SUPPLEMENTARY ONLINE MATERIALS

for

NEW REBBACHISAURID REMAINS FROM THE HUINCUL FORMATION (MIDDLE CENOMANIAN-EARLY TURONIAN) OF THE CENTRAL NEUQUÉN BASIN, PATAGONIA, ARGENTINA

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1. Tables

1.1. TABLE S1. List of the new rebbachisaurid remains from the El Orejano locality (Neuquén Province, Patagonia, Argentina)		
Element	**Collection number**	**Provenance**
Anterior-to-mid dorsal vertebra	MAU-PV-EO-633	Lower section of Huincul Formation, 37°58'03S/69°13'55”W
Anterior-to-mid dorsal vertebra	MAU-PV-EO-634	Lower section of Huincul Formation, 37°58’03”S/69°14’14”W
Anterior caudal vertebra	MAU-PV-EO-666	Lower section of Huincul Formation, 37°58'06"S/ 69°14'10"O

2. Phylogenetic analysis

2.1. Codification of MAU-PV-EO-633

The following codification is based on 418 morphological features of data matrix Bellardini *et al.* (2022):

MAU-PV-EO-633

???
??11???1????????????????
??2??1????00?0111????????????1???
??
??

2.2. Codification of MAU-PV-EO-634

The following codification is based on 418 morphological features of data matrix Bellardini *et al.* (2022):

MAU-PV-EO-634

???
???1??1??10???????????2

???1??10?1???????001?1??
??
??

2.3. Codification of MAU-PV-EO-666

The following codification is based on 418 morphological features of data matrix Bellardini *et al.* (2022):

MAU-PV-EO-666

??
??
???1?10&40101131000?0101000????0?????????
??
??

2.4. Character list

Skull

1. Posterolateral processes of premaxilla and lateral processes of maxilla, shape: without midline contact (0); with midline contact forming marked narial depression, subnarial foramen not visible laterally (1). (Wilson, 2002:character 1).

2. Premaxillary anterior margin shape: without step (0); with marked step but short step (1); with marked and long step (2) (modified from Wilson, 2002:character 2).

3. Premaxila, ascending process shape in lateral view: convex (0); concave, with a large dorsal projection (1); sub-rectilinear and directed posterodorsally (2). (Whitlock, 2011:character 3)

4. Premaxilla, external surface: without anteroventrally orientated vascular grooves originating from an opening in the maxillary contact (0); vascular grooves present (1). (Whitlock, 2011:character 2)

5. Premaxilla-maxilla suture, shape: planar (0); twisted along its length, giving the contact a sinuous appearance in lateral view (1). (D’Emic, 2012:character 2)

6. Premaxilla, small finger-like, vertically oriented premaxillary process near anteromedial corner of external naris: (0) absent; (1) present. (D'Emic, 2012:character 3)

7. Maxillary border of external naris, length: short, making up much less than one fourth narial perimeter (0); long, making up more than one third narial perimeter (1). (Wilson,2002:character 3).

8. Maxilla, foramen anterior to the preantorbital fenestra: absent (0); present (1). (Zaher *et al*., 2011: character 244).

9. Preanteorbital fenestra: absent (0); present, being wide and laterally opened (1). (Modified from Wilson, 2002:character 4).

10. Subnarial foramen and anterior maxillary foramen, position: well distanced from one another (0); separated by narrow bony isthmus (1). (Wilson, 2002:character 5)

11. Antorobital fenestra: much shorter than orbital maximum diameter, less than 85% of orbit (0); subequal to orbital maximum diameter, greater than 85% orbit (1). (Modified from Wilson, 2002:character 6 following to Whitlock, 2011:character 13)

12. Antorbital fenestra, shape of dorsal margin: straight or convex (0); concave (1). (Whitlock, 2011:character 14).

13. Antorbital fossa: present (0); absent (1). (Wilson, 2002:character 7)

14. External nares position: terminal (0); retracted to level of orbit (1); retracted to a position between orbits (2). (Wilson, 2002:character 8)

15. External nares, maximum diameter: shorter (0); or longer than orbital maximum diameter (1). (Wilson, 2002:character 9)

16. Orbital ventral margin, anteroposterior length: broad, with subcircular orbital margin (0); reduced, with acute orbital margin (1). (Wilson, 2002:character 10)

17. Lacrimal, anterior process: present (0); absent (1). (Wilson, 2002:character 11)

18. Lacrimal, anteriorly projecting vertical plate of bone: absent (0); present (1). (D'Emic, 2012: character 4)

19. Jugal contribution to the ventral border of the skull: present and long (0); absent or very reduced (1). (Carballido et al., 2012:character 16).

20. Quadratojugal-Maxilla contact: absent or small (0); broad (1). (Whitlock, 2011:character 10).

21. Jugal-ectopterygoid contact: present (0); absent (1). (Wilson, 2002:character 12)

22. Jugal, contribution to antorbital fenestra: absent (0); present, but very reduced (1); present and large, bordering approximately one-third its perimeter (2). (Modified from Wilson, 2002:character 13).

23. Quadratojugal, position of anterior terminus: posterior to middle of orbit (0); anterior margin of orbit or beyond (1). (Whitlock, 2011:character 30).

24. Quadratojugal, anterior process length: short, anterior process shorter than dorsal process (0); long, anterior process more than twice as long as dorsal process (1). (Wilson, 2002:character 32)

25. Quadratojugal, angle between anterior and dorsal processes: less than or equal to 90°, so that the quadrate shaft is directed dorsally (0); greater than 90°, approaching 130°, so that the quadrate shaft slants posterodorsally (1). (Whitlock, 2011:character 31).

26. Ventral edge of anterior surface of the quadratojugal: straight, not expanded ventrally (0); slightly expanded ventrally, forming a small bulge, which height is less than twice the ramus height (1); well expanded ventrally, forming a notorious bulge, which height is twice or more the minimum height of the ramus (2). (Modified from Upchurch et al., 2004:character 26)

27. Squamosal contribution to the supratemporal fenestra: present, the squamosal is well visible in dorsal view (0); reduced or absent (1). (Curry Rogers, 2005:character 37).

28. Squamosal-quadratojugal contact: present (0); absent (1). (Wilson, 2002:character 31)

29. Squamosal, posteroventral margin: smooth (0); "with prominent, ventrally directed ""prong"" (1). (Whitlock, 2011:character 37).

30. Prefrontal posterior process size: small, not projecting far posterior of frontal-nasal suture (0); elongate, approaching parietal (1). (Wilson, 2002:character 14)

31. Prefrontal, posterior process shape: flat (0); hooked (1). (Wilson, 2002:character 15)

32. Prefrontal, anterior process: absent (0); present (1). (Curry Rogers, 2005:character 30)

33. Prefrontal-Frontal contact width: large, equal or longer that the anteroposterior length of the prefrontal (0); narrow, less than half the anteroposterior length of the prefrontal (1). (Zaher *et al.*, 2011:character 239).

34. Postorbital, ventral process shape: transversely narrow (0); broader transversely than anteroposteriorly (1). (Wilson, 2002:character 16).

35. Postorbital, posterior process: present (0); absent (1). (Wilson, 2002:character 17).

36. Postorbital, posterior margin articulating with the squamosal : with tapering posterior process (0); with a deep posterior process (1). (Zaher *et al.*, 2011:character 245).

37. Frontal contribution to supratemporal fossa: present (0); absent (1). (Wilson, 2002:character 18)

38. Frontals, midline contact (symphysis): sutured (0); or fused in adult individuals (1). (Wilson, 2002:character 19)

39. Frontal, anteroposterior length: approximately twice (0); or less than minimum transverse breadth (1). (Wilson, 2002:character 20)

40. Frontal-nasal suture, shape: flat or slightly bowed anteriorly (0); V-shaped, pointing posteriorly (1). (Whitlock, 2011:character 21)

41. Frontals, dorsal surface: without paired grooves facing anterodorsally (0); grooves present, extend on to nasal (1). (Whitlock, 2011:character 22)

42. Frontal, contribution to dorsal margin of orbit: contribution to dorsal margin of orbit: less than 1.5 times the contribution of prefrontal (0); at least 1.5 times the contribution of prefrontal (1). (Whitlock, 2011:character 23)

43. Parietal occipital process, dorsoventral height: short, less than the diameter of the foramen magnum (0); deep, nearly twice the diameter of the foramen magnum (1). (Wilson, 2002: character21)

44. Parietal, contribution to post-temporal fenestra: present (0); absent (1). (Wilson, 2002:character 22)

45. Parietal, distance separating supratemporal fenestrae: less than the long axis of supratemporal fenestra, 0.8 or less (0); almost the same than the long axis of supratemporal fenestra 0.8-1.2 (1); much larger than the long axis of supratemporal fenestra more than 1.2 (2). (Modified from Wilson, 2002: character 24).

46. Postparietal foramen: absent (0); present (1). (Wilson, 2002:character 23)

47. Paroccipital process distal terminus: straight, slightly expanded surface (0); rounded, tongue-like process (1). (Whitlock, 2011:character 42)

48. Supratemporal fenestra: present (0); absent (1). (Wilson, 2002:character 25)

49. Supratemporal fenestra, long axis orientation: anteroposterior (0); transverse (1). (Wilson, 2002:character26)

50. Supratemporal fenestra, maximum diameter: much longer than (0); or subequal to that of foramen magnum (1). (Wilson, 2002:character 27)

51. Supratemporal region, anteroposterior length: temporal bar longer (0); or shorter anteroposteriorly than transversely (1). (Wilson, 2002:character 28)

52. Supratemporal fossa, lateral exposure: not visible laterally, obscured by temporal bar (0); visible laterally, temporal bar shifted ventrally (1). (Wilson, 2002:character 29)

53. Supraoccipital, sagital nuchal crest: broad, weakly developed (0); narrow, sharp and distinct (1). (Whitlock, 2011:character 45). 46

54. Laterotemporal fenestra, anterior extension: posterior to orbit (0); ventral to orbit (1). (Wilson, 2002:character 30)

55. Quadrate fossa: absent (0); present (1). (Wilson, 2002:character 33)

56. Quadrate fossa, depth: shallow (0); deeply invaginated (1). (Wilson, 2002:character 34)

57. Quadrate fossa, orientation: posterior (0); posterolateral (1). (Wilson, 2002:character 35)

58. Quadrate, articular surface shape: quadrangular in ventral view, oriented transversely (0); roughly triangular in shape or thin, crescent-shaped surface with anteriorly directed medial process (1). (Modified based on Mannion *et al*., 2011. from Whitlock, 2011:character 32).

