

ONLINE SUPPLEMENTARY APPENDICES

APPENDIX S1: DESCRIPTION OF NEW CHARACTERS

Note: characters numbered according to their location in the full analysis.

9. Supratemporal fenestra oriented primarily dorsally (0), mostly dorsally but visible as a sliver in lateral view (1), or extensively laterally (2). The supratemporal fenestrae of most archosaur outgroups (e.g. *Erythrosuchus*: Gower 2003; proterochampsids: Sill 1967, Romer 1971c, Arcucci 1990) face completely dorsally, a condition also seen in basal dinosaurs (Fig. 3B; Galton 1984, 1985b; Colbert 1989; Sereno & Novas 1993), phytosaurs (Chatterjee 1978), ornithosuchids (Walker 1964; Bonaparte 1971), and many “rauisuchians” (*Arizonasaurus*: Nesbitt 2005; *Batrachotomus*: Fig. 3F, Gower 1999; *Effigia*: Nesbitt 2007; *Postosuchus*: Long & Murry 1995; *Shuvosaurus*: Chatterjee 1993). In contrast, the supratemporal fenestrae of most aetosaurs face fully laterally (Fig. 3C), a condition often held as an autapomorphy of the clade (e.g. Heckert & Lucas 1999). This state is also seen in *Gracilisuchus* (MCZ 4116, 4117; Romer 1972a; Brinkman 1981). Additionally, it is apparent that many crurotarsan taxa possess supratemporal fenestrae that are partially exposed laterally, and thus visible as a narrow sliver in lateral view (*Erpetosuchus*: Benton & Walker 2002; *Lotosaurus*: IVPP unnumbered; *Prestosuchus*: Fig. 3E, Barberena 1978; *Saurosuchus*: Alcober 2000; *Teratosaurus*: Sulej 2005; *Tikisuchus*: Chatterjee & Majumdar 1987; basal crocodylomorphs: *Terrestrisuchus*, *Sphenosuchus*, Crush, 1984 Walker 1990). In many “rauisuchian” taxa this appears to be at least partially the result of dorsolateral rotation of the squamosal. Whereas in most archosaurs (e.g. *Batrachotomus*: SMNS 80260) the

ventral ramus of the squamosal projects straight ventrally, in “rauisuchians” with a slightly laterally facing fenestra (e.g. *Rauisuchus*: BPSG AS XXV 62) the ventral ramus projects lateroventrally, and thus the primitive “lateral” surface faces partially dorsally. This rotation serves to expose the lateral margin of the fenestra in lateral view. Some pterosaurs (e.g. *Eudimorphodon*: Wild 1978), *Scleromochlus* (Fig. 3A; Benton 1999) and the crurotarsan *Qianosuchus* (Li *et al.* 2006) appear to possess fully laterally-facing supratemporal fenestrae, but we conservatively score them for the first derived state (“narrow sliver in lateral view”) here, as these specimens appear to be mediolaterally crushed (which likely results in a partially laterally facing fenestra to appear to be more fully laterally facing).

12. Anterior border of premaxilla vertical (0) or slopes posterodorsally (1). The anterior margin of the premaxilla is roughly vertical in immediate archosaur outgroups, pterosaurs, most dinosauromorphs, phytosaurs, ornithosuchids, basal crocodylomorphs, and most “rauisuchians” (Fig. 3A-C, E-F). Aetosaurs exhibit a slightly different morphology in which the anterior margin of the premaxilla is short and strongly reduced, but nevertheless the anterior margin is usually vertical or slightly inclined anterodorsally (*Aetosaurus*: Fig. 3C; SMNS 5770; *Desmotosuchus*: Small 2002). However, in *Effigia* (Nesbitt 2007), *Lotosaurus* (IVPP unnumbered), and *Shuvosaurus* (Fig. 3D; TTUP 9282; Chatterjee 1993; Rauhut 1997) the anterior margin of the premaxilla is strongly convex and slopes posteriorly, which likely relates to the presence of a cropping beak in these edentulous taxa. Not surprisingly, this condition is also seen in many ornithischian dinosaurs (e.g. *Heterodontosaurus*: Santa Luca 1980; *Lesothosaurus*: Sereno 1991b),

although a more traditional subvertical anterior border is seen in the beaked, herbivorous dinosauriform *Silesaurus* (Dzik 2003).

13. Ventral margin of premaxilla shorter (0) or longer (1,2) than ventral margin of maxilla. Most immediate archosaur outgroups and basal archosaurs possess maxillae that are much larger than the premaxillae, and thus have a longer ventral margin (Fig. 3A-C, E-F). In contrast, some crurotarsans possess an expanded premaxilla that is longer ventrally than the maxilla. Among these taxa two general and likely non-homologous conditions are apparent. First, phytosaurs are characterised by extremely elongate premaxillae that form the majority of a greatly expanded snout. In these taxa the maxilla is still large and it appears as if the premaxillae have expanded anteriorly to form the snout. Second, the “rauisuchians” *Effigia* (Nesbitt 2007), *Lotosaurus* (IVPP unnumbered), and *Shuvosaurus* (Fig. 3D; TTUP 9282; Chatterjee 1993; Rauhut 1997) possess extremely shortened maxillae that are shorter ventrally than the premaxillae, which likely formed a beak. The premaxillae are not greatly expanded, and comparison to other crurotarsans indicates that the maxillae in these taxa are reduced. Therefore, it appears that possession of a longer premaxilla relative to the maxilla results from two different morphological transformations (expanded premaxillae and reduced maxillae, respectively), and thus this character is divided into two derived states.

14. Subnarial process of premaxilla absent or very short (0), elongate and finger-like (1), shortened and blunt (2). The premaxilla of most archosaurs is comprised of a main body and two major processes visible in lateral view, one of which floors the external naris and often contacts the maxilla (the subnarial process), and one that articulates with the nasal anterior or dorsal to the naris (the dorsal process). The subnarial

process is absent or extremely small in pterosaurs (*Dimorphodon*: BMNH 41212; *Eudimorphodon*: Wild 1978), aetosaurs (*Aetosaurus*: Fig. 3C, SMNS 5770; *Desmatosuchus*: Small 2002), ornithosuchids (*Ornithosuchus*: BMNH R2409; Walker 1964; *Riojasuchus*: Bonaparte 1971; Sereno 1991a), most phytosaurs (e.g. *Mystriosuchus*: SMNS uncatalogued, McGregor 1906, Hungerbühler 2002), *Qianosuchus* (Li *et al.* 2006), and apparently *Scleromochlus* (Fig. 3A; Benton 1999). In this analysis the states “absent” and “very small” are not separated because it is difficult to define a boundary between the two conditions, in large part because of poor preservation. It is possible that an extremely reduced process may appear as absent, especially in specimens that are poorly preserved, incompletely prepared, or incompletely figured in the literature.

Those taxa that possess a discrete subnarial process exhibit two general morphologies. First, a range of basal dinosaurs (e.g. *Herrerasaurus*: Fig. 3B, PVSJ 407, Sereno & Novas 1993; *Lesothosaurus*: BMNH RU B.23, Sereno 1991b) and “rauisuchians” (e.g. *Lotosaurus*: IVPP unnumbered; *Postosuchus*: TTUP 9000, Long & Murry 1995; *Prestosuchus*: Fig. 3E, Barberena 1978; *Rauisuchus*: BPSG AS XXV 60; *Saurosuchus*: Alcober 2000; *Shuvosaurus*: Figure 3D, Chatterjee 1993) possess subnarial processes that are elongate, often thin, and finger-like. Second, many other “rauisuchians” (e.g. *Batrachotomus*: Fig. 3F, SMNS 80260; *Effigia*: Nesbitt 2007; apparently *Yarasuchus*: Sen 2005) and basal crocodylomorphs (*Protosuchus*: Gow 2000; *Sphenosuchus*: Walker 1990) possess discrete subnarial processes that are shortened and often triangular or spade-shaped in lateral view. These two derived states do not appear to be correlated with the states of character 15, which relate to the extent of the subnarial process. Many taxa possess elongate processes that still terminate ventral to the external

naris (e.g. *Lotosaurus*, *Rauisuchus*, *Prestosuchus*), whereas some taxa have shortened processes that nonetheless extend posterior to the external naris (e.g. *Protosuchus*, *Sphenosuchus*).

