

# A basal sauropod dinosaur from the Early Jurassic of Morocco

## Un dinosaure sauropode primitif du Jurassique inférieur du Maroc

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### **Cladistic analysis**

The 235 characters used in our analysis are the 234 characters of Wilson (2002) to which we add one character (235). Two in-group taxa *Tazoudasaurus* and *Atlasaurus* have been added to the 27 sauropod taxa analysed by Wilson.

All characters were unordered except multisate characters 8, 37, 64, 66, 198 which are ordered.

### **Characters (Wilson, 2002)**

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).
2. Premaxillary anterior margin, shape: without step (0); with marked step, anterior portion of skull sharply demarcated (1).
3. Maxillary border of external naris, length: short, making up much less than one-fourth narial perimeter (0); long, making up more than onethird narial perimeter (1).
4. Preantorbital fenestra: absent (0); present (1).
5. Subnarial foramen and anterior maxillary foramen, position: well distanced from one another (0); separated by narrow bony isthmus (1).

6. Antorbital fenestra, maximum diameter: much shorter than (0) or subequal to (1) orbital maximum diameter.
7. Antorbital fossa: present (0); absent (1).
8. External nares, position: terminal (0); retracted to level of orbit (1); retracted to a position between orbits (2).
9. External nares, maximum diameter: shorter (0) or longer (1) than orbital maximum diameter.
10. Orbital ventral margin, anteroposterior length: broad, with subcircular orbital margin (0); reduced, with acute orbital margin (1).
11. Lacrimal, anterior process: present (0); absent (1).
12. Jugal–ectopterygoid contact: present (0); absent (1).
13. Jugal, contribution to antorbital fenestra: very reduced or absent (0); large, bordering approximately one-third its perimeter (1).
14. Prefrontal, posterior process size: small, not projecting far posterior of frontal–nasal suture (0); elongate, approaching parietal (1).
15. Prefrontal, posterior process shape: flat (0); hooked (1).
16. Postorbital, ventral process shape: transversely narrow (0); broader transversely than anteroposteriorly (1).
17. Postorbital, posterior process: present (0); absent (1).
18. Frontal contribution to supratemporal fossa: present (0); absent (1).
19. Frontals, midline contact (symphysis): sutured (0) or fused (1) in adult individuals.
20. Frontal, anteroposterior length: approximately twice (0) or less than (1) minimum transverse breadth.
21. 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).
22. Parietal, contribution to post-temporal fenestra: present (0); absent (1).
23. Postparietal foramen: absent (0); present (1).
24. Parietal, distance separating supratemporal fenestrae: less than (0) or twice (1) the long axis of supratemporal fenestra.
25. Supratemporal fenestra: present (0); absent (1).
26. Supratemporal fenestra, long axis orientation: anteroposterior (0); transverse (1).
27. Supratemporal fenestra, maximum diameter: much longer than (0) or subequal to (1) that of foramen magnum.

28. Supratemporal region, anteroposterior length: temporal bar longer (0) or shorter (1) anteroposteriorly than transversely.
29. Supratemporal fossa, lateral exposure: not visible laterally, obscured by temporal bar (0); visible laterally, temporal bar shifted ventrally (1).
30. Laterotemporal fenestra, anterior extension: posterior to orbit (0); ventral to orbit (1).
31. Squamosal–quadratojugal contact: present (0); absent (1).
32. Quadratojugal, anterior process length: short, anterior process shorter than dorsal process (0); long, anterior process more than twice as long as dorsal process (1).
33. Quadrate fossa: absent (0); present (1).
34. Quadrate fossa, depth: shallow (0); deeply invaginated (1).
35. Quadrate fossa, orientation: posterior (0); posterolateral (1).
36. Palatobasal contact, shape: pterygoid with small facet (0), dorsomedially orientated hook (1), or rocker-like surface (2) for basipterygoid articulation.
37. Pterygoid, transverse flange (i.e. ectopterygoid process) position: posterior of orbit (0); between orbit and antorbital fenestra (1); anterior to antorbital fenestra (2).
38. Pterygoid, quadrate flange size: large, palatobasal and quadrate articulations well separated (0); small, palatobasal and quadrate articulations approach (1).
39. Pterygoid, palatine ramus shape: straight, at level of dorsal margin of quadrate ramus (0); stepped, raised above level of quadrate ramus (1).
40. Palatine, lateral ramus shape: plate-shaped (long maxillary contact) (0); rod-shaped (narrow maxillary contact) (1).
41. Epipterygoid: present (0); absent (1).
42. Vomer, anterior articulation: maxilla (0); premaxilla (1).
43. Supraoccipital, height: twice (0) subequal to or less than (1) height of foramen magnum.
44. Paroccipital process, ventral nonarticular process: absent (0); present (1).
45. Crista prootica, size: rudimentary (0); expanded laterally into ‘dorsolateral process’ (1).
46. Basipterygoid processes, length: short, approximately twice (0) or elongate, at least four times (1) basal diameter.
47. Basipterygoid processes, angle of divergence: approximately 45° (0); less than 30° (1).
48. Basal tubera, anteroposterior depth: approximately half dorsoventral height (0); sheet-like, 20% dorsoventral height (1).