59. Quadrate, articular surface shape: quadrangular in ventral view, oriented transversely or roughly triangular in shape (0); thin, crescent-shaped surface with anteriorly directed medial process (1). (Modified based on Mannion *et al*., 2011 from Whitlock, 2011:character 32).

60. Palatobasal contact, shape: pterygoid with small facet (0); dorsomedially orientated hook (1); or rocker-like surface for basipterygoid articulation (2). (Wilson, 2002:character 36)

61. Pterygoid, transverse flange (i.e. ectopterygoid process) position: posterior of orbit (0); between orbit and antorbital fenestra (1); anterior to antorbital fenestra (2). (Wilson, 2002:character37)

62. Pterygoid, quadrate flange size: large, palatobasal and quadrate articulations well separated (0); small, palatobasal and quadrate articulations approach (1). (Wilson, 2002:character 38)

63. Pterygoid, palatine ramus shape: straight, at level of dorsal margin of quadrate ramus (0); stepped, raised above level of quadrate ramus (1). (Wilson, 2002:character39)

64. Pterygoid, sutural contact with ectopterygoid: broad, along the medial or lateral surface (0); narrow, restricted to the anterior tip of the ectopterygoid (1). (Zaher *et al*. 2011:character 240)

65. Palatine, lateral ramus shape: plate-shaped (long maxillary contact) (0); rod-shaped (narrow maxillary contact) (1). (Wilson, 2002:character 40)

66. Epipterygoid: present (0); absent (1). (Wilson, 2002:character 41)

67. Vomer, anterior articulation: maxilla (0); premaxilla (1). (Wilson, 2002:character 42)

68. Supraoccipital, height: twice subequal to (0); or less than height of foramen magnum (1). (Wilson, 2002:character 43)

69. Paroccipital process, ventral non-articular process: absent (0); present (1). (Wilson, 2002:character 44)

70. Crista prootica, size: rudimentary (0); expanded laterally into dorsolateral process (1). (Wilson, 2002:character 45)

71. Basipterygoid processes, length: short, approximately twice (0); or elongate, at least four times basal diameter (1). (Wilson, 2002:character 46)

72. Basipterygoid processes, angle of divergence: approximately 45° (0); less than 30° (1). (Wilson, 2002:character 47)

73. Basal tubera, anteroposterior depth: approximately half dorsoventral height (0); sheet-like,

20% dorsoventral height (1). (Wilson, 2002:character 48)

74. Basal tubera, breadth: much broader than (0); or narrower than occipital condyle (1). (Wilson, 2002:character 49)

75. Basal tubera: distinct from basipterygoid (0); reduced to slight swelling on ventral surface of basipterygoid (1). (Whitlock, 2011:character 53)

76. Basal tubera, shape of posterior face: convex (0); slightly concave (1). (Whitlock, 2011:character 54)

77. Basioccipital depression between foramen magnum and basal tubera: absent (0); present (1). (Wilson, 2002:character 50)

78. Basisphenoid/basipterygoid recess: present (0); absent (1). (Wilson, 2002:character 51)

79. Basisphenoid/quadrate contact: absent (0); present (1). (Wilson, 2002)

80. Basisphenoid, sagital ridge between basipterygoid processes: absent (0); present (1). (Zaher *et al*., 2011:character 242)

81. Basipterygoid processes, orientation: perpendicular to (0); or angled approximately 45° to skull roof (1). (Wilson, 2002:character 53)

82. Basipterygoid, area between the basipterygoid processes and parasphenoid rostrum: is a mildly concave subtriangular region (0); forms a deep slot-like cavity that passes posteriorly between the bases of the basipterygoid processes (1). (Mannion *et al*., 2013:character 48)

83. Occipital region of skull, shape: anteroposteriorly deep, paroccipital processes oriented posterolaterally (0); flat, paroccipital processes oriented transversely (1). (Wilson, 2002:character 54)

84. Occipital condyle, lateral surface of the basioccipital: flat or slightly convex (0); strongly concave (1). (Remes *et al*., 2009:character 50)

85. Dentary, depth of anterior end of ramus: slightly less than that of dentary at midlength (0); 150% minimum depth (1). (Wilson, 2002:character 55)

86. Dentary, anteroventral margin shape: gently rounded (0); sharply projecting triangular process (1). (Wilson, 2002:character 56)

87. Dentary symphysis, orientation: angled 15° or more anteriorly to (0); or perpendicular to axis of jaw ramus (1). (Wilson, 2002:character 57)

88. Dentary, cross-sectional shape of symphysis: oblong or rectangular (0); subtriangular, tapering sharply towards ventral extreme (1); subcircular (2). (Whitlock, 2011:character 60)

89. Dentary, tuberocity on labial surface near symphysis: absent (0); present (1). (Whitlock, 2011:character 57)

90. Dentary, posteroventral process shape: single (0); divided (1). (D'Emic, 2012:character 10)

91. Mandible, coronoid eminence: strongly expressed, clearly rising above plane of dentigerous portion (0); absent (1). (Whitlock, 2011:character 62)

92. External mandibular fenestra: present (0); absent (1). (Wilson, 2002:character 58)

93. Surangular depth: less than twice (0); or more than two and one-half times maximum depth of the angular (1). (Wilson, 2002:character 59)

94. Surangular ridge separating adductor and articular fossae: absent (0); present (1). (Wilson, 2002:character 60)

95. Adductor fossa, medial wall depth: shallow (0); deep, prearticular expanded dorsoventrally (1). (Wilson, 2002:character 61)

96. Splenial posterior process, position: overlapping angular (0); separating anterior portions of prearticular and angular (1). (Wilson, 2002:character 62)

97. Splenial posterodorsal process: present, approaching margin of adductor chamber (0); absent (1). (Wilson, 2002:character 63)

98. Coronoid, size: extending to dorsal margin of jaw (0); reduced, not extending dorsal to splenial (1); absent (2). (Wilson, 2002:character 64)

99. Tooth rows, shape of anterior portions: narrowly arched, anterior portion of tooth rows Vshaped (0); broadly arched, anterior portion of tooth rows U-shaped (1); rectangular, toothbearing portion of jaw perpendicular to jaw rami (2). (Wilson, 2002:character 65).

100. Tooth rows, length: extending to orbit (0); restricted anterior to orbit (1); restricted anterior to antorbital fenestra (2); restricted anterior to subnarial foramen (3). (Modified from Wilson, 2002:character 66)

101. Maxillary teeth shape: straight along axis (0); twisted axially through an arc of 30-45º: absent (0); present (1). (D'Emic, 2012:character 15)

102. Dentary teeth, number: greater than 20 (0); 10-17 (1); 9 or fewer (2). (Modified from Wilson, 2002:character73)

103. Replacement teeth per alveolus, number: two or fewer (0); more than four (1). (Wilson, 2002:character 74)

104. Lateral plate: absent (0); present (1). (Upchurch *et al*., 2004:character 9)

105. Teeth, orientation: perpendicular (0); or oriented anteriorly relative to jaw margin (1). (Wilson, 2002:character 75)

106. Tooth crowns, orientation: aligned along jaw axis, crowns do not overlap (0); aligned slightly anterolingually, tooth crowns overlap (1). (Wilson, 2002:character 69)

107. Tooth crowns, shape: narrow crowns (0); broad crowns (1).

108. Tooth crowns, cross-sectional shape at mid-crown: elliptical (0); D-shaped (1); subcylindrical (2); cylindrical (3). (Wilson, 2002:character 70)

109. SI values for tooth crowns: less than 3.0 (0); 3.0-4.0 (1); 4.0-5.0 (2); more than 5.0 (3). (Upchurch *et al*., 2004:chs. 67-69)

110. Crown-to-crown occlusion: absent (0); present (1). (Wilson, 2002:character 67)

111. V-shaped wear facets: present (0); absent (1). (Modified from Wilson, 2002:character 68)

112. Development of the marginal wear facets: well developed (0); slightly developed as marginal facets (1).

113. One high angle wear facet and a second low angle wear facet: absent (0); present (1).

114. Single planar wear facet in labial or lingual surface of the teeth: absent (0); present (1).

115. Marginal tooth denticles: present (0); absent on posterior edge (1); absent on both anterior and posterior edges (2). (Wilson, 2002:character 72)

116. Enamel surface texture: smooth (0); wrinkled (1). (Wilson, 2002:character71)

117. Thickness of enamel asymmetric labiolingually: absent (0); present (1). (Whitlock, 2011:character 74)

118. Teeth, longitudinal grooves on lingual aspect: absent (0); present (1). (Wilson, 2002:character 76)

Cervical vertebrae

119. Cervical vertebrae, number: 10 or fewer (0); 12 (1); 13-14 (2); 15 (3); 16 or more (4). (Modified from Wilson, 2002:character 80 and Upchurch *et al*., 2004:chs. 96-100)

120. Atlas, intercentrum occipital facet shape: rectangular in lateral view, length of dorsal aspect subequal to that of ventral aspect (0); expanded anteroventrally in lateral view, anteroposterior length of dorsal aspect shorter tan that of ventral aspect (1). (Wilson, 2002:character 79)

