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SUPPLEMENTARY ONLINE MATERIAL FOR

A new bernissartiid crocodyliform from the Barremian Wessex Formation (Wealden Group) of the Isle of Wight, southern England

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SOM 1.1. Character generation and coding methods

The character list is a combination of 216 characters from previously published analyses (see references in SOM 1.2.) and 26 new characters. The character states were coded from the data matrices of Pol & Powell (2011) and Salisbury *et al.* (2006). The coding was adjusted or supplemented where necessary using published information and photos of the individual taxa. Compound characters were avoided so that the resulting tree topologies would not be affected by the character construction (Brazeau, 2011). To remove compound characters some characters were split into two or more component characters and the coding was adjusted accordingly.

Taxa with multiple states for the same character are coded with an '&' between the states. When there is uncertainty as to which state is applicable, but there is evidence for both '/' is used between the states. Taxa with unknown states for a character are coded with '?', those with non-applicable states are coded with '-', all other character states are coded between 0 and 4. Two characters are given additive states (Ch. 44 & 48) and are marked with '+' in SOM 1.2.

SOM 1.2. Character list

Character 1. In dorsal view the lateral contour of the rostrum is straight (0), or sinusoidal (1) (After Ortega *et al.* 2000: ch.130)

Character 2. Rostrum proportions: narrow oreinirostral (0), broad oreinirostral (1), nearly tubular (2), or platyrostral (3) (Clark 1994: Ch. 3)

Character 3. From the cranial table the rostrum dorsal surface is concave (0), convex (1), approximately straight (2)

Character 4. The widest point of the premaxilla compared to the width of the rostrum at alveoli 4 or 5, smaller or equal (0), greater (1) (After Jouve 2009: Ch 341)

Character 5. In dorsal view the premaxilla is pointed (0), or blunt (1)

Character 6. Expansion of the premaxilla anterior to the external nares (0), absent (1)

Character 7. Ventral edge of the premaxilla is at the same height as that of the maxilla (0), or located deeper, with dentary sculpted to fit (1) (After Ortega *et al.* 2000: Ch. 10)

Character 8. Premaxilla is long and narrow (0), or short and broad (1) (Modified from Clark, 1994: Ch. 5)

Character 9. The distance between the rostrum tip and the most anterior extremity of the premaxilla-maxilla suture compared to the distance between the anterior and posterior extremities of the premaxilla-maxilla suture: greater (0), smaller (1) (After Jouve 2004: Ch. 205)

Character 10. Dorsal border of nares formed mostly by nasals (0), or by both the nasals and the premaxilla (1) (Pol 1999. Ch. 136)

Character 11. Dorsal premaxillary processes short, not extending beyond third maxillary alveolus (0), or long, extending beyond third maxillary alveolus (1) (Brochu 1999: Ch. 145)

Character 12. Small foramen located in the premaxilla-maxilla suture in lateral surface (not for big mandibular teeth): absent (0), or present (1) (Pol 1999: Ch. 149)

Character 13. Posterior end of premaxilla-maxilla suture on dorsal surface of rostrum: straight forming an acute V-shaped suture (0), or gradually curving medially forming a broad U-shape suture (1) (Gasparini *et al.* 2006: Ch. 242)

Character 14. Ventrally opened notch on ventral edge of rostrum at premaxilla-maxilla contact (for big mandibular teeth): absent (0), present (1) (Modified from Clark 1994: Ch. 9)

Character 15. If present, the premaxilla-maxilla dental notch is laterally open (0), closed/constrained (1) (Modified from Clark 1994, Ch. 9)

Code with a dash for any taxa coded "0" in character 14.

Character 16. Maxilla extends posterior of the anterior margin of the orbit (0), terminates before the orbit (1) (After Wu *et al.* 2001: Ch. 114)

Character 17. Large and aligned neurovascular foramina on lateral maxillary surface: absent (0), or present (1) (Pol 1999: Ch. 152)

Character 18. Depression on posterolateral surface of maxilla: absent (0), or present (1) (Wu *et al.* 1997: Ch. 127)

Character 19. Ventral edge of the maxilla is straight (0), convex (1), or sinusoidal (2) (Modified from Ortega *et al.* 2000: Ch. 21)

Character 20. External nares facing anterolaterally or anteriorly (0), or dorsally (1) (Modified from Clark 1994: Ch. 6)

Character 21. Notch in premaxilla on lateral edge of external nares: absent (0), or present on the dorsal half of the external nares lateral margin (1) (Pol 1999: Ch. 135)

Character 22. External nares divided by a septum (0), or confluent (1) (Clark 1994: Ch. 66)

Character 23. Anterodorsal margin of the external nares with small dorsal projection at the level of the suture between right and left premaxillae (0), or without premaxillary dorsal projection (1) (Modified from Jouve 2004: Ch. 3 by Fortier *et al.* 2011: Ch. 264)

Character 24. Premaxilla participation in internarial bar: forming at least ventral half (0), or with little participation (1) (Clark 1994: Ch. 4)

Code with a dash for any taxa coded "1" in character 22.

Character 25. Nasal contributes to narial border: yes (0), no (1) (Clark 1994: Ch. 13)

Character 26. Nasal bones: paired (0), or fused (1) (Gasparini *et al.* 2006: Ch. 257)

Character 27. Nasal contacts lachrymal (0), or the prefrontals and maxillae intercept them (1) (Modified from Clark 1994: Ch. 11)

Character 28. Nasal-premaxilla contact: present (0), or absent (1) (Clark 1994: Ch. 14)

Character 29. Nasal lateral edges: nearly parallel (0), oblique to each other converging anteriorly (1), or oblique to each other diverging anteriorly (2) (Pol 1999: Ch. 141)

Character 30. Nasal lateral border posterior to external nares: laterally concave (0), or straight (1) (Pol 1999: Ch. 140)

Character 31. If the nasals do not reach the nares or premaxilla, they are more than half the rostrum length (0), less than half the rostrum length (1)

Code with a dash for any taxa coded "1" in character 28.

Character 32. Considerable posterolateral expansion of the nasals present (0), absent (1)

Character 33. Caudal tip of nasals: converge at sagittal plane (0), or caudally separated by anterior sagittal projection of frontals (1) (Ortega *et al.* 2000: Ch. 24)

Character 34. Posterolateral region of nasals: flat surface facing dorsally (0), or lateral region deflected ventrally, forming part of the lateral surface of the snout (1) (Pol & Apesteguia 2005: Ch. 223)

Character 35. Lachrymal contacts nasal along medial/posterior edge only (0), or medial/anterior edges (1) (Clark 1994: Ch. 12)

Character 36. Lachrymal exposure in dorsal view: present (0), absent (1) (After Andrade *et al.* 2011)

Character 37. Nasal participation on antorbital fenestra: yes (0), or no (1) (Ortega *et al.* 2000: Ch. 70)

Code with a dash for any taxa coded "1" in character 38.

Character 38. Antorbital fenestra present (0), or absent (1) (Benton & Clark 1988; Norell & Clark 1990: Ch. 2)

Character 39. Shape of antorbital fenestra: rounded, dorsoventrally high (0), or elongate and slit like (1) (After Gasparini *et al*. 2006: Ch. 246)

Code with a dash for any taxa coded "1" in character 38.

Character 40. Antorbital fenestra as large as orbit (0), or less than half the diameter of the orbit (1) (Clark 1994: Ch. 67)

Code with a dash for any taxa coded "1" in character 38.

Character 41. Heterodonty: present (0), absent (1)

Character 42. Prognathus anterior teeth: present (0), absent (1)

Character 43. Premaxillary teeth 1 and 2 position: separated like adjacent teeth (0), or nearly confluent (1) (Larsson & Gado 2000: Ch. 162)

+ Character 44. Premaxillary teeth: five (0), four (1), three (2), two (3) or one (4) (Modified from Wu & Sues 1996: Ch. 27 and Ortega *et al.* 2000: Ch. 133 by Gasparini *et al*. 2006: Ch.106)

Character 45. Edentulous region in the premaxilla below the external nares: absent (0), or present (1) (Riff & Kellner 2011: Ch. 266)

Character 46. Posterior premaxillary teeth: similar in size to anterior teeth (0), or much longer (1) (Clark 1994: Ch. 78)

Character 47. Last premaxillary tooth position relative to tooth row: anterior (0), or anterolateral (1) (Sereno *et al.* 2001: Ch. 70)

+ Character 48. Maxilla: with eight or more teeth (0), seven (1), six (2), five (3), or four teeth (4) (Wu & Sues 1996: Ch. 30)

Character 49. Maxillary teeth crowns are isodont (0) increase and then decrease in size in a wave (1), or increase and then decrease in size in more than one wave (festooned) (2) (Modified from Clark 1994: Ch. 79)

Character 50. Maxillary teeth: not compressed laterally (0), or compressed laterally (1) (Pol 1999: Ch. 154 and Ortega *et al.* 2000: Ch. 104)

Character 51. Maxillary teeth are markedly recurved: present (0), absent (1)

Character 52. Position of first enlarged maxillary teeth: second or third alveoli (0), or fourth or fifth (1) (Modified from Ortega *et al.* 2000: Ch. 156 by Gasparini *et al*. 2006: Ch. 184)

Code with a dash for any taxa coded "0" in character 49.