49. Basal tubera, breadth: much broader than (0) or narrower than occipital condyle (1).
50. Basioccipital depression between foramen magnum and basal tubera: absent (0); present (1).
51. Basisphenoid/basipterygoid recess: present (0); absent (1).
52. Basisphenoid–quadrato contact: absent (0); present (1).
53. Basipterygoid processes, orientation: perpendicular to (0) or angled approximately 45° to (1) skull roof.
54. Occipital region of skull, shape: anteroposteriorly deep, paroccipital processes oriented posterolaterally (0); flat, paroccipital processes oriented transversely (1).
55. Dentary, depth of anterior end of ramus: slightly less than that of dentary at midlength (0); 150% minimum depth (1).
56. Dentary, anteroventral margin shape: gently rounded (0); sharply projecting triangular process or ‘chin’ (1).
57. Dentary symphysis, orientation: angled 15° or more anteriorly to (0) or perpendicular to (1) axis of jaw ramus.
58. External mandibular fenestra: present (0); absent (1).
59. Surangular depth: less than twice (0) or more than two and one-half times (1) maximum depth of the angular.
60. Surangular ridge separating adductor and articular fossae: absent (0); present (1).
61. Adductor fossa, medial wall depth: shallow (0); deep, prearticular expanded dorsoventrally (1).
62. Splenial posterior process, position: overlapping angular (0); separating anterior portions of prearticular and angular (1).
63. Splenial posterodorsal process: present, approaching margin of adductor chamber (0); absent (1).
64. Coronoid, size: extending to dorsal margin of jaw (0); reduced, not extending dorsal to splenial (1); absent (2).
65. Tooth rows, shape of anterior portions: narrowly arched, anterior portion of tooth rows V-shaped (0); broadly arched, anterior portion of tooth rows U-shaped (1); rectangular, tooth-bearing portion of jaw perpendicular to jaw rami (2).
66. Tooth rows, length: extending to orbit (0); restricted anterior to orbit (1); restricted anterior to subnarial foramen (2).
67. Crown-to-crown occlusion: absent (0); present (1).

68. Occlusal pattern: interlocking, V-shaped facets (0); high-angled planar facets (1); low-angled planar facets (2).
69. Tooth crowns, orientation: aligned along jaw axis, crowns do not overlap (0); aligned slightly anterolingually, tooth crowns overlap (1).
70. Tooth crowns, cross-sectional shape at midcrown: elliptical (0); D-shaped (1); cylindrical (2).
71. Enamel surface texture: smooth (0); wrinkled (1).
72. Marginal tooth denticles: present (0); absent on posterior edge (1); absent on both anterior and posterior edges (2).
73. Dentary teeth, number: greater than 20 (0); 17 or fewer (1).
74. Replacement teeth per alveolus, number: two or fewer (0); more than four (1).
75. Teeth, orientation: perpendicular (0) or oriented anteriorly relative (1) to jaw margin.
76. Teeth, longitudinal grooves on lingual aspect: absent (0); present (1).
77. Presacral bone texture: solid (0); spongy, with large, open internal cells, 'camellate' (Britt, 1993, 1997) (1).
78. Presacral centra, pneumatopores (pleurocoels): absent (0); present (1).
79. Atlantal 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 than that of ventral aspect (1).
80. Cervical vertebrae, number: 9 or fewer (0); 10 (1); 12 (2); 13 (3); 15 or greater (4).
81. Cervical neural arch lamination: well developed, with well defined laminae and coels (0); rudimentary; diapophyseal laminae only feebly developed if present (1).
82. Cervical centra, articular face morphology: amphicoelous (0); opisthocoelous (1).
83. Cervical pneumatopores (pleurocoels), shape: simple, undivided (0); complex, divided by bony septa (1).
84. Anterior cervical centra, height:width ratio: less than 1 (0); approximately 1.25 (1).
85. Anterior cervical neural spines, shape: single (0); bifid (1).
86. Mid-cervical centra, anteroposterior length/height of posterior face: 2.5–3.0 (0); > 4 (1).
87. Mid-cervical neural arches, height: less than that of posterior centrum face (0); greater than that of posterior centrum face (1).
88. Middle and posterior cervical neural arches, centroprezygapophyseal lamina (cppl), shape: single (0); divided (1).