121. Axis, centrum shape: over two and a half times as long as tall (0); less than twice as long as tall (1). (D'Emic, 2012: character 20)

122. Cervical vertebrae, parapophyses, shape and orientation: short and weakly developed, projected laterally or slightly ventrally (0); middle development, ventrally such that the cervical ribs are displaced ventrally around half the height of the centrum (1); well developed, broad and ventrally projected such that cervical ribs are displaced ventrally more than the height of the centrum (2). (Modified from D'Emic, 2012:character 29)

123. Cervical centra, articulations: amphicoelous (0); opisthocoelous (1). (Salgado et al., 1997:character 1; Wilson, 2002:character 82; Upchurch, 1998:character 81 and Upchurch *et al*., 2004:character 103)

124. Cervical centra, ventral surface: is flat or slightly convex transversely (0); transversely concave (1). (Upchurch, 1998:character 84 and Upchurch *et al*., 2004:character 107)

125. Cervical centra, midline keels on ventral surface: prominent and plate-like (0); reduced to low ridges or absent (1). (Upchurch, 1998:character 83 and Upchurch *et al*., 2004:character 106)

126. Cervical centra, pleurocoels: absent (0); present with well defined anterior, dorsal, and ventral edges, but not the posterior one (1); present, with well defined edges (2); absent, but with deep lateral fossa which bears small pneumatopores that communicate to the interior pneumatic cavities. (3).

127. Cervical centra, pleurocoels: singles without division (0); with a well defined anterior excavation and a posterior smooth fossa (1); divided by a bone septum, resulting in an anterior and a posterior lateral excavation (2); divided in three or more lateral excavations, resulting in a complex morphology (3); with a well defined anterior excavation and a posterior smooth fossa (Modified from Salgado *et al*., 1997; Wilson, 2002; Harris, 2006)

128. Cervical vertebrae, well developed epipophyses: absent (0); present (1).

129. Cervical vertebrae, epipophyses shape: stout, pillar like expansions above postzygapophyses (0); posteriorly projecting prongs (1). (D'Emic, 2012:character 24)

130. Prezygapophyses, anterior process suited ventrolaterally to the articular surface: absent (0); present (1). (Remes *et al*., 2009:character 79)

131. Cervical vertebrae with an accessory lamina, which runs from the PODL (or slightly anteriorly) up to the SPOL: absent (0); present (1). (Modified from D'Emic, 2012:character 25)

132. Cervical vertebrae, height divided width (measured in its posterior articular surface): higher than 1.1 (0), around 1 (1); between 0.9 and 0.7 (2); smaller than 0.7 (3). (Modified from Wilson, 2002:character 84; Upchurch,1998:character 85 and Upchurch *et al*., 2004:character 108)

133. Cervical centra, small notch in the dorsal margin of the posterior articular surface: absent (0); present (1). (Carballido *et al*., 2012)

134. Cervical vertebrae, neural arch lamination: well developed, with well marked laminae and fossae (0); rudimentary, with diapophyseal laminae absents or very slightly marked (1). (Wilson, 2002:ch, 81)

135. Cervical vertebrae with an accessory lamina, which runs from the postzygodiapophyseal lamina (PODL) up to the spinoprezygapophyseal lamina (SPRL): absent (0); present (1). (Modified from Sereno *et al*., 2007:chs. 50, 51; Whitlock, 2011:chs. 78, 96).

136. Cervical centra, internal pneumaticity: absent (0); present with singles and wide cavities (1); present, with several small and complex internal cavities (2). (Modified from Carballido *et al*., 2011)

137. Anterior cervical vertebrae, prespinal lamina: absent (0); present (1). (Carballido *et al*., 2012).

138. Anterior cervical vertebrae, neural spine shape: single (0); bifid (1). (Wilson, 2002:character 72; Upchurch *et al*., 2004:character 118)

139. Middle and posterior cervical vertebrae, prespinal lamina: absent (0); present (1). (Carballido *et al*., 2012).

140. Middle cervical vertebrae, lateral fossae on the prezygapophysis process: absent (0); present (1). (Harris, 2006).

141. Middle, cervical vertebrae, height of the neural arch: less than the height of the posterior articular surface (0); higher than the height of the posterior articular surface (1). (Wilson, 2002:character 87; similar Upchurch *et al*., 2004:111 and 112)

142. Middle cervical centrum, anteroposterior length divided the height of the posterior articular surface: less than 4 (0); more than 4 (1). (Wilson, 2002:character 74; and Upchurch *et al*., 2004:character 102).

143. Middle and posterior cervical vertebrae, morphology of the centroprezygapophyseal lamina: single (0); dorsally divided, resulting in a lateral and medial lamina, being the medial lamina linked with the intraprezygapophyseal lamina and not with the prezygapophysis (1); divided, resulting in the

presence of a “true” divided centroprezygapophyseal lamina, which is dorsally connected to the prezygapophysis (2). (Carballido *et al*., 2012).

144. Middle and posterior cervical vertebrae, morphology of the centropostzygapophyseal lamina (CPOL): single (0); divided, with the medial part contacting the intrapostzygapophyseal lamina (1) (Carballido *et al*., 2012)

145. Middle and posterior cervical vertebrae, articular surface of zygapophyses: flat (0); transversally convex (1). (Upchurch *et al*., 2004)

146. Middle and posterior cervical vertebrae, prominent triangular flange on posterior edge of the diapophyseal process (in the PCDL): absent (0); present (1). (Remes *et al*., 2009;character 78)

147. Middle cervical vertebrae, prezygapophyses position: do not extend beyond the anterior margin of the centrum (0); extends beyond the anterior margin of the centrum (1). (Salgado *et al*., 1997:character 37)

148. Middle and posterior cervical vertebrae, parapophysis shape: subcircular (0); anteroposteriorly elongate (1). (D’Emic, 2012:character 28)

149. Posterior cervical vertebrae, lateral profile of the neural spine: displays steeply sloping cranial and caudal faces (0); displays steeply sloping cranial face and noticeably less steep caudal margin (1). (Upchurch *et al*., 2004:character 119)

150. Posterior cervical vertebrae, neural spine shape: not expanded distally (0); expanded but not as much as the width of the centrum (1); laterally expanded, being equal or wider than the vertebral centrum (1). (Modified from González Riga *et al*., 2009)

151. Posterior cervical vertebrae, lateral expansion: SPRLs does not contact the lateral margins of the neural spine (0); SPRLs are contacting the lateral margins of the neural spine (1). (Modified from González Riga and Ortiz, 2014: character 26–27)

152. Posterior cervical and anterior dorsal vertebrae, neural spine shape: single (0); bifid (1). (Wilson, 2002:character 90, Upchurch *et al*., 2004:character 118)

153. Posterior cervical vertebrae, proportions – ratio total height / centrum length: less than 1.5 (0); more than 1.5 (1). (González Riga *et al*., 2009:character 32)

154. Posterior cervical and anterior dorsal bifid neural spines, median tubercle: absent (0); present (1).

Dorsal vertebrae

155. Number of dorsal vertebrae: 14 or more (0); 13 (1); 12 (2); 10 (3). (Modified from Wilson, 2002:character 91; Upchurch *et al*., 2004:character 122−125)

156. Dorsal centra, pleurocoels: absent (0); present (1). (Wilson, 2002:character 78; Upchurch *et al*., 2004:128)

157. Dorsal vertebrae, transverse processes: are directed laterally or slightly upwards (0); are directed strongly dorsolaterally (1). (Upchurch *et al*., 2004:character 138)

158. Dorsal vertebrae, distal end of the transverse process: curves smoothly into the dorsal surface of the process (0); is set off from the dorsal surface, the latter having a distinct dorsally facing flattened area (1). (Upchurch *et al*., 2004:character 140)

159. Anterior dorsal vertebrae, non bifid neural spine in anterior or posterior view: posses subparallel lateral margins (0); posses lateral margins which slightly diverge dorsally (1); posses lateral margins which strongly diverge dorsally (2). (Modified 52 from Wilson, 2002:character 107; Upchurch *et al*., 2004:character 155)

160. Middle to posterior dorsal vertebrae, non bifid neural spine in anterior or posterior view: posses subparallel lateral margins (0); posses lateral margins which slightly diverge dorsally (1); posses lateral margins which strongly diverge dorsally (2). (Modified from Wilson, 2002:character 107; Upchurch *et al*., 2004:character 155)

161. Dorsal centra, pneumatic structures: absent, dorsal centra with solid internal structure (0); present, dorsal centra with simple and big air-spaces (camerate) (1); present, dorsal centra with small and complex air-spaces (polycamerate) (2); present, dorsal centra with small and complex air spaces (semicamellate/camellate) (3). (Modified from Carballido *et al*., 2011)

162. Anterior and middle dorsal neural spines, spinoprezygapophyseal lamina (SPRL): absent (0); present (1). (Modified from Upchurch *et al*. (2007:character 131).

163. Posterior dorsal neural spines, spinoprezygapophyseal lamina (SPRL): absent (0); present (1). (Modified from Upchurch *et al*., 2007:character 132).