Character 53. Occlusal pits between maxillary teeth 7 & 8: absent (0), present (1) (Modified from Salisbury *et al.* 2006: Ch. 78)

Character 54. Anterior dentary teeth opposite premaxilla-maxilla contact: no more than twice the length of other dentary teeth (0), or more than twice the length (1) (Clark 1994: Ch.80)

Character 55. Dentary teeth posterior to tooth opposite premaxilla-maxilla contact: equal in size (0), or enlarged dentary teeth opposite to smaller teeth in maxillary tooth-row (1) (Clark 1994: Ch. 81)

Character 56. Dentary teeth occlude lingually with the maxillary teeth (0), are in line with each other (1) (Modified from Salisbury 2006: Ch. 78)

Character 57. Compressed crown of posterior teeth: oriented parallel to the longitudinal axis of skull (0), or obliquely disposed (1) (Pol 1999: Ch. 151)

Code with a dash for any taxa coded "0" in character 50.

Character 58. Posterior teeth with rings of undulated enamel: absent (0), or present (1) (Soto *et al.* 2011: Ch. 242)

Character 59. Crenulated enamel striations: present (0), absent (1)

Character 60. Tooth margins in posterior region of the toothrow: with denticulate carinae (0), or without carinae or with smooth or crenulated carinae (1), or with tubercular denticles (2) (Modified from Ortega *et al.* 1996: Ch. 11 by Pol & Powell 2011: Ch. 120)

Character 61. Mesial carina in maxillary teeth: present (0) or absent (1) (Riff & Kellner 2011: Ch.269)

Character 62. Multicusped teeth, present (0), absent (1)

Character 63. Posterior teeth exhibit tribodont condition: present (0) absent (1)

Character 64. Paired caniform teeth: present (0) absent (1)

Character 65. Multicusped teeth have a single large cusp with smaller accessory cusps: present (0), absent (1)

Code with a dash for any taxa coded "1" in character 62.

Character 66. Prominent constriction at cervical region of the cheek teeth: absent (0), present (1) (After Ortega *et al.* 1996: Ch. 13)

Character 67. Apical half of the tooth is wider than the crown: absent (0), present (1) (After Ortega *et al.* 2000: Ch. 101)

Character 68. Alveoli for dentary teeth 3 and 4 nearly the same size and confluent (0), or fourth alveolus larger than third, and alveoli are separated (1), or the third is much larger and alveoli are separated (2) (Modified from Brochu 1999: Ch. 52.)

Character 69. Maxillary alveoli 4 and 5 same size (0), or 5 largest (1), or 4 largest(2). (Modified from Salisbury *et al.* 2006: Ch. 89, adapted from Norell 1988: Ch. 1; Brochu 1999: Ch. 89)

Character 70. Caudal maxillary alveoli round (0) or mediolaterally compressed (1) (Brochu 2004: Ch. 165)

Character 71. Maxillary dental groove: absent (0), present (1) (After Ortega *et al.* 2000: Ch. 19)

Character 72. Invagenated maxillary alveolar edges absent (0), present (1) (Modified from Gasparini *et al.* 2006: Ch. 236)

Character 73. Invaginated maxillary alveolar edges present as a continuous sheet (0), or present as discrete invaginations at each alveoli (1) (Modified from Gasparini *et al.* 2006: Ch. 236)

Code with a dash for any taxa coded "0" in character 72.

Character 74. Dentary gently curved (0), deeply curved (1), or linear (2) between fourth and tenth alveoli. (Brochu 1999: Ch. 68)

Character 75. Dentary extends posteriorly beneath mandibular fenestra (0), or does not extend beneath fenestra (1) (Clark 1994: Ch.70)

Code with a dash for any taxa coded "0" in character 106.

Character 76. Mandibular symphysis in lateral view: shallow and tapering anteriorly (0), deep and tapering anteriorly (1), deep and anteriorly convex (2), or shallow and anteriorly convex (3) (Modified from Wu & Sues 1996: Ch. 17 by Gasparini *et al*. 2006: 103)

Character 77. Shape of dentary symphysis in ventral view: tapering anteriorly forming an angle (0), U-shaped, smoothly curving anteriorly (1), or lateral edges longitudinally oriented, convex anterolateral corner, and extensive transversally oriented anterior edge (2) (Pol 1999: Ch. 212)

Character 78. Posterior peg at symphysis: absent (0), or present (1) (Pol and Apesteguia 2005: Ch. 181)

Character 79. Dentary smooth lateral to seventh alveolus (0), or with lateral concavity for the reception of the enlarged maxillary tooth (1) (Buckley & Brochu 1999: Ch.105)

Character 80. Dentary symphysis extends to sixth through eighth dentary alveolus (0), or to fourth or fifth alveolus (1), or beyond eighth dentary alveolus (2) (Modified from Brochu 2004: Ch. 166 by Salisbury *et al.* 2006: Ch. 166)

Character 81. Posteroventral edge of mandibular ramus: straight or convex (0), or markedly deflected (1) (Wu *et al.* 1997: Ch. 112)

Character 82. Process of splenial separates angular and coronoid (0), or no splenial processbetween angular and coronoid (1) (Brochu 1999: Ch. 59)

Character 83. Splenial with rostral perforation for mandibular ramus of cranial nerve V (0), or lacks rostral perforation for mandibular ramus of cranial nerve V (1) (Modified from Brochu 1999: Ch. 41 by Salisbury *et al.* 2006: Ch. 41)

Character 84. Splenial involvement in mandibular symphysis: absent (0), present (1) (After Clark 1994: Ch. 77)

Character 85. Splenial-dentary suture at symphysis on ventral surface: v-shaped (0), or transversal (1) (Pol & Apesteguia 2005: Ch. 180)

Character 86. Splenial: thin posterior to symphysis (0), or splenial robust dorsally posterior to symphysis (1) (Buckley & Brochu 1999: Ch. 110; Ortega *et al.* 1997: Ch. 7 from Pol & Powell 2011: Ch. 161)

Character 87. Ventral exposure of splenials: absent (0), or present (1) (Ortega *et al.* 1996: Ch. 9)

Character 88. Angular-surangular suture contacts external mandibular fenestra at caudal angle (0), or passes broadly along ventral margin of external mandibular fenestra (Modified from Norell 1988: Ch. 40 by Salisbury *et al.* 2006: Ch. 47)

Code with a dash for any taxa coded "0" in character 106.

Character 89. Insertion area for M. pterygoideous posterior: does not extend onto lateral surface of angular (0), or extends onto lateral surface of angular (1) (Clark 1994: Ch.76)

Character 90. Angular posterior to mandibular fenestra: widely exposed on lateral surface of mandible (0), or shifted to the ventral surface of mandible (1) (Wu *et al.* 1997: Ch. 110)

Code with a dash for any taxa coded "0" in character 106.

Character 91. Strong ventral arch to the angular absent (0), or present (1)

Character 92. Surangular continues to dorsal tip of lateral wall of glenoid fossa (0) or truncatedand not continuing dorsally (1) (Brochu 1999: Ch 106)

Character 93. Surangular extends to the caudal end of the retroarticular process (0), or is pinched off rostral to the tip of the retroarticular process (1) (Modified from Norell 1988: Ch. 42 by Salisbury *et al.* 2006: Ch. 51)

Character 94. Surangular-articular suture oriented rostrocaudally (0), or bowed strongly laterally (1) within glenoid fossa (Modified from Brochu 1999: Ch. 162 by Salisbury *et al.* 2006: Ch. 162)

Character 95. Surangular-dentary suture intersects external mandibular fenestra rostral to the rostrodorsal corner (0), medially (1), or at the caudodorsal corner (2) (Modified from Brochu 1999: Ch. 65 by Salisbury *et al.* 2006: Ch. 65)

Code with a dash for any taxa coded "0" in character 106.

Character 96. Surangular with spur bordering the dentary tooth-row lingually for at least one alveolar length (0), or lacking such spur (1) (Brochu 1999: Ch. 61)

Character 97. Dorsal edge of surangular: flat (0), or arched dorsally (1) (Clark 1994: Ch. 74)

Character 98. Longitudinal ridge along the dorsolateral surface of surangular: absent (0), or present (1) (Pol & Norell 2004: Ch. 187)

Character 99. Enlarged foramen at anterior end of surangular groove: absent (0), or present (1) (Gasparini *et al.* 2006: Ch. 245)

Character 100. Prearticular: present (0), absent (1) (Clark 1994: Ch. 72)

Character 101. Posterior ridge on glenoid fossa of articular: present(0), or absent (1) (Pol & Apesteguia 2005: Ch. 182)

Character 102. Superior edge of coronoid slopes strongly cranially (0), or almost horizontal (1) (Modified from Brochu 1999: Ch. 54 by Salisbury *et al.* 2006: Ch. 54)

Character 103. The transition of the glenoid fossa to the retroarticular process, posteriorly: tenuous, without delimitation between both (0), or abrupt, making an angle between both (1) (Modified from Nascimento & Zaher 2011: Ch. 262)

Character 104. Retroarticular process points posteriorly (0), posterodorsally (1), or posteroventrally (2)

Character 105. The retroarticular process is short and square to sub-rounded (0), elongate and wedge shaped (1), or extremely elongate, distinct process (2)

Character 106. External mandibular fenestra absent (0) or present (1) (Clark 1994: Ch. 75.)

Character 107. External mandibular fenestra shape: rounded (0), ellipsoid or subrectangular, anteroposteriorly elongated (1), rounded dorsally and anteriorly funneled (2), or nearly a parallelogram (3) (Nascimento & Zaher 2011: Ch. 261)

Code with a dash for any taxa coded "0" in character 106.

Character 108. Jaw joint: placed at level with basioccipital condyle (0), below basioccipital condyle about above level of lower toothrow (1), or below level of toothrow (2) (Wu & Sues 1996: Ch. 24)

Character 109. Incisive foramen present (0) or absent (1)

Character 110. Incisive foramen large (at least half the maximum premaxilla width) (0), or small (1) (modified from Larsson & Sues 2007: Ch. 62)

Code with a dash for any taxa coded "1" in character 109.

Character 111. Incisive foramen located posteriorly (0), or anteriorly (1) relative to the premaxillary tooth row (Brochu 1997: Ch. 153)

Code with a dash for any taxa coded "1" in character 109.

Character 112. Pair of large foramina located in the ventral surface of the premaxilla-maxilla suture (not to reception of mandibular teeth): absent (0), or present (1) (Modified from Larsson & Sues 2007: Ch. 60 by Riff & Kellner 2011: Ch. 258)

Character 113. Premaxillary palate circular paramedian depressions: absent (0), or present located anteriorly on the premaxilla (1) (Sereno *et al.* 2001: Ch.67)

Character 114. Longitudinal depressions on palatal surface of maxillae and palatines: absent (0), or present (1) (Gasparini *et al.* 2006: Ch. 253)

Character 115. Rugose surface on palatal surface of maxilla posterior to last tooth: absent (0), or present (1) (Pol & Powell 2011: Ch. 291)

Character 116. Maxilla-palatine suture: palatine anteriorly rounded (0), or palatine anteriorly pointed (1), or palatine invaginated (2) (Modified from Brochu 1999: Ch. 108 by Gasparini *et al.* 2006: Ch. 243)

Character 117. Palatal surface of maxillae diverge posteriorly from their point of contact (0) or extensively in contact (1) (Modified from Clark 1994: Ch. 10)

Code with a dash if the maxillae do not contact.

Character 118. Vomer entirely obscured by premaxilla and maxilla (0) or exposed on palate at the maxilla-premaxilla suture (1) (Modified from Norell 1988: Ch. 22 by Salisbury *et al.* 2006: Ch. 125)

Character 119. Posterior suture of the palatines is anterior to the posterior margin of the suborbital fenestra (0), or posterior to the suborbital fenestra (1) (After Pol & Powell 2011: Ch. 292)

Character 120. Anterior half of palatine bar between suborbital fenestrae: lateral margins are parallel to sub-parallel (0), or flared anteriorly (1) (Pol & Powell 2011: Ch. 278)

Character 121. Posterior half of palatine bar between suborbital fenestrae: lateral margins are parallel to subparallel (0), or flared posteriorly (1) (Pol & Powell 2011: Ch. 279)

Character 122. Posterolateral end of palatines, completely sutured to the pterygoids (0), or project posterolaterally as rodlike palatine bars (1) (Modified from Martinelli 2003: Ch. 36, Zaher *et al.* 2006: Ch. 196 and Turner 2004: Ch. 119 by Pol & Powell 2011: Ch. 232)

Character 123. Anterior palatal fenestra: absent (0), or present (1) (Wu *et al.* 1997: Ch. 128)

Character 124. Palatine anteromedial margin: exceeding the anterior margin of the suborbital fenestrae extending anteriorly between the maxillae (0), or not exceeding the anterior margin of suborbital fenestrae (1) (Pol 1999: Ch. 143)

Character 125. Basipterygoid process: prominent, forming movable joint with pterygoid (0), or basipterygoid process small or absent, with basisphenoid joint suturally closed (1) (Clark 1994: Ch. 54)

Character 126. Pterygoid parachoanal fossa: absent (0), present (1) (Pol & Powell 2011: Ch. 293 modified from Andrade & Bertini 2008: Ch. 103)

Character 127. Quadrate process of pterygoids: well developed (0), or poorly developed (1) (Pol 1999: Ch. 165)

Character 128. Quadrate ramus of pterygoid in ventral view: narrow (0), or broad (1) (After Wu *et al.* 1997: Ch. 119)

Character 129. Caudomedial processes of pterygoid prominent and project ventrally (0) or small and project caudoventrally (1) or small and project caudally (2) (Modified from Brochu 1999: Ch. 98 by Salisbury *et al.* 2006: Ch. 98)

Character 130. Pterygoid: restricted to palate and suspensorium, joints with quadrate and basisphenoid overlapping (0), or pterygoid extends dorsally to contact laterosphenoid and form ventrolateral edge of the trigeminal foramen, strongly sutured to quadrate and laterosphenoid (1) (Clark 1994: Ch. 38)

Character 131. Palatal surface of pterygoids: smooth (0), or sculpted (1) (Clark 1994: Ch. 40)

Character 132. Pterygoids posterior to choanae: separated (0), or fused (1) (Clark 1994. Ch. 41)

Character 133. Pterygoids: form posterior half of the choanal opening (0), or forms posterior, lateral and part of the anterior margin of the choana (1), or completely enclose choana (2) (Clark 1994: Ch. 43)

Character 134. Pterygoid ramus of quadrate: with flat ventral edge (0), or with deep groove along ventral edge (1) (Clark 1994: Ch. 50)

Character 135. Ectopterygoid abuts maxillary tooth-row (0), or maxilla broadly separates ectopterygoid from maxillary tooth-row (1) (Brochu 1997: Ch. 91)

Character 136. Ectopterygoid extends (0), or does not extend (1) to posterior tip of lateral pterygoid flange (After Brochu 1997: Ch. 149 modified from Norell 1988: Ch. 32)

Character 137. Participation of ectopterygoid in the palatine bar: no (0), or yes (1) (Pol & Apesteguia 2005: Ch. 197)

Character 138. Ectopterygoid main axis oriented: laterally or slightly anterolaterally (0), or anteriorly, subparallel to the skull longitudinal axis (1) (Pol *et al.* 2004: Ch. 164)

Character 139. Ectopterygoid medial process: single (0), or forked (1) (Ortega *et al.* 2000: Ch. 146)

This character codes for both this and also contact with palatines forming choana periphery see Pol & Powell 2011: Ch. 180.

Character 140. Choanal opening: opened posteriorly and continuous with pterygoid surface (0), or closed posteriorly by an elevated wall formed by the pterygoids (1) (Pol & Norell 2004: Ch. 183)

Character 141. Anterior edge of choana situated between the suborbital fenestra (or anteriorly) (0), situated near the posterior edge of suborbital fenestra (1), or posterior to the suborbital fenestra (reaching in some cases the edge of pterygoid flange) (2) (Clark 1994: Ch. 44)

Character 142. Choanal septum shape: narrow vertical bony sheet (0), or T-shaped bar expanded ventrally (1) (Pol & Apesteguia 2005: Ch.186)

Code with a dash for any taxa coded "1" in character 145.

Character 143. If surrounded by pterygoids, the choana is situated near the rostral margin of the pterygoids (0) or towards the caudal margin of the pterygoids (1). (After Salisbury *et al.* 2006: Ch.172 modified from Clark 1994: Ch.44)

Code with a dash for any taxa coded "0" or "1" in character 133.

Eventhough character 141 is also based on Clark 1994: Ch. 44 we consider this character distinct if coded in the proper manner.

Character 144. Choana elongate in the sagittal plane (0), broad (1)

Character 145. Choana sagittal septum: present (0), absent (1)

Character 146. Caudal rim of choana not deeply notched (0), or deeply notched (1) (Salisbury *et al.* 2006: Ch. 107 modified from Brochu 1999: Ch. 107)

Character 147. Paired ridges located medially on ventral surface of basisphenoid: absent (0), or present (1) (Pol & Norell 2004: Ch. 179)

Character 148. Basisphenoid ventral surface: shorter than the basioccipital (0), or wide and similar to, or longer in length than basioccipital (1) (Ortega *et al.* 2000: Ch. 68 modified from Clark 1994: Ch. 55)

Character 149. Basisphenoid exposed on ventral surface of braincase (0), or virtually excluded from ventral surface by pterygoid and basioccipital (1) (Clark 1994: Ch. 56)

Character 150. Cranial table width in respect to ventral portion of skull: as wide as ventral portion (0), or narrower than ventral portion of skull (1) (Wu *et al.* 1997: Ch. 123)

Character 151. Skull expansion at orbits: gradual (0), or abrupt (1) (Clark 1994: Ch.2)

Character 152. Descending process of prefrontal does not contact palate (0), or contacts palate (1) (Clark 1994: Ch. 15)

Character 153. Prefrontal lateral development reduced (0), or enlarged, extending laterally over the orbit (supraorbital crest) (1) (Gasparini *et al.* 2006: Ch. 247)

Character 154. Prefrontals anterior to orbits: elongated, oriented parallel to anteroposterior axis of the skull (0), or short and broad, oriented posteromedially-anterolaterally (1) (Gomani 1997: Ch. 4)

Character 155. Prefrontal pillar solid (0), or with large pneumatic sinus (prefrontal recess of Witmer 1997) (1) (Salisbury 2006: Ch. 99)

Character 156. Prefrontals separated by frontals and nasals (0), or prefrontals meet medially (1) (Norell 1988: Ch. 27)

Character 157. Paired crests along the prefrontal-frontal sutures: absent (0), or present (1) (Pol & Powell 2011: Ch. 289)