18. Premaxilla-maxilla articulation level (0) or angled, forming an arch (1). The premaxilla and maxilla of most archosaurs articulate at the same level ventrally, and thus the tooth rows of both elements are smoothly continuous. Sereno (1991a:character 16) recognised that an arched diastema between the premaxilla and maxilla characterises ornithosuchids. While the diastema is a clear synapomorphy of this group, an arched or notched articulation between the premaxilla and maxilla at their ventral contact is seen in a handful of other basal archosaurs, including *Qianosuchus* (Li *et al.* 2006), *Revueltosaurus* (Parker *et al.* 2005) and the aetosaur *Aetosaurus* (SMNS 5770; Schoch 2007). In these taxa the premaxilla and maxilla meet at an angle, and the tooth row describes a broad arch in this region. This condition is also seen in some basal theropods (*Coelophysis*: Colbert 1989) and the archosaur outgroup *Erythrosuchus* (Gower 2003).

20. Ascending ramus of maxilla thick (0) or thin (1). In most basal archosaurs the ascending ramus of the maxilla is thick, with an anteroposterior length at the base that is greater than half the depth of the maxillary main body at the anterior edge of the antorbital fenestra. Note that because of the varying inclination of the ascending ramus this basal dimension is not always oriented exactly anteroposteriorly. In many of these taxa the ascending ramus is much greater than half the depth of the main body, and sometimes even thicker (e.g. *Aetosaurus*: Fig. 3C, SMNS 5770; *Ornithosuchus*: BMNH R2409; Walker 1964). However, many crurotarsans exhibit extremely thin ascending processes that are far less than half the depth of the main body, including *Qianosuchus*

(Li *et al.* 2006), *Revueltosaurus* (Parker *et al.* 2005), as well as numerous “rauisuchians” (*Arizonasaurus*: Nesbitt, 2005; *Batrachotomus*: Fig. 3F, SMNS 52970, Gower 1999; *Fasolasuchus*: Bonaparte 1981; *Prestosuchus*: Fig. 3E, Barberena 1978; *Ticinosuchus*: Krebs 1965). A thin ascending process also appears to be present in the outgroup *Erythrosuchus* (Gower 2003), but not in more proximal archosaur outgroups (*Chanaresuchus*: Romer 1971c; *Euparkeria*: Ewer 1965).

33. Frontal contributes to the dorsal orbital rim (0) or is excluded (1). Nearly all basal archosaurs and immediate archosaur outgroups possess a frontal that broadly contributes to the dorsal orbital rim, as is clearly seen in lateral and dorsal view of the skull (e.g. Alcober 2000:fig. 11). However, the “rauisuchians” *Postosuchus* (TTUP 9000; Long & Murry 1995) and *Teratosaurus* (Sulej 2005) exhibit a unique condition, in which the frontal is excluded from the orbital rim by a novel palpebral ossification, which extends posteriorly to contact the postorbital dorsal to the orbit. This ossification has previously been interpreted as a greatly enlarged prefrontal (Chatterjee 1985; Sulej 2005), but is in fact a separate ossification (S.J. Nesbitt, pers. comm.; SLB, pers. obs.). In these taxa the frontals are reduced in size and visible on the midline dorsally, but are not apparent laterally (e.g. Sulej 2005:fig. 3). *Batrachotomus* may exhibit an intermediate condition, in which an enlarged prefrontal nearly contacts the postfrontal and postorbital but allows a narrow region of the frontal to contribute to the orbital rim (Fig. 3F, SMNS 52970, 80260; Gower 1999:fig. 2). As this intermediate condition is unknown in other taxa, and a distinct palpebral is clearly absent, *Batrachotomus* is scored for the primitive state, but this character should be expanded into a three-state character if future discoveries reveal a *Batrachotomus*-like morphology in additional taxa.

34. Sagittal crests on the frontals absent (0) or present (1). The dorsal surface of the frontal of most basal archosaurs and immediate outgroups is generally flat, without any dorsal expansions. However, some crurotarsans exhibit a raised midline sagittal crest, which is low and broad in *Lotosaurus* (IVPP unnumbered) and *Saurosuchus* (Alcober 2000) and narrow, deep, and sharp in *Batrachotomus* (SMNS 80260, Gower 1999) and *Sphenosuchus* (Walker 1990). Whether these conditions are homologous is uncertain, but we score as identical all taxa possessing a dorsal midline crest pending further study of archosaur cranial anatomy. It is unlikely that this character is related to body size, judging by the large size range of the aforementioned taxa.

41. Jugal triradiate (0) or elongate (1). The jugal of most basal archosaurs and immediate outgroups is a triradiate or tetraradiate element, with an anterior ramus that contacts the maxilla (and often gives rise to a dorsal projection that articulates with the lacrimal), a posterior ramus that contacts the quadratojugal, and a dorsal ramus that articulates with the postorbital (Fig. 3A-C, E-F). Usually the jugal forms most of the ventral floor of the orbit but does not extend far anterior to this opening. Additionally, the main body of the jugal under the orbit is deep in most taxa. In contrast, the jugals of *Effigia* (AMNH 30587; Nesbitt 2007) and *Shuvosaurus* (Fig. 3D; TTUP 9280; Chatterjee 1993; Rauhut 1997) exhibit a unique morphology, in which a dorsal projection for articulation with the lacrimal is completely absent in lateral view, the dorsal ramus for articulation with the postorbital is short, the main body is shallow, and the anterior ramus extends far anterior to the orbit. Taken together, these features result in an elongate, rod-like shape of the jugal. The anterior extension of the jugal may be correlated with the reduced maxillae of these taxa (character 13), but *Lotosaurus* (IVPP unnumbered)

possesses a reduced maxilla in concert with a more traditional jugal morphology. It is also possible that the elongation of the jugal is correlated with the enlarged orbits of these taxa (character 3), but some avemetatarsalians (e.g. *Scleromochlus*: Benton 1999; basal ornithischians: BMNN RU B.23) exhibit enlarged orbits with a more traditional jugal morphology.

47. Posterior process of squamosal at same level as (0) or offset ventral to (1) anterior process. The squamosal of most archosaurs is triradiate in lateral view, with an anterior ramus that articulates with the postorbital, a ventral ramus that often contacts the quadratojugal or postorbital in some taxa, and a posterior ramus that often appears to be free-standing in lateral view but usually contacts the paroccipital process medially (Fig. 3A-E). The posterior ramus appears to be absent or extremely reduced in erythrosuchids (Parrish 1992; Gower 2003) but is present in more proximal archosaur outgroups (*Euparkeria*: Ewer 1965; proterochampsids: Sill 1964, Romer 1971c, Arcucci 1990). Within the crown group, most taxa exhibit a posterior ramus that is at the same level as the anterior ramus, or slightly offset dorsally. Note that in many taxa the squamosal is tilted posteroventrally, and although it may appear that the posterior ramus is located further ventrally, in fact the two rami are smoothly continuous and at the same level. However, in some taxa the posterior ramus is clearly offset ventrally from the anterior ramus. This is most apparent in *Batrachotomus* (Fig. 3F; SMNS 80260; Gower 1999), in which a discrete, tab-like posterior ramus is separated from the anterior ramus by a distinct step. A similar although less pronounced morphology is seen in other “rauisuchians” (*Postosuchus*: TTUP 9000, 9002, Long & Murry 1995; *Teratosaurus*: Sulej 2005; *Tikisuchus*: Sulej 2005). The condition in basal crocodylomorphs is

somewhat unclear and deserves further study. The squamosals of *Dibothrosuchus* (Wu & Chatterjee 1993), *Saltoposuchus* (Serenó & Wild 1992), and *Sphenosuchus* (Walker 1990) are tilted somewhat posteroventrally, but nonetheless exhibit a noticeable offset between the anterior and posterior rami. A similar offset is apparent in *Kayentasuchus*, *Litargosuchus* (Clark & Sues 2002), and *Protosuchus* (Gow 2000), but the enlarged and heavily modified squamosals of these taxa render homology assessment difficult. *Terrestrisuchus* is reconstructed as lacking a ventrally offset posterior process (Crush 1984:fig. 2), but the material is too fragmentary and poorly preserved to assess confidently (SLB, pers obs., NHM collection).