164. Dorsal vertebrae, single not bifid neural spines, single prespinal lamina (PRSL): absent (0); present (1). (Modified from Salgado *et al*., 1997:character14)

165. Dorsal vertebrae, single not bifid neural spines, single prespinal lamina (PRSL): rough and wide, present in the dorsalmost part of the neural spine (0); rough and wide, extended trough almost all the neural spine (1); smooth and narrow (2). (Carballido *et al*., 2012)

166. Dorsal vertebrae with single neural spines, middle single fossa projected through the middline of the neural spine: present (0); absent (1). (Carballido *et al*., 2012)

167. Dorsal vertebrae with single neural spines, middle single fossa, projected through the midline of the neural spine: relatively wide median simple fossa (0); a thin median simple fossa (1); extremely reduced median simple fossa (2). (Carballido *et al*., 2012)

168. Anterior dorsal centra, articular face shape: amphicoelous (0); opisthocoelous (1). (Wilson, 2002:character 94; Upchurch *et al*., 2004:character 104)

169. Anterior and middle dorsal centra, pleurocoels: have rounded caudal margins (0); have tapering, acute caudal margins (1). (Salgado *et al*., 1997; Upchurch, 1998:character 06; Upchurch *et al*., 2004:ca 127)

170. Middle dorsal neural arches in lateral view, anterior edge of the neural spine: project anteriorly to the diapophysis (0); converge with the diapophysis (1); project posteriorly to the diapophysis (2). (Carballido *et al*., 2012)

171. Anterior and middle dorsal vertebrae, zygapophyseal articulation angle: horizontal or slightly posteroventrally oriented (0); posteroventraly oriented (around 30º) (1); strongly posteroventraly oriented (more than 40º) (2). (Carballido *et al*., 2012)

172. Anterior dorsal vertebrae, neural spine orientation: vertical, or slightly inclined (less than 20º) (0); posterodorsally, more than 20º (1); anteriorly directed (2).

173. Anterior dorsal vertebrae neural spine, triangular aliform processes: absent (0); present but do not project far laterally (not as far as caudal zygapophyses) (1); present and project far laterally (as far as caudal zygapophyses) (2). (Modified from Wilson, 2002:character 102 and Upchurch *et al*., 2004:chs. 153–54).

174. Anterior dorsal vertebrae, neural spine minimums width / length: 0.5 or greater (stout and short neural spine) (0); lower than 0.5 (thin and tall neural spines). (Carballido *et al*., 2017:character 174)

175. Anterior dorsal vertebrae, neural spine length (from TPRL to top): less than the height of the centrum (0); slightly higher than the centrum (1); twice or more the height of the centrum (2). (Carballido *et al*., 2017:character 175)

176. Anterior dorsal vertebrae, dorsal edge of the neural spine: flat (0); arrow shaped (1); convex (2). (Carballido *et al*., 2017:character 176)

177. Posterior dorsal vertebrae, dorsal edge of the neural spine: flat (0); arrow shaped (1); convex (2). (Carballido *et al*., 2017:character 177)

178. Middle to posterior dorsal centra, ventral surface: convex transversely (0); flattened (1); is slightly concave, sometimes with one or two crests (2). (Upchurch *et al*., 2004)

179. Middle dorsal vertebrae, hyposphene-hypantrum system: present (0); absent (1). (Modified from Salgado *et al*., 1997:character 25; Wilson, 2002:character 106; Upchurch *et al*., 2004:character 145)

180. Posterior dorsal vertebrae, hyposphene-hypantrum system: present and well developed, usually with a rhomboid shape (0); present and weakly developed, mainly as a laminar articulation (1); absent or only present in posteriormost dorsal vertebrae (2). (Carballido *et al*., 2012)

181. Middle and posterior dorsal vertebrae, transverse processes length: short (0); long (projecting along 1.5 the articular surface width) (1). (Carballido *et al*., 2012)

182. Mid and posterior dorsal vertebrae with a single lamina (the single TPOL) supporting the hyposphene or postzygapophysis from below: absent (0); present (1). (Modified from Upchurch *et al*., 2004:character 146)

183. Middle and posterior dorsal vertebrae, neural canal in anterior view: entirely surrounded by the neural arch (0); enclosed in a deep fossa, enclosed laterally by pedicels (1). (Upchurch *et al*., 2004:character 136)

184. Middle and posterior dorsal vertebrae, neural spine height: approximately twice the centrum length (0); for times the centrum length (1). (Upchurch *et al*., 2004)

185. Middle and posterior dorsal neural spines orientation: vertical (0); slightly inclined, with an angle of around 70 degrees (1); strongly inclined, with an angle not bigger than 40 degrees (2). (Modified from Wilson, 2002:character 104)

186. Middle and posterior dorsal vertebral, central keel: absent (0); present (1). (D'Emic, 2012:character 49)

187. Dorsal vertebrae, height of the neural arch divided the height of the centrum: less than 0.8 (0); more than 0.8 (1). (Pol *et al*., 2011:character 132)

188. Middle to posterior dorsal vertebrae, pleurocoel dorsal margin: rounded (0); angular (1). (Rauhut *et al*., 2015:character 346)

189. Middle to posterior dorsal vertebrae, pleurocoel dorsal margin: well below the dorsal margin of the centrum (0); at the level of the dorsal margin of the centrum or higher (1). (Rauhut *et al*., 2015:character 347)

190. Middle to posterior dorsal vertebrae, small fossa anterior or anteroventral to the pleurocoel: absent (0); present (1). (Rauhut *et al.*, 2015:character 348)

191. Middle and posterior dorsal neural arches, centropostzygapophyseal lamina (CPOL), shape: simple (0); divided (1). (Wilson, 2002:character 95)

192. Middle and posterior dorsal neural arches, anterior centroparapophyseal lamina (ACPL): absent (0); present (1). (Wilson, 2002:character 96; Upchurch *et al*., 2004:character 133)

193. Middle and posterior dorsal neural arches, prezygoparapophyseal lamina (PRPL): absent (0); present (1). (Wilson, 2002:character 97)

194. Middle and posterior dorsal neural arches, posterior centroparapophyseal lamina (PCPL): absent (0); present (1). (Wilson, 2002:character 98, Upchurch *et al*., 2004:character 137)

195. Middle and posterior dorsal centrum in transverse section (height: width ratio): subcircular (ratio, similar to 1 or a bit higher) (0); slightly dorsoventrally compressed (ratios between 0.8 and 1) (1); strongly compressed (ratios below 0.8) (2). (Modified from Upchurch *et al*., 2004)

196. Middle and posterior dorsal vertebrae neural spine, triangular aliform processes: absent (0); present but do not project far laterally (not as far as caudal zygapophyses) (1); present and project far laterally (as far as caudal zygapophyses) (2). (Modified from Wilson, 2002:character 102 and Upchurch *et al*., 2004:chs. 153–154).

197. Middle and posterior dorsal vertebrae, spinodiapophyseal lamina (SPDL): absent (0); present (1). (Upchurch *et al*., 2004:character 157)

198. Middle and posterior dorsal vertebrae, accessory spinodiapophyseal lamina (SPDL): absent (0); present (1). (Upchurch *et al*., 2004:character 151)

199. Dorsal vertebrae, spinodiapophyseal webbing: lamina follows curvature of neural spine in anterior view (0); lamina "festooned" from spine, dorsal margin does not closely follow shape of neural spine and diapophysis (1). (Whitlock, 2011:character104)

200. Anterior dorsal vertebrae, spinopostzygapophyseal lamina (SPOL): absent (0); present (1). (Upchurch *et al*., 2007:character133)

201. Middle and posterior dorsal neural spines, lateral spinopostzygapophyseal lamina (lSPOL): absent (0); present (1). (Wilson, 2002: 100; Upchurch *et al*., 2004:character 159)

202. Middle and posterior dorsal neural arches, spinodiapophyseal lamina (SPDL) and spinopostzygapophyseal lamina (lSPOL) contact: absent (0); present (1). (Wilson, 2002:character 101)

203. Middle and posterior dorsal vertebrae, spinodiapophyseal (SPDL) and spinopostzygapophyseal lamina (lSPOL) contact: ventral, well separated from the triangular aliform process (0); dorsal, forms part of the triangular aliform process (1). (Carballido *et al*., 2012)

204. Middle and posterior dorsal vertebrae, height of neural arch below the postzygapophyses (pedicel): less than height of centrum (0); subequal to or greater than height of centrum (1). (Whitlock, 2011:character 109)

205. Posterior Dorsal vertebrae, medial spinopostzygapophyseal lamina (mSPOL): absent (0); present and forms part of the median posterior lamina (1). (Carballido *et al*., 2012)

206. Posterior dorsal vertebrae, transverse processes: lie posterior, or posterodorsal, to the parapophysis (0); lie vertically above the parapophysis (1). (Upchurch *et al*., 2004:character 139)

207. Posterior dorsal centra, articular face shape: amphicoelous (0); slightly opisthocoelous (1); opisthocoelous (2). (Modified from Wilson, 2002:character 105)

208. Posterior dorsal vertebrae, neural spine: narrower transversely than anteroposteriorly (0); broader transversely than anteroposteriorly (1). (Wilson, 2002: character 92)

209. Posterior dorsal vertebra, posterior centrodiapophyseal lamina (PCDL): has an unexpanded ventral tip (0); expands and may bifurcate toward its ventral tip (1). (Salgado *et al*., 1997)

Ribs

210. Cervical ribs, distal shafts of longest cervical ribs: are elongate and form overlapping bundles (0); are short and do not project beyond the caudal end of the centrum to which they are attached (1). (Wilson, 2002:character 140)

211. Cervical ribs, angle between the capitulum and tuberculum: greater than 90°, so that the rib shaft lies close to the ventral edge of the centrum (0); less than 90°, so that the rib shaft lies below the ventral margin of the centrum (1). (Wilson, 2002:character 139)

212. Dorsal ribs, proximal pneumatopores: absent (0); present (1). (Wilson, 2002:character 141)

213. Anterior dorsal ribs, cross-sectional shape: subcircular (0); plank-like, anteroposterior breadth more than three times mediolateral breadth (1). (Wilson, 2002).