Character 158. Palpebrals: present (0), absent (1) (Modified from Clark 1994: Ch. 65)

Character 159. If present the palpebrals consist of one small palpebral present in orbit (0), one large palpebral (1), or two large palpebrals (2) (Modified from Clark 1994: Ch. 65)

Character 160. Frontal anterior ramus with respect to tip of prefrontal: ending posteriorly (0) or ending anteriorly (1) (Sereno *et al.* 2001: Ch. 27)

Character 161. Dorsal surface of frontal and parietal: flat (0), or with midline ridge (1) (Clark 1994: Ch. 22)

Character 162. Frontals paired (0), or fused (1) (Clark 1994: Ch. 21)

Character 163. Frontal width between orbits: narrow, as broad as nasals (0), or broad, twice as broad as nasals (1) (Clark 1994: Ch. 20)

Character 164. Frontals constricted between orbits causing flared ends (0), pinched anterior margin (1) pinched posterior margin (2)

Character 165. Frontals contribute significantly to the border of the supratemporal fenestra: present (0), absent (1)

Character 166. Frontoparietal suture linear (0), or concavoconvex (1) (Brochu 1999: Ch. 86)

Character 167. Lateral margins of frontal: flush with skull surface (0), or elevated, forming ridged orbital margins (1) (Modified from Brochu 1997: Ch. 103 by Pol & Powell 2011: Ch. 266)

Character 168. Medial margin of the orbit in dorsal view: formed mostly by the frontal (0), or mostly by the prefrontal, the frontal is excluded or participates only slightly (1) (Jouve 2009: Ch. 326)

Character 169. Ventral half of the lachrymal extending ventroposteriorly, widely contacting the jugal (0), or tapering ventroposteriorly, does not contact or contacts the jugal only slightly (1) (Pol & Apesteguia 2005: Ch. 193)

Character 170. The lachrymal is ventrolaterally elongate (0), square (1), or anteroposteriorly elongate (2)

Character 171. Lachrymal longer than prefrontal (0), or prefrontal longer than lachrymal (1), or lachrymal and prefrontal both elongate and nearly the same length (2) (Salisbury *et al.* 2006: Ch. 117 modified from Norell 1988: Ch. 7)

Character 172. Jugal anterior and posterior processes are inline dorsoventrally (0), or anterior and posterior processes at a sharp angle to one another, both processes slope ventrally to form a strongly arched jugal (1) (Turner & Buckley 2008: Ch. 286)

Character 173. Large foramen on the lateral surface of jugal, near its anterior margin: absent (0), or present (1) (Pol & Apesteguia 2005: Ch. 194)

Character 174. Longitudinal ridge on lateral surface of jugal below infratemporal fenestra: absent (0), or present (1) (Pol & Norell 2004: Ch. 183)

Character 175. Base of postorbital process of jugal: directed posterodorsally (0), dorsally (1), or anterodorsally (2) (Pol 1999: Ch. 156)

Character 176. Anterior part of the jugal with respect to posterior part: as broad (0), or twice as broad (1) (Clark 1994: Ch. 17)

Character 177. Jugal extends posteriorly below the quadratojugal terminating with a point (0), or truncated, butting against the posterior skull bones (1)

Character 178. Jugal superior outline beneath the orbit: concave (0), convex (1), or straight (2) (Nascimento & Zaher 2011: Ch. 260)

Character 179. Postorbital process of jugal: anteriorly placed (0), in the middle (1), or posteriorly positioned (2) (Pol 1999: Ch. 157)

Character 180. Parietal with sinus communicating with a pneumatic system (0) or solid, without a sinus (1) (Brochu 1999: Ch. 154)

Character 181. Parietal and squamosal widely separated by the quadrate on the caudal wall of the supratemporal fenestra (0), or the parietal and the squamosal approach each other on caudal wall of supratemporal fenestra without actually making contact (1), or the parietal and the squamosal meet along caudal wall of the supratemporal fenestra (2) (Modified from Brochu 1999: Ch. 131 by Salisbury *et al.* 2006: Ch. 131)

Character 182. Parieto-postorbital suture: absent from dorsal surface of skull roof and supratemporal fossa (0), absent from dorsal surface of skull roof but broadly present within supratemporal fossa (1), or present within supratemporal fossa and on dorsal surface of skull roof (2) (Buckley & Brochu 1999: Ch. 81 modified from Clark 1994: Ch. 23)

Character 183. Postorbital-ectopterygoid contact: present (0), or absent (1) (Pol 1999: Ch. 158)

Character 184. Postorbital-jugal contact: postorbital anterior to jugal (0), or postorbital medial to jugal (1), or postorbital lateral to jugal (2) (Clark 1994: Ch. 16)

In this analysis this character is interpreted as being relative to the dorsal process of the jugal along their suture and not the position of the dorsal process of the jugal.

Character 185. Post orbital bar is flush with the jugal (0), posteriorly inset (1), or completely inset, defined by a ridge (2) (After Ortega *et al.* 2000: Ch. 34)

Character 186. Lateral surface of postorbital bar: formed by postorbital and jugal (0) or only by postorbital (1) (Gasparini *et al.* 2006: Ch. 244)

Character 187. Postorbital bar transversely flattened (0), or columnar (1) (Modified from Clark 1994: Ch. 26)

Character 188. Vascular opening in dorsal surface of postorbital bar absent (0), or present (1) (Clark 1994: Ch. 27)

Character 189. Dorsal end of the postorbital bar broadens dorsally, continuous with dorsal part of postorbital (0), or dorsal part of the postorbital bar constricted, distinct from the dorsal part of the postorbital (1) (Clark 1994: Ch.30)

Character 190. Bar between orbit and supratemporal fenestra broad (0), or narrow (1) (Modified from Clark 1994: Ch. 31)

Character 191. Suture between the postorbital and the squamosal in lateral view: straight or almost straight (0), convex anteriorly (1), or concave anteriorly (2) (After Nascimento & Zaher 2011: Ch. 258)

Character 192. Relative length between squamosal and postorbital: squamosal is longer (0), or postorbital is longer (1) (Ortega *et al.* 2000: Ch. 33)

Character 193. Dorsal margin of squamosal occipital flange is straight (0), or dorsally concave (1) (Gasparini *et al.* 2006: Ch. 251)

Character 194. Squamosal descending process absent (0), or present (1) (Wu *et al.* 1997: Ch. 103)

Character 195. Dorsal and ventral rims of squamosal groove for external ear valve musculature parallel (0), or squamosal groove flares anteriorly (1) (Brochu 1997: Ch. 84)

Character 196. Ridge along dorsal section of quadrate-quadratojugal contact: absent (0), or present (1) (Pol and Norell 2004: Ch. 185)

Character 197. Quadrate without fenestrae (0), with single fenestrae (1) or with three or more fenestrae on dorsal and posteromedial surfaces (2) (Clark 1994: Ch. 45)

Character 198. Quadrate foramen aërum on mediodorsal angle (0), or on dorsal surface (1) of quadrate. (Brochu 1999: Ch. 121)

Code with a dash for any taxa coded "0" in character 196.

Character 199. Quadrate condyles: almost aligned (0), medial condyle expands ventrally, defining intercondylar groove (1) (After Ortega *et al.* 2000: Ch. 53)

Character 200. Quadrate major axis to the dental plane: acute (0), perpendicular (1), oblique (2) (Modified from Ortega *et al.* 2000: Ch. 44)

Character 201. Dorsal primary head of quadrate articulates with squamosal, otoccipital, and prootic (0), or with prootic and laterosphenoid (1) (Clark 1994: Ch. 47)

Character 202. Quadratojugal spine at caudal margin of infratemporal fenestra: absent (0), or present (1) (Ortega *et al.* 2000: Ch. 47)

Character 203. Posteroventral corner of quadratojugal reaching the quadrate condyles (0), or not reaching the quadrate condyles (1) (Pol 1999: Ch. 155)

Character 204. Quadratojugal dorsal process is narrow, contacting only a small part of postorbital (0), or broad, extensively contacting the postorbital (1) (Clark 1994: Ch. 19)

Character 205. Orbits are located on the dorsolateral surface of the skull (0), or on the lateral surface (1)

Character 206. Transverse ridge crossing the frontal anteromedial to the orbits: absent (0), or present (1) (Pol & Powell 2011: Ch. 276)

Character 207. Prefrontal and lachrymal around orbits form flat rims (0), or evaginated, forming elevated rims (1) (Soto *et al.* 2011: Ch. 256)

Character 208. The orbit is greater in magnitude than the supratemporal fenestra (0), smaller (1)

Code with a dash for any taxa coded "1" in character 209.

Character 209. Shallow fossa at anteromedial corner of supratemporal fenestra (0), or no such fossa: anteromedial corner of supratemporal fenestra smooth (1) (Brochu 1997: Ch. 92)

Code with a dash for any taxa coded "1" in character 209.

Character 210. Supratemporal fenestra present (0), or absent (1) (Ortega *et al.* 2000: Ch. 72)

Character 211. Supratemporal fenestrae extension: relatively large, covering most of surface of skull roof (0), or relatively short, fenestrae surrounded by a flat and extended skull roof (1) (Ortega *et al.* 2000: Ch. 41 modified from Clark 1994: Ch. 68)

Code with a dash for any taxa coded "1" in character 209.

Character 212. The medial and anterior margins of the supratemporal fenestra are at 90 degrees (0), or 45 degrees (1) (Gasparini *et al.* 2006: Ch.254)

Code with a dash for any taxa coded "1" in character 209.

Character 213. Anterior opening of temporo-orbital in dorsal view exposed (0), or hidden in dorsal view and overlapped by squamosal rim of supratemporal fossa (1) (Ortega *et al.* 2000: Ch. 75)

Code with a dash for any taxa coded "1" in character 209.

Character 214. Postorbital participation in infratemporal fenestra, almost or entirely excluded (0), or bordering infratemporal fenestra (1) (Wu *et al.* 1997: Ch. 108)

Character 215. Infratemporal fenestra is square (0), triangular (1), or subcircular (2)

Character 216. Basioccipital without well-developed bilateral tuberosities (0), or with large pendulous tubera (1) (Clark 1994: Ch. 57)

Character 217. Occipital surface ventral to basioccipital condyle slopes rostroventrally (0), or is roughly parallel to the transverse plane (1) (Salisbury *et al.* 2006: Ch. 174 modified from Hua & Jouve 2004. Ch. 167)

Character 218. Skull in posterior view: basioccipital visible beneath the occipital condyle (0), or not visible (1) (After Nascimento & Zaher 2011: Ch. 259)

Character 219. Otoccipital: without laterally concave descending flange ventral to subcapsular process (0), or with flange (1) (Clark 1994: Ch. 58)

Character 220. Supraoccipital forms dorsal edge of the foramen magnum (0), or exoccipitals broadly meet dorsal to the foramen magnum, separating supraoccipital from foramen (1) (Clark 1994: Ch. 62)

Character 221. Mastoid antrum does not extend into supraoccipital (0), or extends through transverse canal in supraoccipital to connect middle ear regions (1) (Clark 1994: Ch. 63)

Character 222. Posterior surface of supraoccipital nearly flat (0), or with bilateral posterior prominences (1) (Clark 1994: Ch. 64)

Character 223. Exposure of supraoccipital in skull roof: absent (0), or present (1) (Ortega *et al.* 2000: Ch. 62)

Character 224. Exoccipital terminates dorsal to basioccipital tuberosity (0), or sends a process ventrally and participates in the basioccipital tuberosity (1) (Modified from Salisbury *et al.* 2006: Ch. 151)

Character 225. Descending process of the exoccipital broad (0), or narrow (1) (Modified from Salisbury *et al.* 2006: Ch. 151)

Character 226. Posterior half of axis neural spine wide (0), or narrow (1) (Brochu 1997: Ch. 3)

Character 227. Cervical vertebrae amphicoelous or amphyplatyan (0), or procoelous (1) (Clark 1994: ch. 92)

Character 228. Cervical neural spines are anteroposteriorly large (0), or rod-like (1) (After Clark 1994: Ch. 90)

Character 229. First caudal vertebrae is amphicoelous or amphyplatian (0), biconvex (1), or opisthocoelous (2), or procoelous (3) (Modified from Clark 1994: Ch. 94 by Pol & Powell 2011: Ch. 94)

Character 230. Trunk vertebrae are amphicoelous or amphyplatian (0), or procoelous (1) (Clark 1994: Ch. 93)

Character 231. External surface of dorsal cranial bones: smooth (0), slightly grooved (1) and heavily ornamented with deep pits and grooves (2) (Clark 1994: Ch. 1)

Character 232. Rows of dorsal osteoderms: two parallel rows (0), more than two (1), or more than four with accessory ranges of osteoderms (sensu Frey, 1988) (2) (Modified from Ortega *et al.* 2000: Ch. 107 and 108 [modified from Clark, 1994: Ch. 97])

Code with a dash for any taxa lacking osteoderms.

Character 233. Gap in cervico-thoracic dorsal armour absent (0), or present (1) (Ortega *et al.* 2000: Ch. 109)

Code with a dash for any taxa lacking osteoderms.

Character 234. Trunk osteoderms are absent from ventral part of the trunk (0), or present (1) (Clark 1994: Ch. 100)

Code with a dash for any taxa lacking osteoderms.

Character 235. Dorsal osteoderms without articular anterior process (0), with a discrete convexity on anterior margin (1), or with a well-developed process located anterolaterally in dorsal parasagittal osteoderms (2) (Modified from Clark 1994: Ch. 96 & Brochu 1997: Ch. 40 by Gasparini et al .2006: Ch. 96)

Code with a dash for any taxa lacking osteoderms.

Character 236. Dorsal osteoderms: rounded or ovate (0), or rectangular, broader than long (1), or square (2), or rectangular, longer than broad (3) (Clark 1994: Ch. 95)

Code with a dash for any taxa lacking osteoderms.

Character 237. Some or all osteoderms are imbricated (0), or sutured to one another (1), or not in contact (2) (Modified from Clark 1994: Ch. 98 by Pol & Powell 2011: Ch. 98)

Code with a dash for any taxa lacking osteoderms.

Character 238. Tail osteoderms: dorsal only (0), or completely surrounded by osteoderms (1) (Clark 1994: Ch. 99)

Code with a dash for any taxa lacking osteoderms.

Character 239. Proximal end of radiale expanded symmetrically, similarly to the distal end (0), or more expanded proximolaterally than proximomedially (1) (Buscalioni & Sanz 1988: Ch. 44)

Character 240. Supra-acetabular crest: present (0), or absent (1) (Buscalioni & Sanz 1988: Ch. 49)

Character 241. Pubis participates in the border of the acetabulum (0), or mostly excluded (1) (Modified from Clark 1994: Ch. 86)

Character 242. Fifth pedal digit with phalanges (0), or without phalanges (1) (Clark 1994: Ch. 88)

SOM 2.1. Data matrix

Gracilisuchus stipanicicorum	00[1&2]00100000000-000000010000001?-1000000001102000011 0-0000001?0111-??12100-013??010110??1000000?1100000111011??1?0???????????000?0?00010?0??0?????00010000000??10000100000110000002?22?000000000000?00?00000010001000?0100000?00??100?00000?000?00?
Alligator mississippiensis	13001101000000-000210011001001-?10-0-1--11000100[0&1]0110010-0111111-1112000-0031?0101101010100110110001011120100111000010111000100001012011000120110000110100100000010110100210000101[1&2]02[1&2]1120111000010011001000001010101110 1?011000101[0&1]11221002110111
Araripesuchus wegeneri	11[0&2]00101000100-0002000??001011-100-010010?00000011100[0/1][0&1]000000111-1110100-1?010100??10?1???0??????????????????1--1000010000000100001 01[0/1]0?1000100-00011?10100?00??0[0&1]101000[0/1]001000010[0&2]2?20?120111100012?0?0011?00[0&1]000?010?1101001?010??????2????[1&2]?1????
Argochampsa krebsi	02[0&2]11000111000-00001011-110011-11000-1--11101000001-0???-001?111-01?0000-2??2000???0??????????????????????????001000001100000001000110120?100012-1110001101 00?00??0011100000200000?[0&1]2[1&2]??[0/1]01201?1020011?1??001?0?000010001121100 1?0110?1???2????????????
Asiatosuchusgermanicus	13001101110001000021011-000011-11000-1--11000000?0110010-0010111-?111000-00310000?0100101010000100 0?0?1121100?1?000010010001 1?0?0?0?2?010??12?1??0???10100000??00101000[0/1]020000010[0&2]1?200120111020010010001?000000101011201??1?000?11[0&1]?12????????1111
Baurusuchus pachecoi	00201100000101111000 1?1?0000[0&1]1-?000000111101010311000110001001 10-?1???010012[0&1][0&1]100??101101000101110010?020002010 1?0101?10110110102?0100101011001110100 00?00?10020011?100?0?010001102?22110011100001002?111011100 1?0110110 1?011000??0??01???????10?1
Bernissartia fagesii	13201101010?110001[1/2]1011-100011-11000-1--000[0/1]000020110010-0010101-1100000-1-[0&3]100001010??-0-1010-10?01000100-0011???001001000 01?010110100000 11--010?0110100?00??00101001002000010000?2001201?10200?00000011?00010?01011[0/2]00001?110?1001021011101??1?
Borealosuchus formidabilis	13[0/2]011010?0001000021011-100011-1?000-1--11?00000201110 11-0110111-??00000-0-31000000100?-1-1000-100?1000120-0011?00?010?000001??001012101?0012?1??000110100000??0010100000??200001011?01?1201?100001001000110000001010?1[0/2]01?011000?01[0&1]1121?11?0-0111
Chimaerasuchus paradoxus	01[1/2]011000100010110001 11-001011-1?0-0100101030104001-0??1-??100111??0-100-?-?100?0?100?0-1-????-???11?????0-

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Crocodylus niloticus 13001101010001000021011-[0&1]00011-11000-1--1100000020110011-
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00100100011000010101011000001100 1011[0&1]11221002110111

Dakosaurus andiniensis 01101100011010-10001011-100111[0/1]01111-1--1102?000[0&1]10-
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1]??0??00???????0-------????

Diplocynodon hantoniensis 13[0/2]1110101001100002 1011-1000[0&1]1-?1000-1--1100000020 11?010-
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Dyrosaurus 02001101010000-00001011-110001-11000-1--11010000001-0001-
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0000010000?1010??1011?1?0??02????[1&2]???11?