50. Squamosal, posterodorsal corner of the lateral surface unmarked (0) or excavated by deep pit (1). Although the squamosal is enormously variable in shape and size among basal archosaurs, in most taxa the lateral surface of the main body is unornamented and generally smooth. However, in *Postosuchus* (TTUP 9000, 9002; Chatterjee 1985:fig. 3h, 4b) and *Teratosaurus* (Sulej 2005:fig. 4g) the posterodorsal corner of the lateral surface is excavated by a deep, circular, concave pit. This pit is overhung dorsally by a rugose ridge, which forms part of a continuous lateral skull ridge that incorporates the nasal, lacrimal, prefrontal, and postorbital. However, the presence of the ridge is not invariant with the presence of this pit. Although both *Postosuchus* and *Teratosaurus* possess the ridge, several taxa (e.g. *Batrachotomus*, *Prestosuchus*, *Rauisuchus*, *Saurosuchus*) have a ridge but lack the pit, instead possessing a generally smooth lateral surface of the squamosal.

60. Occipital condyle spherical (0) or dorsoventrally compressed crescent-shaped (1). The occipital condyle of most basal archosaurs and close outgroups is essentially

spherical (e.g. *Batrachotomus*: Gower 2002:fig. 1; *Desmotosuchus*: Small 2002:fig. 5; *Erythrosuchus*: Gower 1997:fig. 2; *Herrerasaurus*: Sereno & Novas 1993:fig. 6; *Postosuchus*: Chatterjee 1985:fig. 5c). However, in *Effigia* (AMNH 30587; Nesbitt 2007:fig. 22c) and *Shuvosaurus* (TTUP 9280; Chatterjee 1993:fig. 5d, 6c) the occipital condyle is extremely dorsoventrally-compressed and crescent-shaped. A similar condition is present in some ornithischians (e.g. *Lesothosaurus*: Sereno 1991), but the condyle is not compressed to the extent seen in *Effigia* and *Shuvosaurus*, in which it approaches four times wider mediolaterally than deep dorsoventrally.

61. Basal tubera oriented vertical (0) or horizontal (1). In most basal archosaurs and close outgroups (example taxa listed for character 60 above) the basal tubera are oriented vertically, and descend as sheet-like processes ventral to the occipital condyle when the braincase is viewed in a standard orientation with the cultriform process held horizontally. However, in *Effigia* (AMNH 30587; Nesbitt 2007:fig. 22) and *Shuvosaurus* (TTUP 9280; Chatterjee 1993:fig. 5,6) the tubera are oriented horizontally. In these taxa the tubera extend anteriorly from the occipital condyle, are at the same level as the condyle in lateral view, and floor the endocranial cavity.

71. Dentary with teeth across the length of the element (0), edentulous anteriorly (1), completely edentulous (2). The dentary bears teeth in most basal archosaurs and immediate outgroups, although several derived clades (e.g. birds, ornithomimosaurian dinosaurs) lose teeth entirely. Some avemetatarsalians (e.g. some pterosaurs) as well as some crurotarsans (*Effigia*: AMNH 30587, Nesbitt 2007; *Lotosaurus*: IVPP unnumbered; *Shuvosaurus*: Fig. 3D, TTUP 9280, 9281, Chatterjee 1993) are characterised by completely edentulous dentaries, as recorded by the second derived state of this character.

The first derived state, dentary edentulous at anterior tip, characterises aetosaurs (Walker 1961; Heckert & Lucas 1999; Small 2002; Parker 2007) and the dinosauromorphs *Silesaurus* (Dzik 2003) and *Sacisaurus* (Ferigolo & Langer 2007). The lower jaw of ornithischians is edentulous anteriorly, but the toothless region is comprised of the neomorphic prementary ossification, and the dentary bears teeth up to its anterior margin. Although Ferigolo & Langer (2007) have identified a prementary in *Sacisaurus* we follow Irmis *et al.* (2007b) in questioning this identification. The potential prementary of *Sacisaurus* is a paired element present on both sides of the skull, not a single midline element as in ornithischians (Irmis *et al.* 2007b). Furthermore, it is uncertain whether the “prementary” of *Sacisaurus* is a separate element or simply an artefact of breakage. As the lower jaw of *Sacisaurus* otherwise closely resembles that of *Silesaurus*, which clearly lacks an accessory ossification, we score both taxa as possessing dentaries that are edentulous anteriorly. However, the score for *Sacisaurus* may be changed in the future if more conclusive evidence shows that a true prementary is present.

72. Anterior region of dentary unexpanded (0) or expanded (1) relative to main body. In most close archosaur outgroups the anterior region of the dentary is approximately as dorsoventrally deep as the midpoint of the main body (Fig. 3B, C). However, several archosaur taxa, including numerous avemetatarsalians and crurotarsans, are characterised by an anterior expansion of the dentary, in which this region is noticeably dorsoventrally expanded relative to the main body. In phytosaurs this expansion takes the form of a bulbous rosette, which holds an extended tooth battery at the tip of the elongated jaws (e.g. Chatterjee 1978). However, in most other taxa this expansion is more subtle, is either squared off or rounded (e.g. *Batrachotomus*: Fig. 3F,

SMNS 80260, Gower 1999; *Postosuchus*: TTUP 9000, Long & Murry 1995), and does not accommodate an enlarged tooth battery.

80. Cervical vertebrae ventral margin weakly concave (0) or highly waisted (1). In most basal archosaurs and immediate outgroups the ventral margin of individual cervicals is slightly concave in lateral view, because the articular faces extend ventrally relative to the main body of the centrum. In these taxa the “constricted region” between the ventral margin at the midpoint of the centrum and the ventral tip of the posterior articular face, measures no more than 35% of the height of the centrum as a whole, and is often much less. However, in the “rauisuchians” *Arizonasaurus* (Nesbitt 2005) and *Sillosuchus* (Alcober & Parrish 1997) the constricted region measures approximately 40% of the centrum height. This does not appear to be correlated with the extreme elongation of the cervicals in these taxa (character 77), as other taxa with elongate cervicals (*Effigia*: Nesbitt 2007; *Qianosuchus*: Li *et al.* 2006; *Shuvosaurus*: TTUP 9001, Long & Murry 1995) do not possess such highly waisted centra.

99. Scapula distal margin slightly expanded (0) or greatly expanded (1). The scapular blade of most archosaurs expands in dorsoventral depth posteriorly, but the extent of this expansion varies. Proximal outgroups exhibit a scapula with an expansion that is less than 2.5 times the minimum depth of the blade (*Chanaresuchus*: 2.3, Romer 1972c; *Erythrosuchus*: 2.4, Gower 2003; *Euparkeria*: 1.5, Ewer 1965). This condition is also seen in many ingroup taxa, including *Scleromochlus* (Benton 1999), pterosaurs (Wild 1978; Bennett 2001), some dinosauromorphs (e.g. *Marasuchus*: Sereno & Arcucci 1994), some basal dinosaurs (e.g. *Herrerasaurus*: PVSJ 53, Sereno 1993; *Coelophysis*: Colbert 1989), phytosaurs (e.g. *Parasuchus*: Chatterjee 1978; *Mystriosuchus*: SMNS

11128), ornithosuchids (*Ornithosuchus*: Fig. 4B; Walker 1964), *Gracilisuchus* (Romer 1972a), and some “rauisuchians” (*Effigia*: Nesbitt 2007; *Prestosuchus*: BPSG AS XXV 12; *Shuvosaurus*: Long & Murry 1995; *Ticinosuchus*: Krebs 1965). In contrast, many other taxa possess greatly expanded distal scapulae, in which the distal depth is greater than 2.5 times the minimal depth of the shaft, including some dinosauromorphs (*Lewisuchus*: Romer 1972b; *Sacisaurus*: Ferigolo & Langer 2007; *Silesaurus*: Dzik 2003), some basal dinosaurs (e.g. *Lesothosaurus*: BMNH RU B.17; *Plateosaurus*: SMNS 13200, 53537), aetosaurs (e.g. *Aetosaurus*: SMNS 5570; *Stagonolepis*: Walker 1964), basal crocodylomorphs (e.g. *Dromicosuchus*: Sues *et al.* 2003; *Protosuchus*: Colbert & Mook 1951; *Sphenosuchus*: Fig. 4A, Walker 1990; *Terrestrisuchus*: BMNH P collection), *Erpetosuchus* (Benton & Walker 2002), *Qianosuchus* (Li *et al.* 2006), and several “rauisuchians” (*Arizonasaurus*: Nesbitt 2005; *Batrachotomus*: SMNS 80271; *Poposaurus*: YPM uncatalogued; *Postosuchus*: Long & Murry 1995; *Rauisuchus*: BPSG AS XXV 91; *Yarasuchus*: Sen 2005).

101. Position of glenoid on coracoid level with (0) or ventral to (1) the scapular glenoid. In immediate archosaur outgroups and basal archosaurs the scapula and coracoid both contribute to the glenoid. When viewed laterally with the scapular blade held horizontal for reference, the coracoid and scapula contributions extend to approximately the same level ventrally in immediate outgroups and most ingroup taxa. In some taxa the coracoid glenoid may extend slightly further ventrally, but it is not noticeably offset from the scapular glenoid. This condition holds in taxa with both a shallowly-excavated glenoid (e.g. *Arizonasaurus*: Nesbitt 2005:fig. 27; *Euparkeria*: Ewer 1965:fig. 9; *Ticinosuchus*: Krebs 1976:fig. 11d) and a deeply concave and extensive fossa (e.g.

Rutiodon: McGregor 1906:pl. IX, 20-21; *Silesaurus*: Dzik 2003:fig. 9; *Sphenosuchus*: Fig. 4A, Walker 1990). On the other hand, several crurotarsans exhibit a derived state in which the coracoid contribution extends much further ventrally than the scapular contribution. Although the two regions are smoothly confluent in some of these taxa (e.g. *Parasuchus*: Chatterjee 1978:fig. 10a), in most taxa the coracoid contribution is noticeably offset and faces primarily posteriorly instead of posteroventrally (e.g. *Aetosaurus*: SMNS 5770; *Batrachotomus*: SMNS 80271; *Erpetosuchus*: Benton & Walker 2002:fig. 5c; *Mystriosuchus*: SMNS 11128, 90204; *Ornithosuchus*: Fig. 4B, Walker 1964; *Postosuchus*: Long & Murry 1995:fig. 131a; *Prestosuchus*: BPSG AS XXV 12; *Rauisuchus*: BPSG AS XXV 91; *Revueltosaurus*: Parker *et al.* 2005:fig. 3a; *Shuvosaurus*: Long & Murry 1995:fig. 164a; *Terrestrisuchus*: BMNH P collection, Crush 1984:fig. 7a; *Yarasuchus*: Sen, 2005:fig. 6a). The presence of this derived condition in taxa of a range of body sizes (*Aetosaurus*: ~50 cm body length; *Batrachotomus*: ~290 cm body length) suggests that it is not size dependent.

112. Ilium dorsal margin straight or convex (0) or saddle-shaped (1). The dorsal margin of the ilium of most basal archosaurs and immediate outgroups is shallowly convex or straight (Fig. 4C,E). However, in some dinosauromorphs (*Lagerpeton*: Sereno & Arcucci 1993:fig. 1; *Marasuchus*: Sereno & Arcucci 1994:fig. 6) and pterosaurs (e.g. *Dimorphodon*: BMNH 41212, Padian 1983:fig. 28; *Eudimorphodon*: Fig. 4D, Wild 1978) the dorsal margin is concave and resembles a saddle in lateral view. Whether this condition is homologous between these two groups is uncertain, as the concave margin is much broader and shallower in pterosaurs and sharper and deeper in basal dinosauromorphs. However, pending further study of basal avemetatarsalians we

conservatively choose to score a binary character here instead of creating a potentially redundant third state. A similar character was used by Ezcurra (2006:193), but was only relevant to the ingroup relationships of dinosaurs in his analysis.

114,115. The ilia of many “rauisuchians” are ornamented by a rugose swelling that arises near the dorsal margin of the acetabulum and trends dorsally or anterodorsally. This ridge-like structure varies among taxa in its strength, texture, and orientation, leading Gower (2000) to question whether it is a homologous feature throughout. Instead of *a priori* excluding characters relating to this swelling because of doubts over homology, we have attempted to incorporate the most important variable aspects of the structure into our analysis. As with any cladistic characters, these characters represent a primary hypothesis of homology that is then tested in the analysis, which we view as the most defensible method of considering ambiguous structures.

Character 114 is a three-state character that deals with the presence of the iliac swelling and its orientation (dorsal or anterodorsal). A similar character denoting the presence/absence of the swelling has been used in some previous studies and is not new to this analysis. However, previous studies have not taken into account the orientation of the swelling, which can be separated into two discrete states (dorsal or anterodorsal) and appears to be phylogenetically informative.

Character 115 refers to the morphology of the swelling at its dorsal termination. Some taxa possess a swelling that is only oriented anteriorly at its dorsal termination (*Effigia*: Nesbitt 2007; *Poposaurus*: TTUP 9243, TMM 31025-12, TMM 43683-1, Weinbaum & Hungerbühler 2007; *Shuvosaurus*: TTUP Post Quarry collection, Long & Murry, 1995 Gower, 2000; *Sillosuchus*: Alcober & Parrish 1997), whereas others have a

swelling that extends both anteriorly and posteriorly at its termination (*Arizonasaurus*: Nesbitt 2005; *Batrachotomus*: SMNS 52970; *Bromsgroveia*: WARMS G3; *Lotosaurus*: IVPP unnumbered; *Postosuchus*: TTUP 9002, Long & Murry 1995; *Rauisuchus*: BPSG AS XXV 88; *Saurosuchus*: Sill 1974; *Teratosaurus*: SMNS 52972). Importantly, these character states do not appear to be dependent on the orientation of the swelling as a whole. Although most dorsally oriented swellings expand both anteriorly and posteriorly, that of *Sillosuchus* expands only anteriorly. Furthermore, anterodorsally oriented swellings may be expanded only anteriorly (*Effigia*, *Poposaurus*, *Shuvosaurus*) or both anteriorly and posteriorly (*Bromsgroveia*, *Lotosaurus*).

We have not included any characters relating to the texture (strongly rugose, smooth, etc.) or strength (strong, weak, etc.) of the swelling, as we find these difficult to define based on our observations of specimens. Gower (2000) noted some differences in texture and strength among taxa, and further study may reveal clear variation in these features that can be explicitly formulated in a character statement. As reviewed by Gower (2000), the iliac swelling deserves further study, and we suggest that future phylogenetic analyses atomise features of the swelling into different characters as we have started to do. This will not only record variation that may be phylogenetically informative, but will also serve as a stronger test of homology than simply including a single character regarding the presence or absence of a swelling. However, we are also aware of the danger of excessive atomisation, as this may overemphasize the importance of this region. In the context of the present analysis, we feel that two characters (114, 115) best describe the most important phylogenetically informative variation without undue atomisation.

117. Iliac preacetabular process large and deep (0) or small, shallow, and finger-like (1). Although the preacetabular process of the ilium in most basal archosaurs and immediate outgroups is small and not expanded greatly anteriorly, its base is still approximately as dorsoventrally deep as the base of the postacetabular process. Additionally, in most taxa the preacetabular process and pubic peduncle are separated by a broadly concave margin and, most importantly, the dorsal surface of the preacetabular process and the blade of the ilium are smoothly continuous. This condition prevails in a wide range of taxa, including pterosaurs (e.g. *Eudimorphodon*: Fig. 4D; Wild 1978), dinosauromorphs (e.g. *Herrerasaurus*: Novas 1993; *Marasuchus*: Sereno & Arcucci 1994), phytosaurs (e.g. *Parasuchus*: Fig. 4C; Chatterjee 1978), aetosaurs (e.g. *Stagonolepis*: Walker 1961), ornithosuchids (e.g. *Ornithosuchus*: Walker 1961), crocodylomorphs (e.g. *Protosuchus*: Colbert & Mook 1951; *Terrestrisuchus*: Crush 1984), and most “rauisuchians” (e.g. *Effigia*: Nesbitt 2007; *Postosuchus*: TTUP 9002, Long & Murry 1995; *Shuvosaurus*: TTUP Post Quarry collection, Long & Murry, 1995; *Teratosaurus*: SMNS 52972, Galton 1985a; *Ticinosuchus*: Krebs, 1965). However, *Arizonasaurus* (Fig. 4E; Nesbitt, 2005) and *Bromsgroveia* (WARMS G3, Benton & Gower 1997) exhibit a unique condition in which the preacetabular process is greatly reduced, with a base that is much shallower than the base of the postacetabular process. In addition, the preacetabular process and pubic peduncle are separated by a narrow notch, and the dorsal margin of the preacetabular process is offset from the dorsal margin of the iliac blade by a distinct step. As a result, the preacetabular process of these taxa resembles a finger-like projection pointing anteriorly.

126. Medioventral lamina of pubis extensive (0), partially reduced (1), strongly reduced (2). As reviewed by Hutchinson (2001), diapsids ancestrally possessed a broad puboischiadic plate, giving the pubes and ischia a plate-like appearance in lateral view. The pubic contribution to this plate is comprised of an extensive medioventral lamina (“obturator flange” of some authors), which in lateral view extends posteroventrally from the thickened anterior shaft of the pubis. In immediate archosaur outgroups the medioventral lamina is extensive, and extends ventrally to approximately the same level as the shaft (*Erythrosuchus*: Hutchinson 2001:fig. 8, Gower 2003:fig. 33; *Euparkeria*: Ewer 1965:fig. 11, Hutchinson 2001:fig. 8; proterochampsids: Romer 1972c:fig. 2c). This condition also prevails in pterosaurs (e.g. *Dimorphodon*: BMNH 41212; *Eudimorphodon*: Wild 1978) and phytosaurs (e.g. *Mystriosuchus*: SMNS 12986; *Parasuchus*: Fig. 4F, Chatterjee 1978). In contrast, many archosaurs exhibit a reduced medioventral lamina, which is here divided into two states to record moderate (lamina measures 50-70% length of shaft) and extensive (less than 50% length of shaft) reduction. Note that this reduction is not absolute but relative, as Hutchinson (2001) has demonstrated that the medioventral lamina itself does not greatly reduce in size, but rather the pubic shaft distal to the lamina expands. Moderate reduction is seen in some dinosauromorphs (*Lagerpeton*: Sereno & Arcucci 1993), *Qianosuchus* (Li *et al.* 2006), *Tikisuchus* (Fig. 4G; Chatterjee & Majumdar 1987), and aetosaurs (e.g. *Aetosaurus*: SMNS 5770; *Stagonolepis*: Walker 1961), whereas extreme reduction characterises most dinosauromorphs (e.g. *Marasuchus*: Sereno & Arcucci 1994; *Silesaurus*: Dzik 2003; dinosaurs: Fig. 4H, Colbert 1989, Novas 1993), ornithosuchids (Walker 1964; Bonaparte 1971), crocodylomorphs (Colbert & Mook 1951; Crush 1984; Walker 1990; Hutchinson

2001), and most “rauisuchians” (e.g. Krebs 1965; Long & Murry 1995; Nesbitt 2005, 2007).

128. Thickness (anteroposterior dimension) of ischial shaft greater than or equal to (0) or less than (1) length of pubic shaft. In the vast majority of basal archosaurs and immediate archosaur outgroups the ischium is a more robust element than the pubis, and has a shaft that is anteroposteriorly longer at its midpoint than the pubic shaft. In some taxa the two shafts exhibit approximately equal length, but only in *Lagerpeton* (Sereno & Arcucci 1993), some basal dinosaurs (e.g. *Herrerasaurus*: Novas 1993), and the “rauisuchians” *Effigia* (Nesbitt 2007) and *Shuvosaurus* (TTUP 9001; Long & Murry 1995) is the pubic shaft considerably more robust than the ischial shaft.

APPENDIX S2: SYNAPOMORPHY LIST

Note: “r” designates a reversal, underlined characters are those with a CI = 1.0

Crurotarsi

ACCTRAN: 14

DELTRAN: 151

Both: 6(2),38,85,92,97,106,156,157,159,161,164,170,172,173

Suchia

ACCTRAN: 1r,22,28,51(2),122,130,182

DELTRAN: 63(2)

Both: 8,95,123,124,126

Aetosauria + *Gracilisuchus* + *Erpetosuchus* + Crocodylomorpha

ACCTRAN: 7,39,42,99,118

DELTRAN: 130

Both: 9(2),48,66(2),67,68,69,70,122(2)

***Gracilisuchus* + *Erpetosuchus* + Crocodylomorpha**

ACCTRAN: 10,14(2),23,46,95(2)

DELTRAN: 28,100

Both: 15,37,45,52,53,156r,157r,174,179,185

***Erpetosuchus* + Crocodylomorpha**

ACCTRAN: 7r,51r,58,91,196r,111,113,123(2),126(2),180

DELTRAN: 23,39,99

Both: 9r,36(2),37(2),40,47,102

Rauisuchia + Ornithosuchidae + *Revueltosaurus*

ACCTRAN: 100

DELTRAN: 28,51(2),66,122

Both: 6r,126(2),130(2),137

Ornithosuchidae + *Revueltosaurus*

ACCTRAN: 14r,73,76,91,123(2),149,154,182r

DELTRAN: none

Both: 18,30,31

Rauisuchia

ACCTRAN: 9,11,19,86

DELTRAN: 182

Both: 87,111

Poposauroidea

ACCTRAN: 5,16,20,29,57,59,64,94,156r,157r,165,179

DELTRAN: 19
Both: 77,85r,99,106r

Poposauroidea minus *Yarasuchus*

ACCTRAN: 11r,89,90,93,97r,98,114(2),118
DELTRAN: 5,16
Both: 113

Poposauroidea minus *Yarasuchus* and *Qianosuchus*

ACCTRAN: 9r,13(2),17,127,181,185,187
DELTRAN: 29,57,64,86,89,93,94,114(2),165
Both: 88,96(2),119,123(2),129

Effigia* + *Shuvosaurus

ACCTRAN: 145
DELTRAN: 36(2),67,90,99r,102,118,125,127(3),128,139,179,181,185,187
Both: 3,5r,39,41,52(2),53,54,55,60,61,65,74,75,76,83,88(2),105,115r,116,120,131,132(2),
133,135,140,150

Rauisuchoidea

ACCTRAN: 4,10,40,114
DELTRAN: 14r
Both: 96,174

Ticinosuchus* + *Stagonosuchus* + *Araganasuchus* + *Fasolasuchus

ACCTRAN: 97r,123r
DELTRAN: 19
Both: 137r,142

Ticinosuchus* + *Stagonosuchus* + *Araganasuchus

ACCTRAN: 147
DELTRAN: 97r
Both: 20

Ticinosuchus* + *Stagonosuchus

ACCTRAN: 86r,91
DELTRAN: 123r
Both: 78

Prestosuchidae + Rauisuchidae

ACCTRAN: 19r,23
DELTRAN: 9,10,40,114
Both: 44,45,101,102

Prestosuchidae

ACCTRAN: 2

DELTRAN: none
Both: 49,51r,122(2),127

Batrachotomus + Prestosuchus

ACCTRAN: 11r,70
DELTRAN: 4,86
Both: 5,20,25,26,27,28r,36,42,59,88,100,151r,174r,182r

Rauisuchidae

ACCTRAN: 30,31,38r,58,72,91,99,123(2),147
DELTRAN: none
Both: 47,62

Rauisuchus + Postosuchus + Teratosaurus

ACCTRAN: 33,51(3)
DELTRAN: 91,99
Both: 43

Postosuchus + Teratosaurus

ACCTRAN: 85r,122(2),127(2),157r,165
DELTRAN: 4,30,33,51(3),58
Both: 26,50

Avemetatarsalia

ACCTRAN: 78,98,112,130,147,150,154,156(2),166,
DELTRAN: none
Both: 37(2),56,64,76,77,96(2),103,104,138,148,168,171,175,178,179,184

Scleromochlus + Pterosauria

ACCTRAN: 9,19,57,63r,73,111
DELTRAN: 1,14r,
Both: 88(2),118,145,180,182

Dinosauromorpha

ACCTRAN: 1r,6,10,14,15,36(2),38,40,67,79(2),108,109,140,149,169
DELTRAN: 112,130,147,154,156(2),166
Both: 95,122,126,162,177,181,185,186

Lagerpeton + Dromomeron

ACCTRAN: 94,128
DELTRAN: none
Both: 131,134,146,152,158(2),163,170(2)

Dinosauriformes

ACCTRAN: 136,143
DELTRAN: 63(2),66,78,79(2),140,149,169

Both: 110,123(2),126(2),141,142,151,155

Dinosauriformes minus *Marasuchus*

ACCTTRAN: 93,95(2),99,120(2),129,176,178r,182,184r

DELTRAN: none

Both: 137(2),144,160,162(2)

Dinosauriformes minus *Marasuchus* and *Pseudolagosuchus*

ACCTTRAN: 122(2),143r,167

DELTRAN: 6,21,95(2),99,129,136,178r,182,184r

Both: 88,138(2),149(2),153,170(2)

Silesaurus* + *Sacisaurus* + *Eucoelophysis* + *Lewisuchus

ACCTTRAN: 14(2),98r,108r,135,156r

DELTRAN: none

Both: 148r

Silesaurus* + *Sacisaurus* + *Eucoelophysis

ACCTTRAN:102

DELTRAN: 135,150

Both: 71,132

Dinosauria

ACCTTRAN: 5,176

DELTRAN: 10,14r,36(2),38,67,98,108,109,120(2),122(2),176

Both: 35,59,81,107,112r,113(2),132(2),133,137r,165

APPENDIX S3: SCORING DIFFERENCES

A list of scoring differences between the current analysis and the analyses of Parrish (1993), Juul (1994), Benton (2004), and Nesbitt (2007). Character numbers from the original analyses are given at left, and denoted by P (Parrish 1993), J (Juul 1994), MB (Benton 2004), and N (Nesbitt 2007). Scores favoured by the current analysis are denoted by B (Brusatte *et al.*). Alternative scores are given at right. We list scoring disagreements involving taxa not included in our analysis, such as some dinosaur ingroup taxa (e.g. the exemplar theropods *Gallimimus* and *Tyrannosaurus* in Nesbitt [2007]), but these disagreements are not factored into the scoring difference counts and CSSI values in Table 4.

Parrish (1993)

- P3 *Batrachotomus* (P=?, B=1); *Rauisuchus* P=1, B=?)
P4 *Batrachotomus* (P=?, B=1), *Rauisuchus* P=1, B=?)
P5 *Lewisuchus* (P=1, B=0)
P6 *Rutiodon* (P=2, B=0)
P7 *Prestosuchus* (P=0, B=?); *Ticinosuchus* (P=0, B=?); *Saurosuchus* (P=0, B=?); *Lotosaurus* (P=0, B=?); *Batrachotomus* (P=?, B=1); *Fasolasuchus* (P=0, B=?); *Rauisuchus* (P=0, B=?); *Gracilisuchus* (P=0, B=?); *Postosuchus* (P=0, B=1)
P10 *Marasuchus* (P=1, B=0); *Rutiodon* (P=0, B=1); *Batrachotomus* (P=?, B=1); *Rauisuchus* (P=1, B=?)
P13 *Riojasuchus* (P=1, B=0); *Lotosaurus* (P=1, B=?); *Batrachotomus* (P=?, B=1)
P14 *Ticinosuchus* (P=1, B=?); *Saurosuchus* (P=1, B=0); *Batrachotomus* (P=?, B=1); *Fasolasuchus* (P=1, B=?); *Postosuchus* (P=1, B=0)
P16 *Plateosaurus* (P=0, B=?); *Ticinosuchus* (P=1, B=0); *Lewisuchus* (P=0, B=?); *Lotosaurus* (P=0, B=?); *Fasolasuchus* (P=1, B=0); *Rauisuchus* (P=?, B=1); *Gracilisuchus* (P=0, B=1); *Postosuchus* (P=0, B=?); *Alligator* (P=0, B=1)
P19 *Marasuchus* (P=0, B=1); *Plateosaurus* (P=0, B=1); *Riojasuchus* (P=0, B=1); *Rutiodon* (P=0, B=1)
P21 *Marasuchus* (P=?, B=0); *Plateosaurus* (P=0, B=?); *Prestosuchus* (P=1, B=0); *Lewisuchus* (P=1, B=?); *Desmotosuchus* (P=1, B=0); *Lotosaurus* (P=1, B=0); *Batrachotomus* (P=1, B=0); *Ticinosuchus* (P=?, B=1)
P23 *Prestosuchus* (P=1, B=0); *Ticinosuchus* (P=1, B=?); *Lewisuchus* (P=0, B=?); *Lotosaurus* (P=?, B=0); *Batrachotomus* (P=?, B=0); *Fasolasuchus* (P=1, B=?); *Rauisuchus* (P=1, B=?); *Postosuchus* (P=?, B=1)
P24 *Saurosuchus* (P=1, B=0); *Batrachotomus* (P=1, B=0); *Fasolasuchus* (P=1, B=?)

- P25 *Ticinosuchus* (P=0, B=?); *Lewisuchus* (P=1, B=0); *Desmatosuchus* (P=1, B=0);
Lotosaurus (P=1, B=0); *Gracilisuchus* (P=1, B=0)
- P26 *Plateosaurus* (P=2, B=0); *Rutiodon* (P=0, B=1); *Prestosuchus* (P=0, B=1);
Ticinosuchus (P=0, B=1); *Saurosuchus* (P=0, B=1); *Lotosaurus* (P=0?, B=1)
- P28 *Rutiodon* (P=0, B=?); *Prestosuchus* (P=0, B=?); *Ticinosuchus* (P=0, B=?);
Lotosaurus (P=1, B=0); *Batrachotomus* (P=?, B=0); *Rauisuchus* (P=1, B=?);
Gracilisuchus (P=1, B=?)
- P29 *Rutiodon* (P=0, B=?); *Prestosuchus* (P=0, B=?); *Lotosaurus* (P=1, B=0);
Batrachotomus (P=1, B=0); *Gracilisuchus* (P=1, B=?)
- P32 *Marasuchus* (P=1, B=0); *Prestosuchus* (P=0, B=1); *Saurosuchus* (P=0, B=1);
Lotosaurus (P=?, B=1); *Batrachotomus* (P=?, B=1); *Rauisuchus* (P=?, B=1);
Gracilisuchus (P=1, B=0); *Alligator* (P=1, B=0)
- P35 *Riojasuchus* (P=?, B=1); *Ticinosuchus* (P=0, B=?); *Lotosaurus* (P=0, B=?);
Batrachotomus (P=?, B=0); *Fasolasuchus* (P=1, B=?); *Rauisuchus* (P=0, B=?);
Postosuchus (P=1, B=0); *Gracilisuchus* (P=0, B=1)
- P36 *Marasuchus* (P=1, B=0); *Prestosuchus* (P=0, B=?); *Saurosuchus* (P=0, B=1);
Lotosaurus (P=0, B=?); *Fasolasuchus* (P=?, B=1); *Rauisuchus* (P=0, B=?);
Gracilisuchus (P=1, B=0)
- P40 *Prestosuchus* (P=0, B=?); *Ticinosuchus* (P=?, B=1); *Saurosuchus* (P=?, B=1);
Lewisuchus (P=0, B=?); *Lotosaurus* (P=0, B=?); *Rauisuchus* (P=0, B=?);
Gracilisuchus (P=0, B=?)

Juul (1994)

- J4 *Gracilisuchus* (J=0, B=1)
- J10 Phytosauria (J=1, B=0)
- J16 Pterosauria (J=1, B=0); *Herrerasaurus* (J=1, B=?)
- J20 *Gracilisuchus* (J=?, B=1); Ornithosuchidae (J=1, B=0)
- J22 Aetosauria (J=1, B=2); Prestosuchidae (J=1, B=2)
- J26 Ornithosuchidae (J=1, B=?)
- J27 *Gracilisuchus* (J=?, B=1)
- J28 *Gracilisuchus* (J=?, B=1)
- J29 Pterosauria (J=0, B=?); *Herrerasaurus* (J=0, B=?); Ornithischia (J=0, B=?);
Saurischia (J=0, B=?); Neotheropoda (J=0, B=?)
- J30 Pterosauria (J=0, B=?); *Herrerasaurus* (J=0, B=?); Ornithischia (J=0, B=?);
Sauropodomorpha (J=0, B=?); Neotheropoda (J=0, B=?)
- J31 *Postosuchus* (J=1, B=0)
- J32 *Gracilisuchus* (J=?, B=1)
- J34 *Postosuchus* (J=0, B=1); Crocodylomorpha (J=?, B=1); Ornithosuchidae (J=0,
B=1)
- J35 *Marasuchus* (J=0, B=1)
- J38 Aetosauria (J=0, B=1)
- J39 Crocodylomorpha (J=1, B=0); Ornithosuchidae (J=1, B=0); *Marasuchus* (J=1,
B=0); *Herrerasaurus* (J=1, B=0); Ornithischia (J=1, B=0); Sauropodomorpha
(J=1, B=0); Neotheropoda (J=1, B=0)
- J43 *Marasuchus* (J=0, B=1)
- J44 *Marasuchus* (J=?, B=1)

- J45 *Gracilisuchus* (J=1, B=0)
 J46 *Postosuchus* (J=2, B=0)
 J48 *Herrerasaurus* (J=0, B=1)
 J49 *Herrerasaurus* (J=1, B=0)
 J50 *Gracilisuchus* (J=0, B=1); *Crocodylomorpha* (J=0, B=1)
 J53 *Postosuchus* (J=0, B=?)
 J54 *Phytosauria* (J=0, B=1); *Gracilisuchus* (J=0, B=1); *Prestosuchidae* (J=0, B=1);
Postosuchus (J=0, B=1); *Crocodylomorpha* (J=0, B=1)
 J57 *Gracilisuchus* (J=1, B=0); *Pterosauria* (J=1, B=0)
 J58 *Postosuchus* (J=?, B=0); *Gracilisuchus* (J=0, B=1)
 J60 *Postosuchus* (J=1, B=0)
 J65 *Pterosauria* (J=0, B=1); *Marasuchus* (J=0, B=1); *Herrerasaurus* (J=0, B=1)
 J66 *Prestosuchidae* (J=?, B=1)
 J70 *Gracilisuchus* (J=1, B=?); *Crocodylomorpha* (J=1, B=0); *Ornithosuchidae* (J=0,
 B=?)
 J72 *Aetosauria* (J=1, B=0); *Pterosauria* (J=0, B=?); *Marasuchus* (J=?, B=0);
Herrerasaurus (J=0, B=?); *Ornithischia* (J=0, B=?); *Sauropodomorpha* (J=0,
 B=?); *Neotheropoda* (J=0, B=?)
 J74 *Gracilisuchus* (J=1, B=0); *Postosuchus* (J=2, B=0)

Benton (2004)

- MB1 *Lagerpeton* (MB=0, B=?); *Marasuchus* (MB=0, B=?)
 MB2 *Prestosuchus* (MB=1, B=0); *Fasolasuchus* (MB=0, B=?)
 MB8 *Phytosauria* (MB=1, B=0); *Gracilisuchus* (MB=1, B=0)
 MB11 *Gracilisuchus* (MB=0, B=1); *Postosuchus* (MB=1, B=0)
 MB12 *Phytosauria* (MB=1, B=0); *Gracilisuchus* (MB=1, B=0); *Postosuchus* (MB=2,
 B=0)
 MB17 *Ornithosuchidae* (MB=0, B=?); *Gracilisuchus* (MB=1, B=?); *Crocodylomorpha*
 (MB=1, B=0)
 MB19 *Ornithosuchidae* (MB=1, B=?); *Gracilisuchus* (MB=0, B=1); *Prestosuchus*
 (MB=?, B=0)
 MB31 *Prestosuchus* (MB=0, B=?)
 MB32 *Prestosuchus* (MB=0, B=?); *Gracilisuchus* (MB=0, B=1); *Marasuchus* (MB=0,
 B=1); *Ticinosuchus* (MB=0, B=1)
 MB33 *Ornithosuchidae* (MB=1, B=?); *Marasuchus* (MB=0, B=?); *Herrerasaurus*
 (MB=0, B=?); *Saurosuchus* (MB=?, B=0)
 MB35 *Ornithosuchidae* (MB=1, B=0)
 MB36 *Prestosuchus* (MB=0, B=1); *Saurosuchus* (MB=0, B=1); *Postosuchus* (MB=0,
 B=1)
 MB37 *Postosuchus* (MB=0, B=1); *Saurosuchus* (MB=?, B=0)
 MB38 *Ticinosuchus* (MB=1, B=0); *Prestosuchus* (MB=1, B=0); *Postosuchus* (MB=1,
 B=?); *Scleromochlus* (MB=?, B=1); *Marasuchus* (MB=?, B=1)
 MB39 *Postosuchus* (MB=1, B=?); *Scleromochlus* (MB=?, B=1); *Marasuchus* (MB=?,
 B=1)
 MB42 *Ticinosuchus* (MB=1, B=?); *Postosuchus* (MB=1, B=0); *Saurosuchus* (MB=?,
 B=0)

- MB43 *Prestosuchus* (MB=0, B=?)
 MB51 *Prestosuchus* (MB=?, B=0); *Gracilisuchus* (MB=?, B=0)
 MB53 *Postosuchus* (MB=1, B=0)
 MB54 *Ticinosuchus* (MB=0, B=?)
 MB55 *Prestosuchus* (MB=0, B=?); *Saurosuchus* (MB=0, B=?); *Gracilisuchus* (MB=?, B=0); *Marasuchus* (MB=0, B=1)
 MB60 *Fasolasuchus* (MB=0, B=1); *Lagerpeton* (MB=1, B=0)
 MB63 *Ticinosuchus* (MB=0, B=?); *Prestosuchus* (MB=?, B=0); *Saurosuchus* (MB=0, B=?)
 MB64 *Ticinosuchus* (MB=0, B=?)
 MB65 *Marasuchus* (MB=0, B=1)
 MB66 *Scleromochlus* (MB=0, B=1); *Lagerpeton* (MB=0, B=1); *Marasuchus* (MB=0, B=1)
 MB70 *Ticinosuchus* (MB=1, B=?)
 MB76 *Lagerpeton* (MB=0, B=1)
 MB78 *Scleromochlus* (MB=0, B=?)
 MB80 *Scleromochlus* (MB=0, B=?); Pterosauria (MB=0, B=?); *Herrerasaurus* (MB=0, B=?); Theropoda (MB=0, B=?); Sauropodomorpha (MB=0, B=?); Ornithischia (MB=0, B=?)
 MB81 *Scleromochlus* (MB=0, B=?); Pterosauria (MB=0, B=?); *Herrerasaurus* (MB=0, B=?); Theropoda (MB=0, B=?); Sauropodomorpha (MB=0, B=?); Ornithischia (MB=0, B=?)
 MB82 Aetosauria (MB=1, B=0); *Prestosuchus* (MB=1, B=0); *Ticinosuchus* (MB=?, B=1); *Scleromochlus* (MB=0, B=?); Pterosauria (MB=0, B=?); *Herrerasaurus* (MB=0, B=?); Theropoda (MB=0, B=?); Sauropodomorpha (MB=0, B=?); Ornithischia (MB=0, B=?)
 MB88 *Gracilisuchus* (MB=1, B=0)
 MB89 *Postosuchus* (MB=?, B=0); *Scleromochlus* (MB=?, B=0)
 MB90 *Gracilisuchus* (MB=0, B=1)
 MB91 *Gracilisuchus* (MB=0, B=1)
 MB93 Phytosauria (MB=0, B=1); Ornithosuchidae (MB=0, B=1); *Ticinosuchus* (MB=0, B=1); *Prestosuchus* (MB=0, B=1); *Gracilisuchus* (MB=0, B=1); Crocodylomorpha (MB=0, B=1)
 MB95 *Prestosuchus* (MB=0, B=1); *Postosuchus* (MB=0, B=?); *Scleromochlus* (MB=0, B=?); Pterosauria (MB=0, B=?); *Lagerpeton* (MB=0, B=?); *Marasuchus* (MB=0, B=?); *Herrerasaurus* (MB=0, B=?); Theropoda (MB=0, B=?); Sauropodomorpha (MB=0, B=?); Ornithischia (MB=0, B=?)

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- N1 *Lagerpeton* (N=0, B=?); *Marasuchus* (N=0, B=?)
 N2 *Lotosaurus* (N=?, B=0)
 N5 *Arizonasaurus* (N=?, B=0); *Lotosaurus* (N=0, B=?)
 N6 *Lagerpeton* (N=0, B=?); *Arizonasaurus* (N=1, B=0); *Lotosaurus* (N=1, B=0)
 N7 *Effigia* (N=?, B=0); *Arizonasaurus* (N=?, B=0); *Shuvosaurus* (N=?, B=0)
 N8 *Postosuchus* (N=2, B=0)
 N10 *Effigia* (N=?, B=0); *Arizonasaurus* (N=?, B=0); *Shuvosaurus* (N=?, B=0)

- N11 *Effigia* (N=1, B=?); *Lotosaurus* (N=0, B=1)
- N12 Phytosauria (N=1, B=0); Ornithosuchidae (N=0, B=?); Crocodylomorpha (N=1, B=0); *Effigia* (N=?, B=0); *Shuvosaurus* (N=?, B=0)
- N15 *Effigia* (N=1, B=0); *Arizonasaurus* (N=1, B=0); *Shuvosaurus* (N=?, B=0); *Sillosuchus* (N=1, B=0); *Lotosaurus* (N=1, B=0)
- N16 Aetosauria (N=1, B=0); *Effigia* (N=?, B=0); *Arizonasaurus* (N=?, B=0); *Shuvosaurus* (N=?, B=1); *Sillosuchus* (N=?, B=0); *Saurosuchus* (N=?, B=0)
- N17 Ornithosuchidae (N=0, B=?); Aetosauria (N=?, B=1); *Marasuchus* (N=0, B=?);
- N18 *Postosuchus* (N=0, B=1); *Arizonasaurus* (N=0, B=1); *Sillosuchus* (N=1, B=?)
- N20 Ornithosuchidae (N=0, B=1); *Postosuchus* (N=0, B=1); *Effigia* (N=0, B=?); *Shuvosaurus* (N=0, B=?); *Lotosaurus* (N=0, B=?)
- N21 *Postosuchus* (N=0, B=?); *Saurosuchus* (N=0, B=?)
- N22 *Postosuchus* (N=1, B=?); *Marasuchus* (N=?, B=1); *Saurosuchus* (N=0, B=?)
- N23 *Postosuchus* (N=1, B=0); *Marasuchus* (N=?, B=1); *Effigia* (N=1, B=0); *Arizonasaurus* (N=1, B=?); *Shuvosaurus* (N=1, B=0); *Saurosuchus* (N=1, B=0)
- N24 *Saurosuchus* (N=0, B=?)
- N25 *Saurosuchus* (N=0, B=?)
- N26 *Saurosuchus* (N=0, B=?)
- N30 *Lotosaurus* (N=1, B=?)
- N31 Ornithosuchidae (N=1, B=0); *Lagerpeton* (N=?, B=0); *Marasuchus* (N=1, B=0); *Gallimimus* (N=0, B=1); Sauropodomorpha (N=0, B=1); Ornithischia (N=0, B=1); *Tyrannosaurus* (N=0, B=1); *Coelophysis* (N=0, B=1)
- N34 *Postosuchus* (N=1, B=0)
- N35 *Lotosaurus* (N=0, B=1)
- N36 *Saurosuchus* (N=1, B=?)
- N37 *Marasuchus* (N=0, B=1); *Saurosuchus* (N=1, B=?); *Lotosaurus* (N=1, B=?)
- N38 *Lotosaurus* (N=1, B=?)
- N39 *Lotosaurus* (N=0, B=?)
- N40 *Shuvosaurus* (N=?, B=0)
- N41 *Lagerpeton* (N=1, B=0); *Effigia* (N=0, B=1); *Shuvosaurus* (N=0, B=1); *Sillosuchus* (N=?, B=0)
- N42 *Sillosuchus* (N=?, B=0)
- N43 *Saurosuchus* (N=0, B=?); *Sillosuchus* (N=0, B=?)
- N44 Aetosauria (N=0, B=1); *Effigia* (N=0, B=?)
- N46 *Marasuchus* (N=0, B=1)
- N47 *Lagerpeton* (N=0, B=1); *Marasuchus* (N=0, B=1)
- N48 Ornithosuchidae (N=1, B=0)
- N50 Ornithosuchidae (N=0, B=?)
- N51 Ornithosuchidae (N=?, B=1)
- N55 *Lagerpeton* (N=0, B=1)
- N59 Pterosauria (N=0, B=?); *Gallimimus* (N=0, B=?); Sauropodomorpha (N=0, B=?); Ornithischia (N=0, B=?); *Tyrannosaurus* (N=0, B=?); *Coelophysis* (N=0, B=?)
- N60 Pterosauria (N=0, B=?); *Gallimimus* (N=0, B=?); Sauropodomorpha (N=0, B=?); Ornithischia (N=0, B=?); *Tyrannosaurus* (N=0, B=?); *Coelophysis* (N=0, B=?)

- N61 Pterosauria (N=0, B=?); *Gallimimus* (N=0, B=?); Sauropodomorpha (N=0, B=?); Ornithischia (N=0, B=?); *Tyrannosaurus* (N=0, B=?); *Coelophysis* (N=0, B=?); *Saurosuchus* (N=0, B=1)
- N64 *Postosuchus* (N=0, B=?)
- N66 *Postosuchus* (N=1, B=0); Crocodylomorpha (N=0, B=1); *Lotosaurus* (N=0, B=?)
- N67 *Postosuchus* (N=1, B=0); *Lotosaurus* (N=0, B=?)
- N68 *Lotosaurus* (N=0, B=?)
- N69 Phytosauria (N=0, B=1); Ornithosuchidae (N=0, B=1); *Postosuchus* (N=0, B=1); Crocodylomorpha (N=0, B=1); *Effigia* (N=0, B=1); *Shuvosaurus* (N=0, B=1); *Lotosaurus* (N=0, B=?)
- N70 *Lotosaurus* (N=0, B=?)
- N72 *Postosuchus* (N=2, B=?); Ornithischia (N=?, B=0); *Saurosuchus* (N=3, B=2); *Sillosuchus* (N=?, B=0)
- N74 *Marasuchus* (N=?, B=0)
- N75 *Arizonasaurus* (N=0, B=?); *Lotosaurus* (N=?, B=1)
- N76 *Lotosaurus* (N=?, B=0)
- N83 *Sillosuchus* (N=1, B=?)