Sacrum

214. Sacral vertebrae, number: 3 or fewer (0); 4 (1); 5 (2); 6 (3). (Wilson, 2002:character 108)

215. Sacrum, sacricostal yoke: absent (0); present (1). (Wilson, 2002:character 109)

216. Sacral vertebrae contributing to acetabulum: numbers 1-3 (0); numbers 2-4 (1). (Wilson, 2002:character 110)

217. Sacral neural spines length: approximately twice length of centrum (0); approximately four times length of centrum (1). (Wilson, 2002:character 111)

218. Sacral ribs, dorsoventral length: low, not projecting beyond dorsal margin of ilium (0); high extending beyond dorsal margin of ilium (1). (Wilson, 2002:character 112)

219. Pleurocoels in the lateral surfaces of sacral centra: absent (0); present (1). (Upchurch et al., 2004:character 165)

Caudal vertebrae

220. Caudal vertebrae, number: 35 or fewer (0); 40 to 55 (1); increased to 70-80 (2). (Wilson, 2002:character114)

221. Caudal bone texture: solid (0); spongy (camellate), with large internal cells (1). (Wilson, 2002:character 113)

222. Anterior caudals, pneumatized neural arch: absent (0); present (1).

223. Caudal transverse processes: persist through caudal 20 or more posteriorly (0); disappear by caudal 15 (1); disappear by caudal 10(2). (Wilson, 2002:character 115)

224. First caudal centrum anterior articular surface: flat (0); concave (1); convex (2).

225. First caudal centrum, posterior articular surface: flat (0); concave (1); convex (2).

226. First caudal neural arch, coel on lateral aspect of neural spine: absent (0); present (1). (Wilson, 2002:character 117)

227. Anterior caudal vertebrae (mainly the first and second): ventral bulge on transverse process: absent (0); present (1). (D'Emic, 2012:character 52)

228. Anterior and middle caudal vertebrae, blind fossae in lateral centrum: absent (0); present (1). (D'Emic, 2012:character 56)

229. Posteriormost anteriors and middle caudal vertebrae, transverse processes orientation: perpendicular (0); swept backwards, reaching the posterior margin of the centrum (1). (D'Emic, 2012:character 59)

230. Anterior caudal vertebrae, transverse processes: ventral surface directed laterally or slightly ventrally (0); directed dorsally (1). (Whitlock, 2011:character 125)

231. Anterior caudal centra (excluding the first), articular face shape: amphiplatyan or amphicoelous (0); procoelous/distoplatyan (1); slightly procoelous (2); procoelous (3); posterior surface markedly more concave than the anterior one (4). (Modified from González Riga *et al*, 2009)

232. Anterior caudal centra, pleurocoels: absent (0); present (1). (Wilson, 2002:character 119)

233. Anterior caudal vertebrae, ventral surfaces: convex transversely (0); concave transversely (1). (Upchurch *et al*., 2004:character 182)

234. Anterior and middle caudal vertebrae, ventrolateral ridges: absent (0); present (1). (Upchurch *et al*., 2004:character 183)

235. Anterior and middle caudal vertebrae, triangular lateral process on the neural spine: absent (0); present (1). (Whitlock, 2011:character 123)

236. Anterior caudal transverse processes shape: triangular, tapering distally (0); "winglike", not tapering distally (1). (Wilson, 2002:character 128)

237. Anterior caudal neural spines, transverse breadth: approximately 50% of (0); or greater than anteroposterior length (1). (Wilson, 2002:character 126)

238. Anterior caudal transverse processes, proximal depth: shallow, on centrum only (0); deep, extending from centrum to neural arch (1). (Wilson, 2002:character 127)

239. Anterior caudal transverse processes, diapophyseal laminae (ACDl, PCDL, PRDL, PODL): absent (0); present (1). (Wilson, 2002:character 129)

240. Anterior caudal transverse processes, anterior centrodiapophyseal lamina (ACDL), shape: single (0); divided (1). (Wilson, 2002:character 130)

241. Anterior caudal vertebrae, hyposphene ridge: absent (0); present (1). (Upchurch *et al.*, 2004:character 187)

242. Anterior caudal centra, length: approximately the same (0); or doubling over the first 20 vertebrae (1). (Wilson, 2002:character 120)

243. Anterior caudal neural arches, spinoprezygapophyseal lamina (SPRL): absent, or present as small short ridges that rapidly fade out into the anterolateral margin of the spine (0); present, extending onto lateral aspect of neural spine (1); present, well developed and extending onto the anterior or anterolateral edges of the neural spine (2)(Modified from Wilson, 2002:character 121).

244. Anterior caudal neural arches, spinodiapophyseal lamina (SPDL): absent (0); present (1).

245. Anterior caudal neural arches, spinoprezygapophyseal lamina (SPRL)-spinopostzygapophyseal lamina (SPOL) contact: absent (0); present, forming a prominent lamina on lateral aspect of neural spine (1). (Wilson, 2002:character 122)

246. Anterior caudal neural arches, prespinal lamina (PRSL): absent (0); present (1). (Wilson, 2002:character 123)

247. Anterior caudal vertebrae, ventral and medially placed SPRL, usually described as bifurcated PRSL: absent (0); present (1).

248. Anterior caudal prespinal lamina (PRSL), triangular shaped product of a dorsal expansion of it: absent (0); present (1).

249. Anterior caudal vertebrae, pair thin laminae that are bounding the prespinal laminae and that diverge dorsally: absent (0); present (1).

250. Middle caudal centra, shape: cylindrical (0); with flat ventral margin (1); quadrangular, flat ventrally and laterally (2). (Modified from Wilson, 2002:character 131)

251. Anterior and middle caudal centra, ventral longitudinal hollow: absent (0); present (1). (Wilson, 2002:character 132)

252. Middle caudal centra, articular face shape: amphiplatyan or amphicoelous (0); procoelous/distoplatyan (1); slightly procoelous (2); procoelous (3). (González Riga *et al*., 2009)

253. Posteriormost anteriors and iddle caudal vertebrae, location of the neural arches: over the midpoint of the centrum with approximately subequal amounts of the centrum exposed at either end (0); on the anterior half of the centrum (1). (Upchurch *et al*., 2004:character 185)

254. Anterior caudal vertebrae, anterior face of the centrum strongly inclined anteriorly: absent (0); present (1). (Santucci and Arruda Campos, 2011:character 256)

255. Middle caudal vertebrae, with the anterior face strongly inclined anteriorly: absent (0); present (1).

256. Middle caudal vertebrae, height of the pedicels below the prezygapophysis: low with curved anterior edge of the pedicel (0); high with vertical anterior edge of the pedicel (1). (Carballido *et al*., 2012)

257. Middle caudal vertebrae, orientation of the neural spines: anteriorly (0); vertical (1); slightly directed posteriorly (2); strongly directed posteriorly (3). (Modified from Wilson, 2002:character 133)

258. Posterior caudal vertebrae, neural spine strongly displaced posteriorly: absent (0); present (1). (Carballido *et al*., 2012).

259. Middle caudal vertebrae, ratio of centrum length to centrum height: less than 2, usually 1.5 or less (0); 2 or higher (1). (Upchurch *et al*., 2004:character 179)

260. Anterior-posterior caudal vertebrae (those with still well developed neural spine), neural spine orientation: vertical (0); slightly directed posteriorly (1); strongly directed posteriorly (2). (Carballido *et al*., 2012)

261. Posterior caudal centra, articular face shape: anphyplatic (0); procoelous (1); opisthocoelous (2). (Modified from González Riga *et al*., 2009)

262. Posterior caudal centra, shape: cylindrical (0); dorsoventrally flattened, breadth at least twice height (1). (Wilson, 2002:character 135)

263. Posterior caudal vertebrae, ratio of length to height: less than 5, usually 3 or less (0); 5 or higher (1). (Upchurch *et al*., 2004:character 180)

264. Distalmost caudal centra, articular face shape: platycoelous (0); biconvex (1). (Wilson, 2002:character 136)

265. Distalmost biconvex caudal centra, number: 10 or fewer (0); more than 30 (1). (Wilson, 2002:character 137)

266. Distalmost biconvex caudal centra, length-to height ratio: less than 4 (0); greater than 5 (1). (Wilson, 2002:character 138)

267. Forked chevrons with anterior and posterior projections: absent (0); present (1). (Wilson, 2002:character 143)

268. Forked chevrons, distribution: distal tail only (0); throughout middle and posterior caudal vertebrae (1). (Wilson, 2002:character 144)

269. Chevrons, crus bridging dorsal margin of haemal canal: present (0); absent (1). (Wilson, 2002:character 145)

270. Chevron haemal canal, depth: short, approximately 25% (0); or long, approximately 50% chevron length (1). (Wilson, 2002:character 146)

271. Chevrons: persisting throughout at least 80% of tail (0); disappearing by caudal 30 (1). (Wilson, 2002:character 147)

272. Posterior chevrons, distal contact: fused (0); unfused (open) (1). (Wilson, 2002:character 148)

Shoulder girdle

273. Posture: bipedal (0); columnar, obligatory quadrupedal posture (1). (Wilson, 2002:character 149)

Scapular girdle

274. Scapular acromion process, size: Narrow (0); broad, width more than 150% minimum width of blade (1). (Wilson, 2002:character 150)

275. Scapular blade, orientation respect to coracoid articulation: perpendicular (0); forming a 45º angle (1). (Wilson, 2002:character 151)

276. Scapular blade, distal expansion: absent (0); present (1).

277. Scapular blade, shape: acromial edge not expanded (both edges are running parallel to each other) (0); rounded expansion on acromial side (1); racquet-shaped (2): marked distal expansion due to the posterodorsal orientation of the dorsal edge (3). (Wilson, 2002:character 152; as modified by Carballido *et al*., 2017:character 277)

278. Scapula, acromion process dorsal margin: concave or straight (0); with V-shaped concavity (1); with U-shaped concavity (2). (Sereno *et al*., 2007: 88)

279. Scapula, highest point of the dorsal margin of the blade: lower than the dorsal margin of the proximal end (0); at the same height than the dorsal margin of the proximal end (1); higher than the dorsal margin of the proximal end (2). (Carballido *et al*., 2012 from Mannion, 2009)

280. Scapula, development of the acromion process: undeveloped (0); well developed (1). (Carballido *et al*., 2012)

281. Scapular length/minimum blade breadth: 5.5 or less (0); 5.5 or more (1). (Carballido *et al*., 2012)

282. Scapula, ventral margin with a well-developed ventromedial process: absent (0); present (1). (Carballido *et al*., 2011)

283. Scapular, acromial process position: lies nearly glenoid level (0); lies nearly midpoint scapular body (1). (Carballido *et al*., 2012)

284. Scapular acromion length: less than 1/2 scapular length (0); at least 1/2 scapular length (1). (Mannion *et al*., 2012:character168)

285. Glenoid scapular orientation: relatively flat or laterally facing (0); strongly bevelled medially (1). (Wilson, 2002:character 153)

286. Scapular blade, cross-sectional shape at base: flat or rectangular (0); D-shaped (1). (Wilson, 2002:character 154)

287. Coracoid, proximodistal length: less than the length of scapular articulation (0); approximately twice the length of scapular articulation (1). (Wilson, 2002:character 155)

288. Coracoid, anteroventral margin shape: rounded (0); rectangular (1). (Wilson, 2002:character 156)

289. Dorsal margin of the coracoid in lateral view: reaches or surpasses the the level of the dorsal margin of the scapular expansion (0); lies below the level of the scapular proximal expansion and separated from the latter by a V-shaped notch (1). (Upchurch *et al*., 2004:character 207)

290. Coracoid, Infraglenoid deep groove: absent (0); present (1).

291. Coracoid, infraglenoid lip: absent (0); present (1). (Wilson, 2002:character 157)

292. Sternal plate, shape: posterolateral margin curved (0); posterolateral margin expanded as a corner (1). (D'Emic, 2012:character 76)

293. Sternal plate, shape: oval (0); crescentic (1). (Wilson, 2002:character 158)

294. Prominent posterolateral expansion of the sternal plate producing a kidney-shaped profile in dorsal view: absent (0); present (1). (Upchurch *et al*., 2004:character 211)

295. Prominent parasagital oriented ridge on the dorsal surface of the sternal plate: absent (0); present (1). (Upchurch *et al*., 2004:character 212)

296. Ridge on the ventral surface of the sternal plate: absent (0); present (1). (Upchurch *et al*., 2004:character 213)

297. Ratio of maximum length of sternal plate to the humerus length: less than 0,75, usually less than 0,65 (0); greater than 0,75 (1). (Upchurch *et al*., 2004:character 209)

Fore limbs

298. Humerus, strong posterolateral bulge around the level of the deltopectoral crest: absent (0); present (1). (D'Emic, 2012:character 80)

299. Humerus, radial and ulnar condyles shape: radial condyle divided on anterior face by a notch (0); undivided (1). (D'Emic, 2012:character 83)

300. Humerus-to-femur ratio: less than 0.60 (0); 0.60 to 0.90 (1); greater than 0.90 (2). (Upchurch *et al*., 2004:character 216)

301. Humeral deltopectoral attachment, development: prominent (0); reduced to a low crest or ridge (1). (Wilson, 2002:character160)

302. Humeral deltopectoral crest, shape: relatively narrow throughout length (0); markedly expanded distally (1). (Wilson, 2002:character161)

303. Humeral midshaft cross-section, shape: circular (0); elliptical (1). (Mannion *et al*, 2011:character 170)

304. Humerus, RI (sensu Wilson and Upchurch, 2003): Gracile (less than 0,27) (0); medium (0,28-0,32) (1); Robust (more than 0,33) (2). (Carballido *et al*., 2012)

305. Humeral distal condyles, articular surface shape: restricted to distal portion of humerus (0); exposed on anterior portion of humeral shaft (1). (Wilson, 2002:character 163)

306. Humeral distal condyle, shape: divided (0); flat (1). (Wilson, 2002:character 164)

307. Humeral, lateral margin: medially deflected (0); almost straight until the half length or even more (1); almost straight until the proximal third of the total length of the humerus (2). (Carballido *et al*., 2012)

308. Humeral proximolateral corner, shape: rounded, the dorsal surface is well convex (0); pronounced / square, the dorsal surface low, almost flat (1). (Wilson, 2002:character 159)

309. Ulnar proximal condyle, shape: subtriangular (0); triradiate, with deep radial fossa (1). (Wilson, 2002:character 165)

310. Ulnar proximal condylar processes, relative lengths: subequal (0); unequal, anterior arm longer (1). (Wilson, 2002:character 166)

311. Ulnar olecranon process, development: prominent, projecting above proximal articulation (0); rudimentary, level with proximal articulation (1). (Wilson, 2002:character 167)

312. Ulna, length-to-proximal breadth ratio: gracile (0); stout (1). (Wilson, 2002:character 168)

313. Radial distal condyle, shape: round (0); subrectangular, flattened posteriorly and articulating in front of ulna (1). (Wilson, 2002:character 169)

314. Radius, distal breadth: slightly larger than midshaft breadth (0); approximately twice midshaft breadth (1). (Wilson, 2002:character 170)

315. Radius, distal condyle orientation: perpendicular to long axis of shaft (0); bevelled approximately 20º proximolaterally relative to long axis of shaft (1). (Wilson, 2002:character 171)

316. Carpal bones, number: 3 or more (0); 2 or fewer (1). (Wilson, 2002:character 173) 317. Carpal bones, shape: round (0); block-shaped, with flattened proximal and distal surfaces (1). (Wilson, 2002:character 174)

318. Metacarpus, shape: spreading (0); bound, with sub-parallel shafts and articular surfaces that extend half their length (1). (Wilson, 2002:character 175)

319. Metacarpals, shape of proximal surface in articulation: gently curving, forming a 90arc (0); U-shaped, subtending a 270arc (1). (Wilson, 2002:character 176)

320. Longest metacarpal-to-radius ratio: close to 0.3 (0); 0.45 or more (1). (Wilson, 2002:character 177)

321. Metacarpal I, length: shorter than metacarpal IV (0); longer than metacarpal IV (1). (Wilson, 2002:character 178)

322. Metacarpal I, distal condyle shape: divided (0); undivided (1). (Wilson, 2002:character 179)

323. Metacarpal I distal condyle, transverse axis orientation: bevelled approximately 20º respect to axis of shaft (0); proximodistally or perpendicular with respect to axis of shaft (1). (Wilson, 2002:character 180)

324. Manual digits II and III, phalangeal number: 2-3-4-3-2 or more (0); reduced, 2-2-2-2-2 or less (1); absent or unossified (2). (Wilson, 2002:character 181)

325. Manual phalanx I.1, shape: rectangular (0); wedge-shaped (1). (Wilson, 2002:character 182)

326. Manual nonungual phalanges, shape: longer proximodistally than broad transversely (0); broader transversely than long proximodistally (1). (Wilson, 2002:character 183)

Pelvic girdle

327. Pelvis, anterior breadth: narrow, ilia longer anteroposteriorly than distance separating preacetabular processes (0); broad, distance between preacetabular processes exceeds anteroposterior length of ilia (1). (Wilson, 200:character 184)

328. Ilium, ischial peduncle size: large, prominent (0); low, rounded (1). (Wilson, 2002:character 185)

329. Ilium, dorsal margin shape: flat (0); semicircular (1). (Wilson, 2002:character 186)

330. Illiun, preacetabular ventral margin shape: straight (0), concave (1); with a convex ventral bump (2)

331. Ilium, preacetabular process shape: pointed, arching ventrally (0); semicircular, with posteroventral excursion of cartilage cap (1). (Wilson, 2002:character 188)

332. Ilium, preacetabular process orientation: anterolateral to body axis (0); perpendicular to body axis (1). (Wilson, 2002:character 189)

333. Highest point on the dorsal margin of the ilium: lies caudal to the base of the pubic process (0); lies cranial to the base of the pubic process (1). (Upchurch *et al*., 2004:character 245)

334. Pubis length respect to ischium: pubis slightly smaller or subequal to ischium (0); pubis larger (120% +) than ischium (1). (Carballido *et al*., 2012)

335. Pubis, ambiens process development: small, confluent with anterior margin of pubis prominent, (0); projects anteriorly from anterior margin of pubis (1). (Wilson, 2002:character 189)

336. Pubic apron, shape: flat (straight symphysis) (0); canted anteromedially (gentle Sshaped symphysis) (1). (Wilson, 2002:character 190).

337. Puboischial contact, length: approximately one third total length of pubis (0); onehalf total length of pubis (1). (Wilson, 2002:character 191)

338. Ischium, acetabular articular surface: maintains approximately the same transverse width throughout its length (0); is transversely narrower in its central portion and strongly expanded as it approaches the iliac and pubic articulations (1). (Mannion *et al*., 2013:character 180)

339. Ischium, iliac peduncle with constriction or "neck": absent (0); present (1). (Whitlock, 2011:character 173).

340. Ischium, elongate muscle scar on proximal end: absent (0); present (1). (Whitlock, 2011:character 174)

341. Ischial blade, shape: emarginate distal to pubic peduncle (0); no emargination distal to pubic peduncle (1). (Wilson, 2002:character 193)

342. Ischia pubic articulation: less or equal to the anteroposterior length of pubic pedicel (0); greater than the anteroposterior length of pubic pedicel (1). (Salgado *et al*., 1997)

343. Ischia, anteroposterior pubic pedicel width divided the total length of the ischium: less than 0.5 (0); 0.5 or larger (1). (Carballido *et al*., 2012).

344. Ischial distal shaft, shape: triangular, depth of ischial shaft increases medially (0); bladelike, medial and lateral depths subequal (1). (Upchurch *et al*., 2004:character 194)

345. Ischial distal shafts, cross-sectional shape: V-shaped, forming an angle of nearly 50º with each other (0); flat, nearly coplanar (1). (Wilson, 2002:character 195)

346. Ischia, distal end: is only slightly expanded (0); is strongly expanded dorsoventrally (1). (Upchurch, 1998:character 183)

347. Ichium, angle formed between the shaft and the acetabular line: forming an almost right angle (80-110°) (0) or; a close angle (less than 70°) (1). (Carballido *et al*., 2012)

348. Ischial tuberosity: absent (0); present (1).

Hind limbs

349. Femur, longitudinal ridge on the anterior face: absent (0); present (1). (D'Emic, 2012:character 107)

350. Femur, fibular condyle: well developed, having a similar height than the tibial one (0); much shorter than the tibial condyle (1).

351. Femur, epicondyle development: well developed (0); reduced, almost absent (1).

352. Femur, fourth trochanter position: almost at the half of the femur (0); in the proximal third of the femur (1).

353. Femur, fourth trochanter development: prominent (0); reduced to crest or ridge (1); extremely reduced (2). (Modified from Wilson, 2002:character 196, following to Whitlock, 2011:character 186)

354. Femur, lesser trochanter: present (0); absent (1). (Wilson, 2002:character 197)

355. Femur midshaft, transverse diameter: subequal to anteroposterior diameter (0); 125–150% anteroposterior diameter (1); at least 185% anteroposterior diameter (2). (Wilson, 2002:character 198)

356. Femur, lateral bulge (marked by the lateral expansion and a dorsomedial orientation of the laterodorsal margin of the femur, which starts below the femur head ventral margin): absent (0); present (1). (Salgado *et al*., 1997)

357. Femur, pronounced ridge on posterior surface between greater trochanter and head: absent (0); present (1). (Whitlock, 2011:character 181)

358. Femur head position: perpendicular to the shaft, rises at the same level than the greater trochanter (0); dorsally directed, rises well above the level of the greater trochanter (1). (Modified from Upchurch *et al*., 2004:character 263)

359. Femur, distal condyles relative transverse breadth: subequal (0); tibial much broader than fibular (1). (Wilson, 2002:character 2000)

360. Femur, distal condyles orientation: perpendicular or slightly bevelled dorsolaterally (0); or bevelled dorsomedially approximately 10 relative to femoral shaft (1). (Wilson, 2002:character 201)

361. Femur, distal condyles articular surface shape: restricted to distal portion of femur (0); expanded onto anterior portion of femoral shaft (1). (Wilson, 2002:character 202)

362. Situation of the femoral fourth trochanter: on the caudal surface of the shaft, near the midline (0); on the caudomedial margin of the shaft (1). (Upchurch *et al*., 2004:character 268)

363. Tibial proximal condyle, shape: narrow, long axis anteroposterior (0); expanded transversely, condyle subcircular (1). (Wilson, 2002:character 203)

364. Tibial cnemial crest, orientation: projecting anteriorly (0); or laterally (1). (Wilson, 2002:character 204)

365. Tibia, distal breadth: approximately 125% (0); more than twice midshaft breadth (1). (Wilson, 2002:character 205)

366. Tibial distal posteroventral process, size: broad transversely, covering posterior fossa of astragalus (0); shortened transversely, posterior fossa of astragalus visible posteriorly (1). (Wilson, 2002:character 206)

367. Fibula, proximal tibial scar, development: not well-marked (0); well-marked and deepening anteriorly (1). (Wilson, 2002:character 207)

368. Fibula, lateral trochanter: absent (0); present (1). (Wilson, 2002:character 208)

369. Fibular distal condyle, size: subequal to shaft (0); expanded transversely, more than twice midshaft breadth (1). (Wilson, 2002:character 209)

370. Fibular, proximal end, anterior crest: absent or poorly developed (0); well developed creating an interlocking proximal crus (1). (D'Emic, 2012:character 111)

371. Fibula, shaft shape: straight, or slightly sigmoidal (0); sigmoid, such that the proximal and distal faces are angled relative to midshaft (1). (D'Emic, 2012:character 113)

372. Astragalus, shape: at least 1.5 times wider than anteroposteriorly long (0); anteroposterior and transverse dimensions subequal (1). (D'Emic, 2012:character 115)

373. Astragalus, shape: rectangular (0); wedge shaped, with reduced anteromedial corner (1). (Wilson, 2002:character210)

374. Astragalus, fibular facet: faces laterally (0); faces posterolaterally, anterior margin visible in posterior view (1). (Whitlock, 2011:character 186)

375. Astragalus, foramina at base of ascending process: present (0); absent (1). (Wilson, 2002:character 211)

376. Astragalus, ascending process length: limited to anterior two-thirds of astragalus (0); extending to posterior margin of astragalus (1). (Wilson, 2002:character 212)

377. Astragalus, posterior fossa shape: undivided (0); divided by vertical crest (1). (Wilson, 2002:character 213)

378. Astragalus, transverse length: 50% more than (0); or subequal to proximodistal height (1). (Wilson, 2002:character 214)

379. Calcaneum: present (0); absent or unossified (1). (Wilson, 2002:character 215)

380. Distal tarsals 3 and 4: present (0); absent or unossified (1). (Wilson, 2002:character 216)

381. Metatarsus, posture: bound (0); spreading (1). (Wilson, 2002:character 217)

382. Metatarsal I proximal condyle, transverse axis orientation: perpendicular to (0); angled ventromedially approximately 15º to axis of shaft (1). (Wilson, 2002:character 218)

383. Metatarsal I distal condyle, transverse axis orientation: perpendicular to (0); angled dorsomedially to axis of shaft (1). (Wilson, 2002:character 219)

384. Metatarsal III length divided by metatarsal I length: less than 1.3 (0); more than 1.3 (1). (González Riga *et al*., 2016:character 331)

385. Longest metatarsal: metatarsal III (0); metatarsal IV (1). (González Riga et al., 2016:character 334)

386. Metatarsal I distal condyle, posterolateral projection: absent (0); present (1). (Wilson, 2002:character 220)

387. Metatarsal I, minimum shaft width: less than that of metatarsals II-IV (0); or greater than that of metatarsals IIIV (1). (Wilson, 2002:character 221)

388. Metatarsal I and V proximal condyle, size: smaller than (0); or subequal to those of metatarsals II and IV (1). (Wilson, 2002:character 222)

389. Metatarsal III length: more than 30% (0); or less than 25% that of tibia (1). (Wilson, 2002:character 223)

390. Metatarsals III and IV, minimum transverse shaft diameters: subequal to (0); or less than 65% that of metatarsals I or II (1). (Wilson, 2002:character 224)

391. Metatarsal IV, proximomedial end, shape: flat or slightly concave (0); possesses a distinct embayment (1). (D'Emic, 2012:character 117)

392. Metatarsal IV, distal end, orientation: roughly perpendicular to long axis of bone (0); bevelled upwards medially (1). (D'Emic, 2012:character 118)

393. Metatarsal V, length: shorter than (0); or at least 70% length of metatarsal IV (1). (Wilson, 2002:character 225)

394. Pedal nonungual phalanges, shape: longer proximodistally than broad transversely (0); broader transversely than long proximodistally (1). (Wilson, 2002:character 226)

395. Pedal digits II-IV, penultimate phalanges, development: subequal in size to more proximal phalanges (0); rudimentary or absent (1). (Wilson, 2002:character 227)

396. Pedal unguals, orientation: aligned with (0); or deflected lateral to digit axis (1). (Wilson, 2002:character 228)

397. Pedal digit I ungual, length relative to pedaldigit II ungual: subequal (0); 25% larger than that of digit II (1). (Wilson, 2002:character 229)

398. Pedal digit I ungual, length: shorter (0); or longer than metatarsal I (1). (Wilson, 2002:character 230)

399. Pedal ungual I, shape: broader transversely than dorsoventrally (0); sickle-shaped, much deeper dorsoventrally than broad transversely (1). (Wilson, 2002:character 231)

400. Pedal ungual II-III, shape: broader transversely than dorsoventrally (0); sickleshaped, much deeper dorsoventrally than broad transversely (1). (Wilson, 2002:character 232)

401. Pedal digit IV ungual, development: subequal in size to unguals of pedal digits II and III (0); rudimentary or absent (1). (Wilson, 2002:character 233)

402. Unguals of pedal digit II and III, proximal dimensions: as broad as deep (0); significantly broader than deep (1). (Allain and Aquesbi, 2008:character 253)

403. Number of phalanges in pedal digit II: 3 (0); 2 (1). (González Riga *et al*., 2016:character 348)

404. Number of phalanges in pedal digit III: 4 (0); 3 (1). (González Riga *et al*., 2016:character 349)

405. Number of phalanges in pedal digit IV: 3 or more (0); 2 (1); 1 (2). (González Riga *et al*., 2016:character 350)

406. Postorbital, excluded from the infratemporal fenestra due to the articulation of the jugal with the squamosal: absent (0), present (1). (Canudo *et al*., 2018)

407. Squamosal, ventral shape: thin (0); broad (1). (Canudo *et al*., 2018)

408. Preantorbital fenestra development: small, differentiated from the posterior maxillary foramen in its direction (see Wilson and Sereno, 1998) (0); laterally opened middle sized fenestra (1); laterally opened large fenestra (2). (Canudo *et al*., 2018)

409. Mid- and posterior dorsal neural arches, centroprezygapophyseal fossa depth shallow or absent (0); deep, passing nearly all the way through the neural arch. (Wilson and Allain, 2015:character 101)

410. Mid- Posterior dorsal vertebrae, parapophysis, position with respect to prezygapophyses: at the same level or below (0); well above (1). (Wilson and Allain, 2015:character 100)

411. Posterior dorsal neural arches, centroprezygapophyseal lamina (CPRL), shape: single (0); divided (1). (Wilson and Allain, 2015:character 107)

412. Posterior dorsal neural arches, spinoparapophyseal lamina (SPPL): absent (0); present (1). (Wilson and Allain, 2015:character 109)

413. Middle caudal vertebrae, prezygapophyses orientation: anterodorsally oriented (around 45 degrees) (0); anteriorly oriented (nearly horizontal) (1). (Canudo *et al*., 2018)

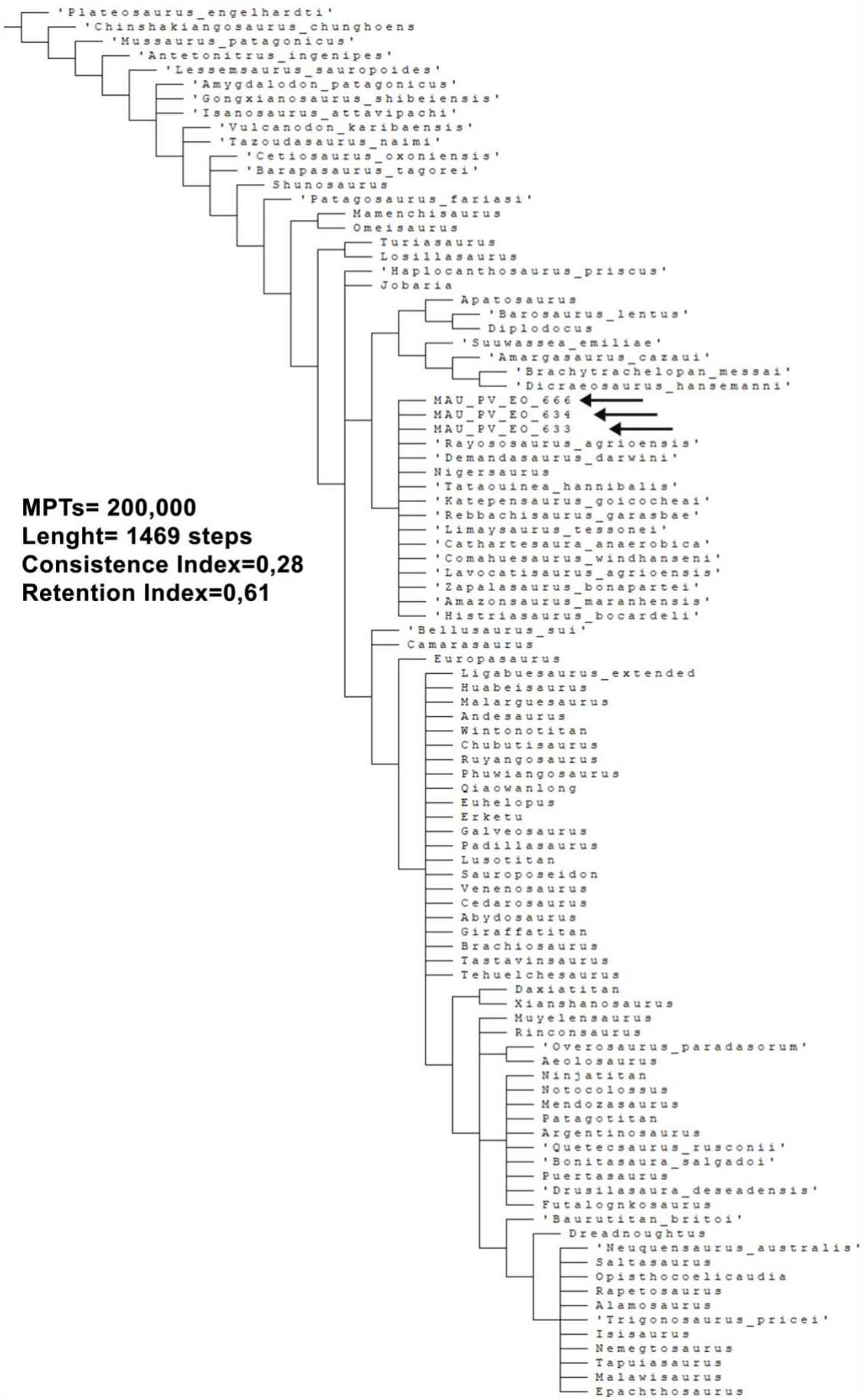
414. Scapular acromion, ventral process: absent (0), present (1)

415. Illium, postacetabular posteroventral edge: open concave (0); U-shaped notch (1); horizontal and low V-shaped notch (2)

416. Pubis, ischiadic articular surface: continuous without marked angle change (0); marked step formed by a proximal posterior directed surface and a more distal posterodorsal oriented surface (1)

417. Pubis, proximal symphysis: merges with the pubic shaft (0); forms a marked ventromedially directed process (1)

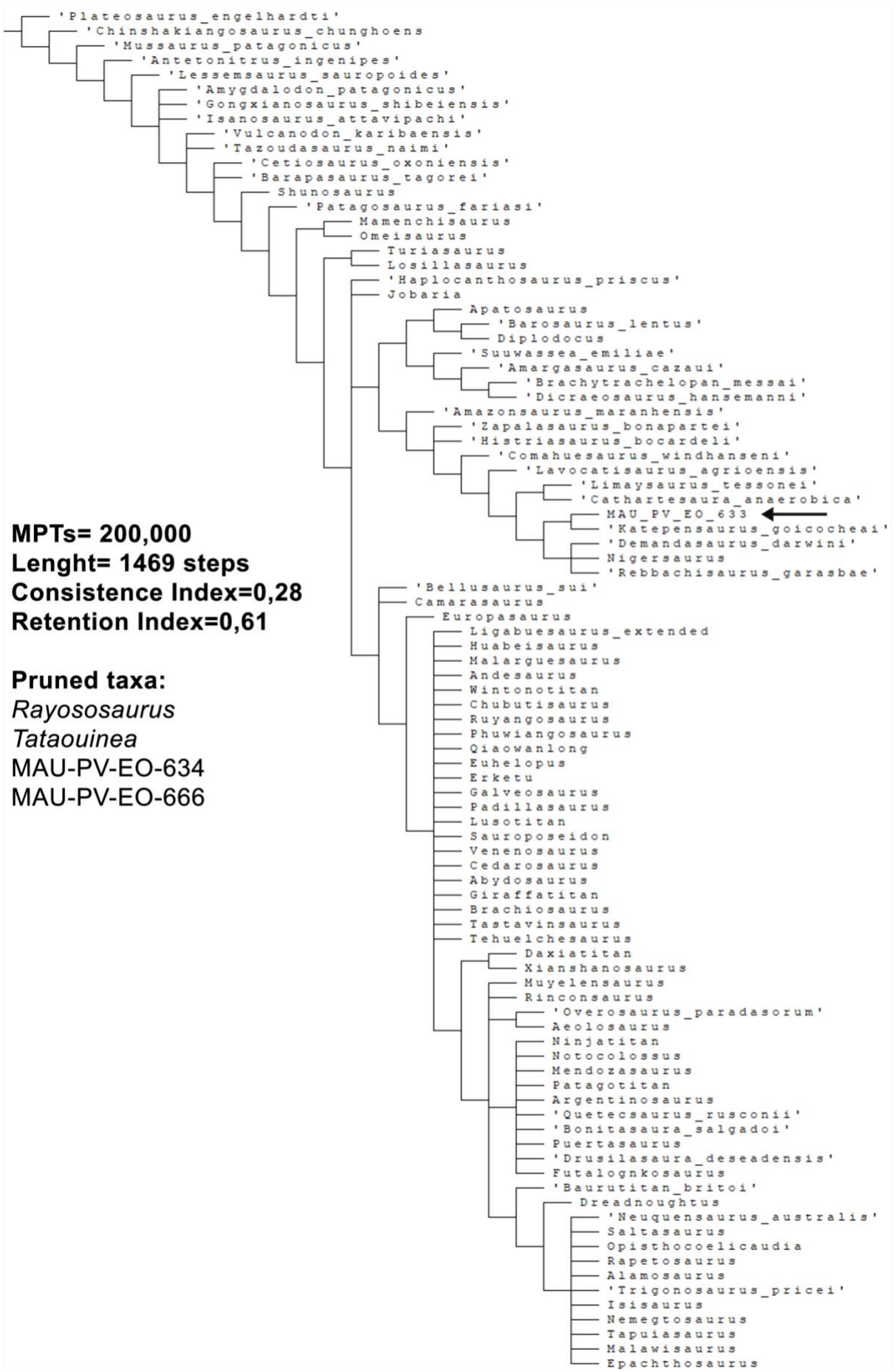
2.5. Strict consensus tree Fig. S1



MPTs= 200,000
Lenght= 1469 steps
Consistence Index=0,28
Retention Index=0,61

Figure S1. Strict consensus tree obtained from the phylogenetic analysis carried out based on the data matrix Bellardini *et al*. (2022). Black arrows show the positions of the new rebbachisaurid specimens within the polytomy that includes a Rebbachisauridae. Abbrev.: **MPTs**, most parsimonious trees.

2.6. Reduced strict consensus tree Fig. S2



MPTs= 200,000
Lenght= 1469 steps
Consistence Index=0,28
Retention Index=0,61

Pruned taxa:
Rayososaurus
Tataouinea
MAU-PV-EO-634
MAU-PV-EO-666

Figure S2. Reduced strict consensus tree obtained after pruning 4 unstable taxa. Black arrows show the MAU-PV-EO-633 position within Rebbachisauridae. Abbrev.: **MPTs**, most parsimonious trees.