Edentosuchus tienshanensis 0100??0?0??00100100?????10?010-1?0?0-1--0????10[2&3]001-?100-
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01010?001?0101011010000101[0&1]?101?0?1?111011???[1&2]???0[1&2]
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Geosaurus araucanensis 02200101011000-10001001010011 0001111-1--1?020000001-0001-
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0??00???00?00-------????

Gobiosuchus kielanae 0120010000000110000000100010 01-100-0100111020100001-0100-0110111-0?20010-0-310010??0?00-000001-1010?0?1000-11--?000?01011?10100101000011000-0-----0100010000002010011001001001100002?221100001?20010120001001100--1---0201001??00??0??011010101?11?

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Mahajangasuchus insignis 030011010100010100[1&2][0&1]?????11011-100-01011110[0&1]000011100110001[0&1]1111-112?000-2132?1?0????110[0&1]00?0?0?1001[0&1]?1[0/1]1112???100001?0100001 000010110[0&1]0000111????00110100??0??001011010021100010012112 201010?0010000001010000?0100110??01100???0[0&1]0020??000?1[0&1]1?

Mariliasuchus amarali 01[0/2]01100000100-0100011?-000010-10?00-1--00010103010-000000020111-111[0/1]010-2-101000?1110[0&1]0010?1101[0&1]0011?000112010?00001010111010101010001010111???00010101??0020[0&1]10100001??01001[0&1]11??111 201011?0010020110010100000100110??01?00???01?010??002??0??

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Pietraroiasuchus	13[0/2]01101010010-0???1011-1010[0&2]1-110-0-1-- 11000?00????0??0???1?111-??22000-?-?1001??0[0&1]?11-1-0?0?- 0??01?1???0-????0????100000101011[1/2]0?1[0/1]??????12-- 11????11?00?00??001010000022100[0/1]??1[1/2]?21??210?01?0??0?0???? 1?0000[0/1]0010?11??0?1??111?1?[0/3]1[0&2]?11110?????
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Protosuchus richardsoni	00[0&2]01100100?010010000010001011-100- 0100111010100[0&1][0&1]0-01000??00111-01?0?00- ?0000010??0?0[0&1]000000?111?000?110101?????00?- ???????1?01?11001???0000??????1011000?00020000[0&2]110000100?111 00?20110000100001?12?00100110001010?000??11100???00?02001210100 01
Rugosuchus nonganensis	132[0&1]11010000010?002100??010001- 1?000????11?00000201 11????????111-1????00-2-[0&3]100[0/1]0??10?1- 001?1?-?00010?0000- ??????0?010?110001??0?10?1???01?10??0??00110?00?0????11010??00??0 00?1001?21?22010?0?10??0???01?0?0000?0101100000 1?0011?????2[1&2] ???20?????
Sarcosuchus imperator	03011111111000-10001?11-100011-1[0&1]010-1--11000110001-0100- 1010111-011?000- 012100?0??101?100100?2?000?0?1101110100 10?11?110000100??0011?11 00011-- 01??0110100?00??10101010100000011100??0?2200010?001000?00?[0&1] 000001101001 10??01000???0??020?0210??11?
Steneosaurus bollensis	0201110[0&1]010000-00001011-1001111011[0/1]0-1--11010000001-000?- ?010111-01?0000- 21010020??10010?00?0?0?000?0??1201101100[0&1]?110100000100[0&1] ?1010011000100-11?10000000?001- 0110[0/1]0000020??010100?20?20100002 1?1?0??000000000 1000001[0/1]1 0?0??00???00?0[0&1&2]00121000111
Terminonaris robusta	0221101[0&1]111000-10001011-100011-11000-1--11000110001-?001- 0010111- ?1???0112?010??0??10?1???0?00?100010?002???01?010?110000000 10??[1/2]0011?11000110-

	[0/1]0000110?00?????10101000102O1?0?1?[0/2]??20?12???10?[0&1]??0?? ?00?1??00?110[0&1]0?1?0????0????000?020?1210?011?
Theriosuchus pusillus	[0&1]320[0&1]10000000100002[0&1]0011000011- 1[0&1]0[0/1]010?111000000[1&2]111001?000[0&1]0111-1110000- 2131[0&1]0????1001?0???????0??1?????1?1???000?0100000001000?1010 001000100- 00?00010100?00010110001100[1/2]200010[0&1]00?20012?1111?0?1??1?0 ?10000000001001[0/2]0????1?????102020?021011111
IWCMS 2012.203/4	1320110101001100002[0&1]011-100011-10000-1-- 00?10?00201101?000011101-1[0&1]00??0-1-320000?01001-?-10??- 11001?????0-0?????0?0100100001001??012??000010- 0011???10101000??0010[0&1]001002000010000?20?[1&2]001010200100 1??0?1?00000001[0&1]110000?1?1110?????2???????????

SOM 3.1. TNT settings

An analysis was run in TNT 1.1 (Goloboff *et al.* 2008), last updated September 2013, on a PC with an AMD FX 4350 (4.2 GHz Quad core) CPU and 8 GB (RAM) memory. The RAM available to the program was set to the maximum 1GB.

In the analysis *Gracilisuchus* was set as the outgroup. There were 36 active taxa and 241 characters. Only additive characters were given unequal weights on the initial run. In the first phase of tree searching a 'new technology' search was used to recover some of the most parsimonious tree (MPT) topologies, the settings are listed below:

Get trees from… Driven search (36 taxa at level 15) with initial additional sequences = 5
Find minimum length 1 time
Random seeds set to 16838 (using rseed* command)
Replace existing trees
Auto-constrain

Use… Sectorial search parameters:
RSS – Factor for number of selections = 43; Min. sector size = 18; Max. sector size = 18
CSS – Rounds = 3; Min. sector size = 10
For RSS and CSS globally swap every… 2 changes in sectors of size below 75; 10 changes in sectors of size above 75
For selections of size… above 75 use 6 drifting cycles; below 75 use 3 starts and fuse trees 0 times

Use… Ratchet parameters:
Stop perturbation phase when 20 substitutions made, or 99% swapping completed
Perturbation phase... 4 up-weighting probability, 4 down-weighting probability. Use alternate equal weights.
Number of iterations… 10,000 total number, 0 auto-constrained.

Use… Tree fusing parameters:
3 rounds, swapping after exchanging, start from best tree
When using driver… use fusing to multiply optimal trees

The second phase of tree searching used the 'traditional search' function to find the maximum number of MPTs. The search used trees saved to the RAM from the 'new technology' search as the starting trees. A TBR (Tree Bisection Reconnection) swapping algorithm was used to find more topologies of the same length.

Once a set of trees were recovered a strict consensus (SOM 3.3.1.) and agreement subtree(s) (SOM 3.3.2.) were calculated, the results are presented below. Additionally, bootstrap (SOM 3.4.) and Bremer (SOM 3.5.) analyses were run.

To perform a Bootstrap analysis the memory was set to save 100 trees and the RAM was set to 1000 Mbytes. Then 'resample the matrix with Bootstrap' was selected, by going to 'Analyze'; 'Resampling'; and clicking 'Bootstrap' in the menu. The analysis searched for 100 replicates using a 'traditional search' (Wagner trees, 10 replicates, TBR on), saving the absolute frequencies.

To perform a Bremer support search 'Bremer supports' was selected in the 'Trees' menu. The analysis was set to collapse nodes with '0' support, using 'absolute supports'. The supports were calculated using the option 'TBR from existing trees' and it was asked to retain trees suboptimal by 11 steps after testing with trial and error.

Finally, a 'new technology' search was performed using the exact same settings as before (with the exception of the number of random seeds [=10953]), but applying implied weighting. The implied weighting concavity constant (K) was set to 3.0 which is default in TNT. The result is presented below (SOM 3.6.). The traditional search method is not conducted for the implied weights analysis, as it does not recover additional trees.

SOM 3.2. TNT results

Initial TNT new technology run

Number of rearrangements tried = 1,544,389,665

5 trees saved

Tree length = 862

TNT traditional search

Start swapping from 5 trees, score 862 steps

Number of rearrangements tried = 247,469

17 trees saved

Tree length = 862

CI = 0.325

RI = 0.503

Implied weighting analysis

TNT new technology run

Number of rearrangements tried = 1,544,545,988

1 tree saved

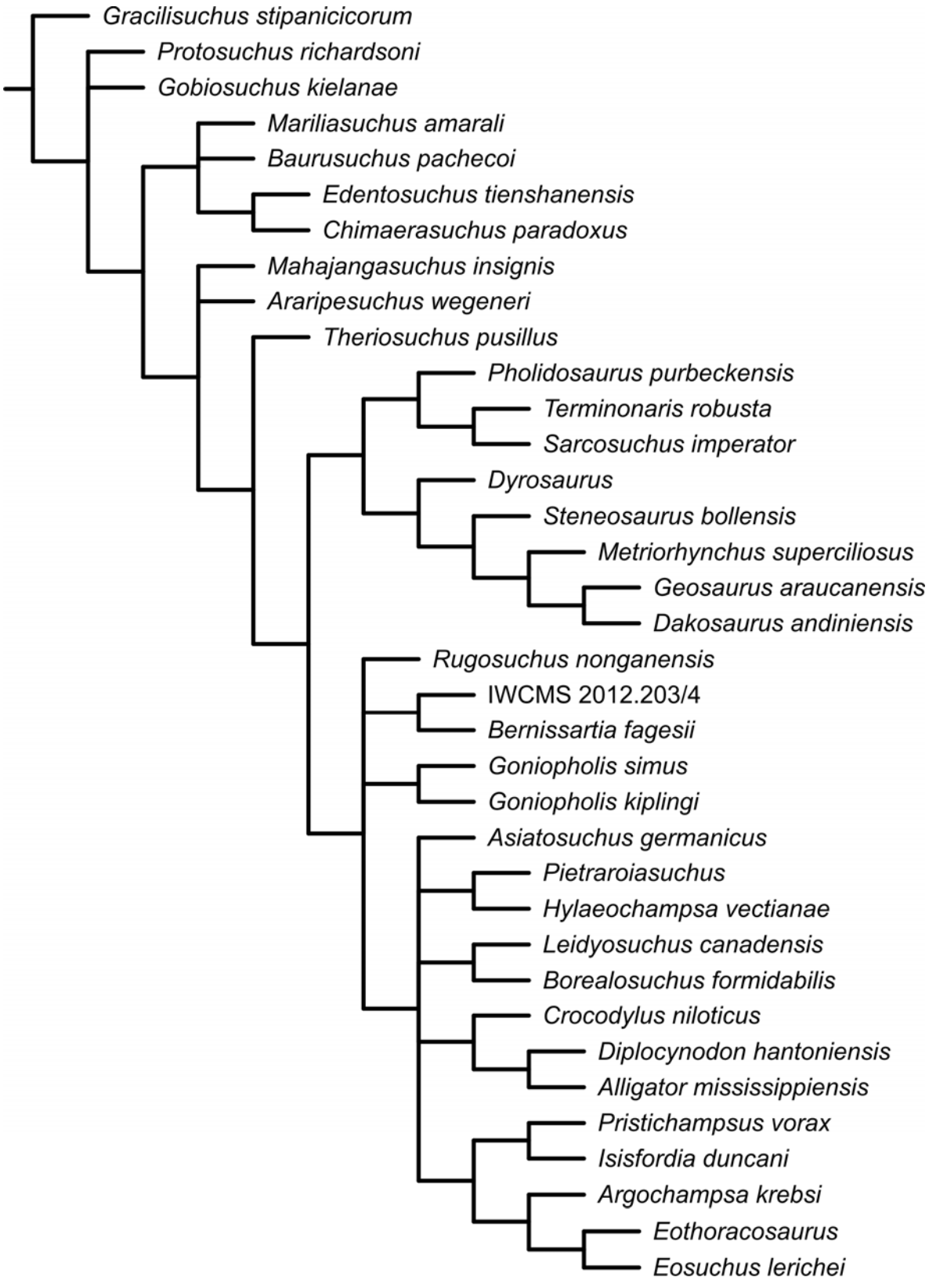
Tree length = 85.99888

CI = 0.323

RI = 0.499

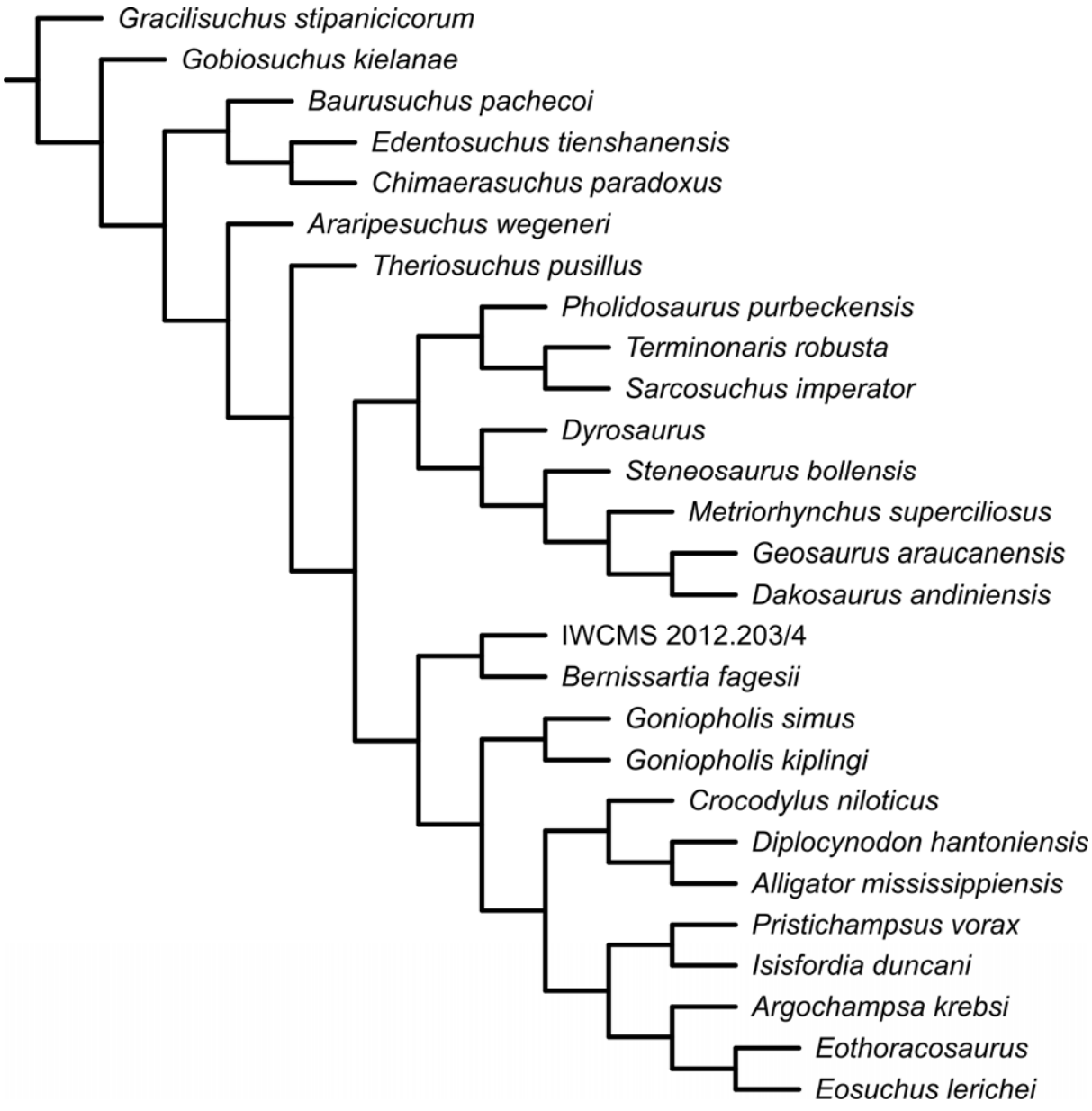
SOM 3.3. TNT consensus cladogram & agreement subtrees

SOM 3.3.1.



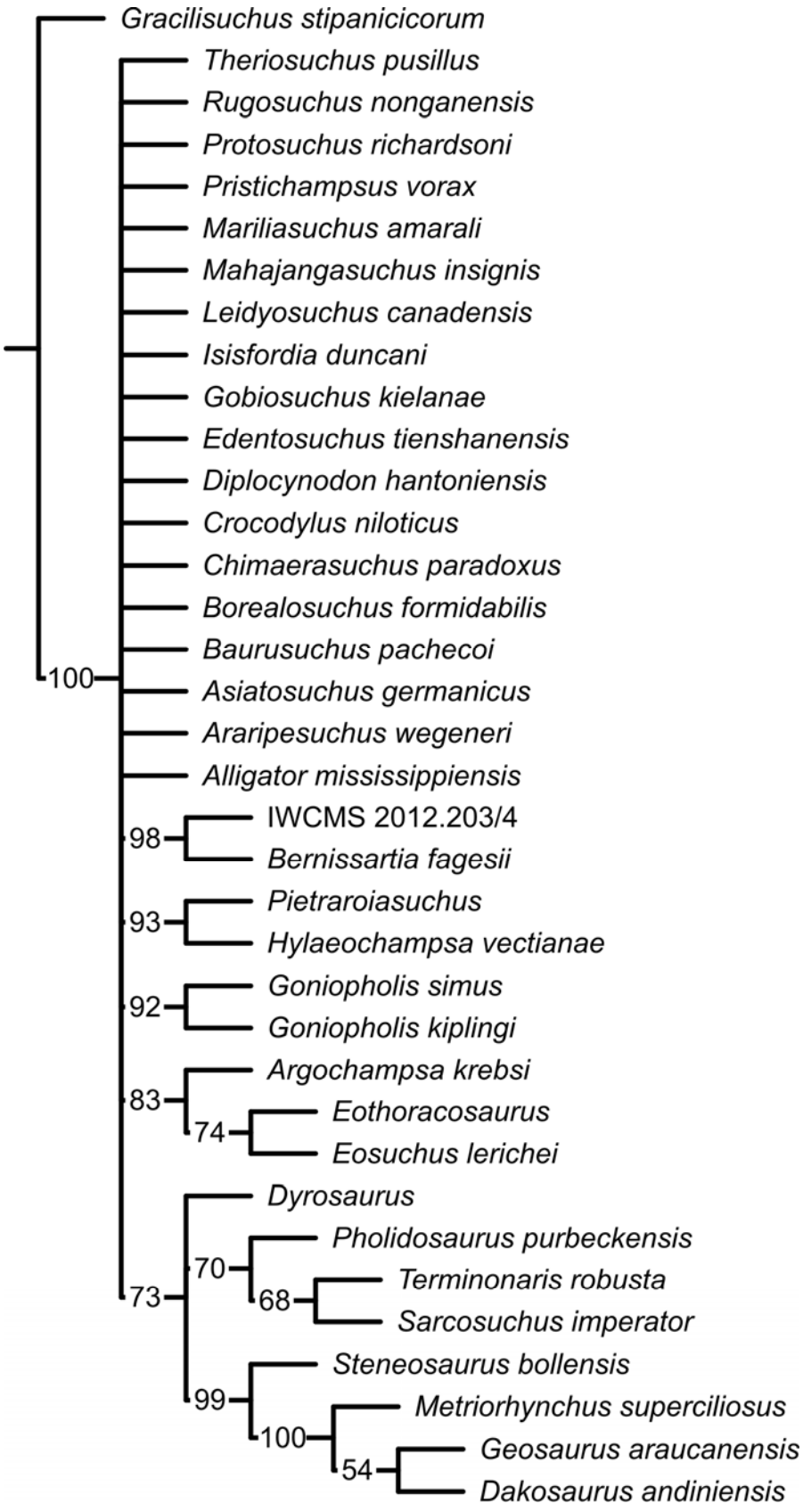
Strict consensus of 17 cladograms.

SOM 3.3.2.



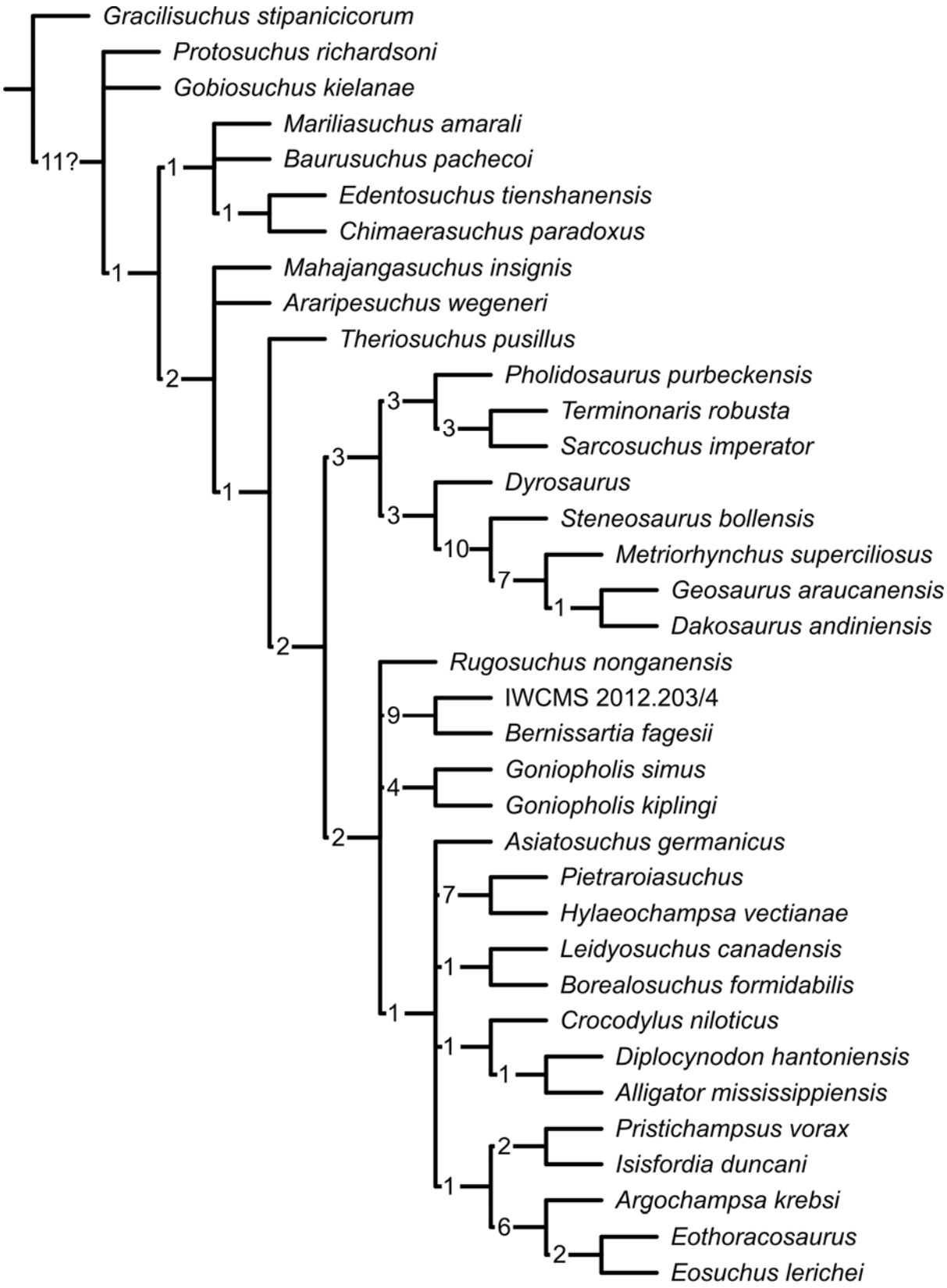
Agreement subtree of 17 MPTs – 27 taxa maintained.

SOM 3.4. TNT bootstrap cladogram



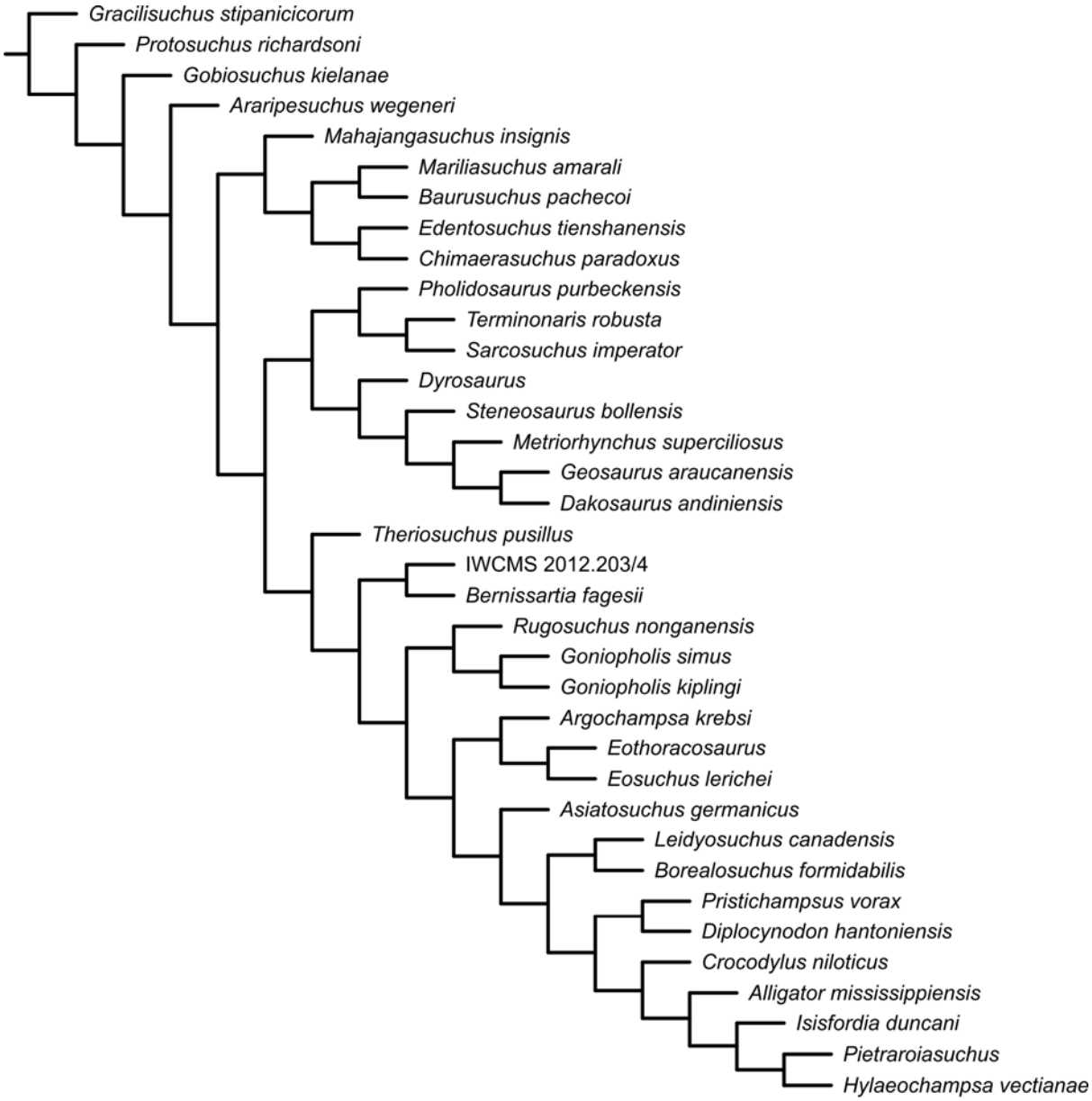
Bootstrap analysis using Wagner trees.

SOM 3.5. TNT Bremer cladogram



Bremer supports from 23309 trees.

SOM 3.6. TNT implied weighting cladogram



Single MPT from implied weights TNT analysis.

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