89. Posterior cervical and anterior dorsal neural spines, shape: single (0); bifid (1).
90. Posterior cervical and anterior dorsal bifid neural spines, median tubercle: absent (0); present (1).
91. Dorsal vertebrae, number: 15 (0); 14 (1); 13 (2); 12 (3); 11 (4); 10 or fewer (5).
92. Dorsal neural spines, breadth: narrower (0) or much broader (1) transversely than anteroposteriorly.
93. Dorsal neural spines, length: approximately twice (0) or approximately four times (1) centrum length.
94. Anterior dorsal centra, articular face shape: amphicoelous (0); opisthocoelous (1).
95. Middle and posterior dorsal neural arches, centropostzygapophyseal lamina (cpol), shape: single (0); divided (1).
96. Middle and posterior dorsal neural arches, anterior centroparapophyseal lamina (acpl): absent (0); present (1).
97. Middle and posterior dorsal neural arches, prezygoparapophyseal lamina (prpl): absent (0); present (1).
98. Middle and posterior dorsal neural arches, posterior centroparapophyseal lamina (pcpl): absent (0); present (1).
99. Middle and posterior dorsal neural arches, spinodiapophyseal lamina (spdl): absent (0); present (1).
100. Middle and posterior dorsal neural arches spinopostzygapophyseal lamina (spol) shape: single (0); divided (1).
101. Middle and posterior dorsal neural arches, spinodiapophyseal lamina (spdl) and spinopostzygapophyseal lamina (spol) contact: absent (0); present (1).
102. Middle and posterior dorsal neural spines, shape: tapering or not flaring distally (0); flared distally, with pendant, triangular lateral processes (1).
103. Middle and posterior dorsal neural arches, ‘infradiapophyseal’ pneumatopore between acdl and pcpl: absent (0); present (1).
104. Middle and posterior dorsal neural spines, orientation: vertical (0); posterior, neural spine summit approaches level of diapophyses (1).
105. Posterior dorsal centra, articular face shape: amphicoelous (0); opisthocoelous (1).
106. Posterior dorsal neural arches, hyosphene–hypantrum articulations: present (0); absent (1).
107. Posterior dorsal neural spines, shape: rectangular through most of length (0); ‘petal’ shaped, expanding transversely through 75% of its length and then tapering (1).
108. Sacral vertebrae, number: 3 or fewer (0); 4 (1); 5 (2); 6 (3).
109. Sacrum, sacricostal yoke: absent (0); present (1).
110. Sacral vertebrae contributing to acetabulum: numbers 1–3 (0); numbers 2–4 (1).

111. Sacral neural spines, length: approximately twice (0) or four times (1) length of centrum.
112. Sacral ribs, dorsoventral length: low, not projecting beyond dorsal margin of ilium (0); high extending beyond dorsal margin of ilium (1).
113. Caudal bone texture: solid (0); spongy, with large internal cells (1).
114. Caudal vertebrae, number: more than 45 (0); 35 or fewer (1).
115. Caudal transverse processes: persist through caudal 20 or more posteriorly (0); disappear by caudal 15 (1); disappear by caudal 10 (2).
116. First caudal centrum, articular face shape: flat (0); procoelous (1); opisthocoelous (2); biconvex (3).
117. First caudal neural arch, coel on lateral aspect of neural spine: absent (0); present (1).
118. Anterior caudal centra (excluding the first), articular face shape: amphiplatyan or platycoelous (0); procoelous (1); opisthocoelous (2).
119. Anterior caudal centra, pneumatopores (pleurocoels): absent (0); present (1).
120. Anterior caudal centra, length: approximately the same (0) or doubling (1) over the first 20 vertebrae.
121. Anterior caudal neural arches, spinoprezygapophyseal lamina (sprl): absent (0); present and extending onto lateral aspect of neural spine (1).
122. 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).
123. Anterior caudal neural arches, prespinal lamina (prsl): absent (0); present (1).
124. Anterior caudal neural arches, postspinal lamina (posl): absent (0); present (1).
125. Anterior caudal neural arches, postspinal fossa: absent (0); present (1).
126. Anterior caudal neural spines, transverse breadth: approximately 50% of (0) or greater than (1) anteroposterior length.
127. Anterior caudal transverse processes, proximal depth: shallow, on centrum only (0); deep, extending from centrum to neural arch (1).
128. Anterior caudal transverse processes, shape: triangular, tapering distally (0); 'wing-like', not tapering distally (1).
129. Anterior caudal transverse processes, diapophyseal laminae (acdl, pcdl, prdl, podl): absent (0); present (1).
130. Anterior caudal transverse processes, anterior centriadiapophyseal lamina (acdl), shape: single (0); divided (1).

131. Anterior and middle caudal centra, shape: cylindrical (0); quadrangular, flat ventrally and laterally (1).
132. Anterior and middle caudal centra, ventral longitudinal hollow: absent (0); present (1).
133. Middle caudal neural spines, orientation: angled posterodorsally (0); vertical (1).
134. Middle and posterior caudal centra, anterior articular face shape: flat (0); procoelous (cone shaped) (1); opisthocoelous (2).
135. Posterior caudal centra, shape: cylindrical (0); dorsoventrally flattened, breadth at least twice height (1).
136. Distalmost caudal centra, articular face shape: platycoelous (0); biconvex (1).
137. Distalmost biconvex caudal centra, length-to-height ratio: less than 4 (0); greater than 5 (1).
138. Distalmost biconvex caudal centra, number: 10 or fewer (0); more than 30 (1).
139. Cervical rib, tuberculum–capitulum angle: greater than 90° (0); less than 90°, rib ventrolateral to centrum (1).
140. Cervical ribs, length: much longer than centrum, overlapping as many as three subsequent vertebrae (0); shorter than centrum, little or no overlap (1).
141. Dorsal ribs, proximal pneumatocoels: absent (0); present (1).
142. Anterior dorsal ribs, cross-sectional shape: subcircular (0); plank-like, anteroposterior breadth more than three times mediolateral breadth (1).
143. ‘Forked’ chevrons with anterior and posterior projections: absent (0); present (1).
144. ‘Forked’ chevrons, distribution: distal tail only (0); throughout middle and posterior caudal vertebrae (1).
145. Chevrons, ‘crus’ bridging dorsal margin of haemal canal: present (0); absent (1).
146. Chevron haemal canal, depth: short, approximately 25% (0) or long, approximately 50% (1) chevron length.
147. Chevrons: persisting throughout at least 80% of tail (0); disappearing by caudal 30 (1).
148. Posterior chevrons, distal contact: fused (0); unfused (open) (1).
149. Posture: bipedal (0); columnar, obligately quadrupedal posture (1).
150. Scapular acromion process, size: narrow (0); broad, width more than 150% minimum width of blade (1).
151. Scapular blade, orientation: perpendicular to (0) or forming a 45° angle with (1) coracoid articulation.



152. Scapular blade, shape: acromial edge not expanded (0); rounded expansion on acromial side (1); racquet-shaped (2).
153. Scapular glenoid, orientation: relatively flat or laterally facing (0); strongly bevelled medially (1).
154. Scapular blade, cross-sectional shape at base: flat or rectangular (0); D-shaped (1).
155. Coracoid, proximodistal length: less than (0) or approximately twice (1) length of scapular articulation.
156. Coracoid, anteroventral margin shape: rounded (0); rectangular (1).
157. Coracoid, infraglenoid lip: absent (0); present (1).
158. Sternal plate, shape: oval (0); crescentic (1).
159. Humeral proximolateral corner, shape: rounded (0); square (1).
160. Humeral deltopectoral attachment, development: prominent (0); reduced to a low crest or ridge (1).
161. Humeral deltopectoral crest, shape: relatively narrow throughout length (0); markedly expanded distally (1).
162. Humeral midshaft cross-section, shape: circular (0); elliptical, with long axis orientated transversely (1).
163. Humeral distal condyles, articular surface shape: restricted to distal portion of humerus (0); exposed on anterior portion of humeral shaft (1).
164. Humeral distal condyle, shape: divided (0); flat (1).
165. Ulnar proximal condyle, shape: subtriangular (0); triradiate, with deep radial fossa (1).
166. Ulnar proximal condylar processes, relative lengths: subequal (0); unequal, anterior arm longer (1).
167. Ulnar olecranon process, development: prominent, projecting above proximal articulation (0); rudimentary, level with proximal articulation (1).
168. Ulna, length-to-proximal breadth ratio: gracile (0); stout (1).
169. Radial distal condyle, shape: round (0); subrectangular, flattened posteriorly and articulating in front of ulna (1).
170. Radius, distal breadth: slightly larger than (0) or approximately twice (1) midshaft breadth.
171. Radius, distal condyle orientation: perpendicular to (0) or bevelled approximately 20° proximolaterally (1) relative to long axis of shaft.
172. Humerus-to-femur ratio: less than 0.60 (0); 0.60 or more (1).
173. Carpal bones, number: 3 or more (0); 2 or fewer (1).
174. Carpal bones, shape: round (0); block-shaped, with flattened proximal and distal surfaces (1).

175. Metacarpus, shape: spreading (0); bound, with subparallel shafts and articular surfaces that extend half their length (1).
176. Metacarpals, shape of proximal surface in articulation: gently curving, forming a 90° arc (0); U-shaped, subtending a 270° arc (1).
177. Longest metacarpal-to-radius ratio: close to 0.3 (0); 0.45 or more (1).
178. Metacarpal I, length: shorter than (0) or longer than (1) metacarpal IV.
179. Metacarpal I, distal condyle shape: divided (0); undivided (1).
180. Metacarpal I distal condyle, transverse axis orientation: bevelled approximately 20° proximodistally (0) or perpendicular (1) with respect to axis of shaft.
181. 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).
182. Manual phalanx I.1, shape: rectangular (0); wedge-shaped (1).
183. Manual nonungual phalanges, shape: longer proximodistally than broad transversely (0); broader transversely than long proximodistally (1).
184. Pelvis, anterior breadth: narrow, ilia longer anteroposteriorly than distance separating preacetabular processes (0); broad, distance between preacetabular processes exceeds antero-posterior length of ilia (1).
185. Ilium, ischial peduncle size: large, prominent (0); low, rounded (1).
186. Iliac blade dorsal margin, shape: flat (0); semicircular (1).
187. Iliac preacetabular process, orientation: antero-lateral to (0) or perpendicular to (1) body axis.
188. Iliac preacetabular process, shape: pointed, arching ventrally (0); semicircular, with posteroventral excursion of cartilage cap (1).
189. Pubis, ambiens process development: small, con-fluent with (0) or prominent, projecting anteriorly from (1) anterior margin of pubis.
190. Pubic apron, shape: flat (straight symphysis) (0); canted anteromedially (gentle S-shaped symphysis) (1).
191. Puboischial contact, length: approximately one-third (0) or one-half (1) total length of pubis.
192. Ischial blade, length: much shorter than (0) or equal to or longer than (1) pubic blade.
193. Ischial blade, shape: emarginate distal to pubic peduncle (0); no emargination distal to pubic peduncle (1).
194. Ischial distal shaft, shape: triangular, depth of ischial shaft increases medially (0); bladelike, medial and lateral depths subequal (1).

195. Ischial distal shafts, cross-sectional shape: V-shaped, forming an angle of nearly 50° with each other (0); flat, nearly coplanar (1).
196. Femoral fourth trochanter, development: prominent (0); reduced to crest or ridge (1).
197. Femoral lesser trochanter: present (0); absent (1).
198. Femoral midshaft, transverse diameter: sub-equal to (0), 125–150%, or (1) at least 185% (2) anteroposterior diameter.
199. Femoral shaft, lateral margin shape: straight (0); proximal one-third deflected medially (1).
200. Femoral distal condyles, relative transverse breadth: subequal (0); tibial much broader than fibular (1).
201. Femoral distal condyles, orientation: perpendicular or slightly bevelled dorsolaterally (0) or bevelled dorsomedially approximately 10° (1) relative to femoral shaft.
202. Femoral distal condyles, articular surface shape: restricted to distal portion of femur (0); expanded onto anterior portion of femoral shaft (1).
203. Tibial proximal condyle, shape: narrow, long axis anteroposterior (0); expanded transversely, condyle subcircular (1).
204. Tibial cnemial crest, orientation: projecting anteriorly (0) or laterally (1).
205. Tibia, distal breadth: approximately 125% (0) or more than twice (1) midshaft breadth.
206. Tibial distal posteroventral process, size: broad transversely, covering posterior fossa of astragalus (0); shortened transversely, posterior fossa of astragalus visible posteriorly (1).
207. Fibula, proximal tibial scar, development: not well-marked (0); well-marked and deepening anteriorly (1).
208. Fibula, lateral trochanter: absent (0); present (1).
209. Fibular distal condyle, size: subequal to shaft (0); expanded transversely, more than twice mid-shaft breadth (1).
210. Astragalus, shape: rectangular (0); wedge-shaped, with reduced anteromedial corner (1).
211. Astragalus, foramina at base of ascending process: present (0); absent (1).
212. Astragalus, ascending process length: limited to anterior two-thirds of astragalus (0); extending to posterior margin of astragalus (1).
213. Astragalus, posterior fossa shape: undivided (0); divided by vertical crest (1).
214. Astragalus, transverse length: 50% more than (0) or subequal to (1) proximodistal height.
215. Calcaneum: present (0); absent or unossified (1).

216. Distal tarsals 3 and 4: present (0); absent or unossified (1).
217. Metatarsus, posture: bound (0); spreading (1).
218. Metatarsal I proximal condyle, transverse axis orientation: perpendicular to (0) or angled ventromedially approximately 15° to (1) axis of shaft.
219. Metatarsal I distal condyle, transverse axis orientation: perpendicular to (0) or angled dorsomedially to (1) axis of shaft.
220. Metatarsal I distal condyle, posterolateral projection: absent (0); present (1).
221. Metatarsal I, minimum shaft width: less than (0) or greater than (1) that of metatarsals II–IV.
222. Metatarsal I and V proximal condyle, size: smaller than (0) or subequal to (1) those of metatarsals II and IV.
223. Metatarsal III length: more than 30% (0) or less than 25% (1) that of tibia.
224. Metatarsals III and IV, minimum transverse shaft diameters: subequal to (0) or less than 65% (1) that of metatarsals I or II (1).
225. Metatarsal V, length: shorter than (0) or at least 70% (1) length of metatarsal IV.
226. Pedal nonungual phalanges, shape: longer prox-imodistally than broad transversely (0); broader transversely than long proximodistally (1).
227. Pedal digits II–IV, penultimate phalanges, development: subequal in size to more proximal phalanges (0); rudimentary or absent (1).
228. Pedal unguals, orientation: aligned with (0) or deflected lateral to (1) digit axis.
229. Pedal digit I unguual, length relative to pedal digit II unguual: subequal (0); 25% larger than that of digit II (1).
230. Pedal digit I unguual, length: shorter (0) or longer (1) than metatarsal I.
231. Pedal unguual I, shape: broader transversely than dorsoventrally (0); sickle-shaped, much deeper dorsoventrally than broad transversely (1).
232. Pedal unguual II–III: flattened plantar surface (0); sickle-shaped, much deeper dorsoventrally than broad transversely (1).
233. Pedal digit IV unguual, development: subequal in size to unguuals of pedal digits II and III (0); rudimentary or absent (1).
234. Osteoderms: absent (0); present (1).
235. Unguals of pedal digit II and III, proximal dimensions: as broad as deep (0); significantly broader than deep (1) (Wilson and Sereno, 1998).



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*Brachiosaurus*

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*Camarasaurus*

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00010101111010011111100111110001110111101001101101111001111011111111111110  
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*Dicraeosaurus*

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*Diplodocus*

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*Haplocanthosaurus*

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*Amargasaurus*

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*Euhelopus*

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*Jobaria*

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*Malawisaurus*

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*Nigersaurus*

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*Rayososaurus*

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*Rebbachisaurus*

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*Alamosaurus*

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*Nemegtosaurus*





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*Tazoudasaurus*

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