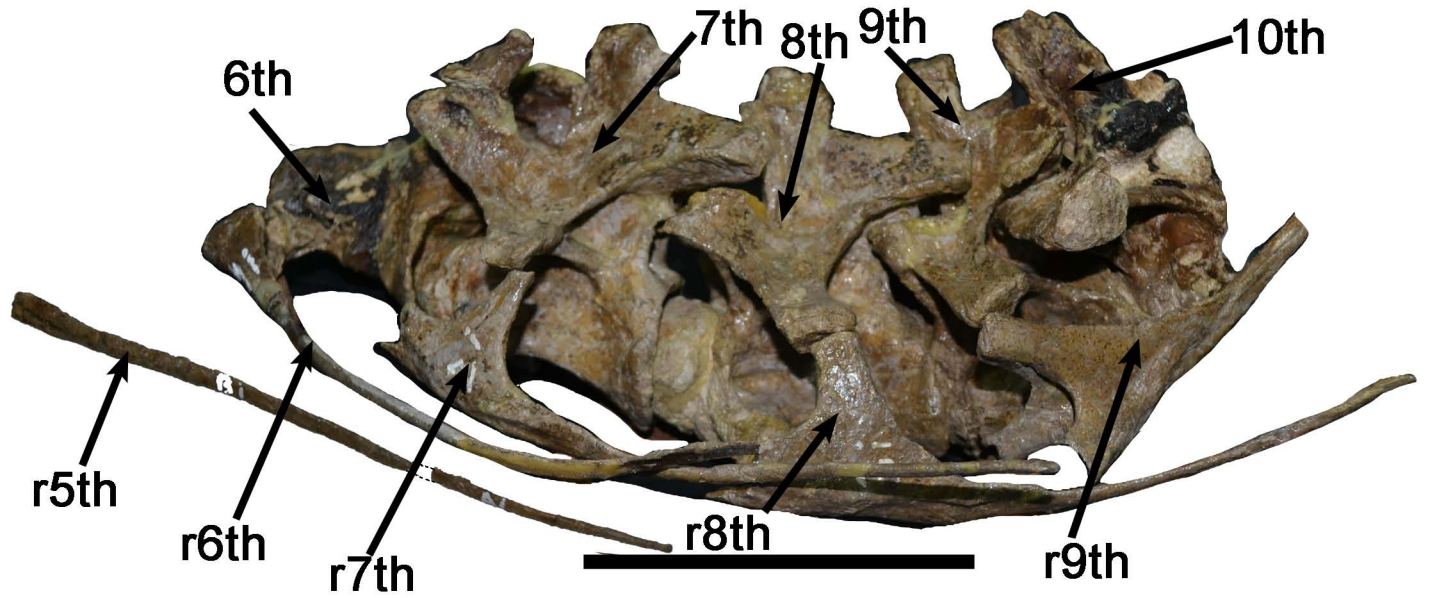

A
pmx
snp
mx
B
C
pmx
D
V


A
B
C
qf
ujs
qf
qs
ljs
qs


A
dt2
dt1
dt3
ch
B
ch
C
dt1
dt4
D
mg
E
id
id
id
mg
ch


mf


aa


6th
7th
8th
9th
10th
r5th
r6th
r7th
r8th
r9th

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: