**APPENDIX 1**

**Comments and modifications to the character matrix of Vallin & Laurin (2004).**

Character numbers and abbreviated descriptions (in bold) refer to character list by Laurin (1998a), with additional characters listed in Laurin & Reisz (1999) and Vallin & Laurin (2004). The characters are followed by comments and changes made by the present authors. Note that some of the taxa discussed here were not included in the other matrices of this study, and are therefore not covered in the supermatrix (Appendix 4). We nevertheless discuss characters and taxa that are not included in the supermatrix in order to reanalyse and examine the individual matrices.

**Character 2.** **Lateral lines present at least in adults (0); only in larvae (1); never present (2).** The lateral line ontogeny of microsaurs was previously coded as (12) [either (1) or (2)]. This should be done for amphibamids as well. *Doleserpeton* recoded (12). *Amphibamus* is best coded (2), based on Milner (1982).

**Character 3.** **Dermal sculpturing: ‘honeycomb’ (0); cosmine (1); widely spaced pits (2); low bumps (3); smooth bone (4).** Unlike the previous coding, *Doleserpeton* does not have honeycomb sculpturing on its dermal bones in any specimen. The bones are almost completely smooth. This is in stark contrast to the similarly small-sized *Amphibamus grandiceps*. *Doleserpeton*: previous coding (0), new coding (4). We also suggest recoding *Tersomius* (3).

**Character 5.** **Orbit shape: ovoid (0); confluent with a large antorbital fenestra (1); open posteriorly (2).** It is hard to justify the previous coding, where lysorophians, anurans, and salamanders are all coded as having the same orbit shape. They may all be “open” posteriorly, but whereas the orbit of salamanders and frogs is bordered laterally by the maxilla, this is not the case in lysorophians. Furthermore, the posteriorly “open” condition of this character is accounted for by other characters (e.g. loss of bones). The baphetid condition is not shared with any other group. This character has been excluded.

**Character 6.** **Jaw joint position: posterior to the occiput (0); near to the level of the occiput (1); in front of the occiput (2).** *Triadobatrachus* (previous coding 1) has a jaw joint positioned posterior to the occiput as in some modern frogs (e.g. *Rana catesbeiana*). This can be seen in ventral view (Rocek & Rage, 2000). *Triadobatrachus* recoded (0). A comparison to the coding of Anderson et al. (2008) shows how this character can be interpreted differently (character 87). This is partly due to a great deal of variation within clades. We prefer to recode Adelogyrindae {12}, Aistopoda {012}, and Branchiosauridae {01}.

**Character 10.** **Anterior tectal: present (0); absent (1).** The anterior tectal is absent (as such) in *Doleserpeton*, *Amphibamus* and *Apateon*. However, this bone may be homologous with the septomaxilla (Clack, 2002), and it is almost universally “absent” (as an anterior tectal) in tetrapods. We therefore exclude this character.

**Character 13.** **Parietal-squamosal contact: absent (0); present (1).**  In *Eocaecilia*, there is a clear contact between these bones at mid-length of the parietal. In *Triadobatrachus*, the posterior edge of the fused fronto-parietal extends laterally to contact the squamosal. The part contacting the squamosal may be a fused tabular (personal observation). Unlike the previous coding, the contact is actually absent in hynobiid salamanders (Duellman & Trueb, 1994). In lysorophians, the column-like squamosal contacts the parietal ventrally, anterior to the tabular. The contact cannot be seen in dorsal view. Some microsaurs also have this contact in front of the tabular. In Brachystelechidae the parietal is apparently fused to the postparietal, judging from the size and position of its posterior parts. The contact with the squamosal occurs posterior to the tabular, unlike that of lysorophians. The different contacts described above do not seem to be homologous. Due to the numerous problems with the interpretation of this character, it has been removed. Excluded.

**Character 15.** **Pineal foramen: present (0); absent (1).** The frontoparietals are unfused along the midline in *Discoglossus* (Pugener & Maglia, 1997), obscuring the presence or absence of a pineal foramen. Recoded (-).

**Character 17.** **Supratemporal: present (0); absent (1).**  There is a bone located well within the skull table in *Eocaecilia*, which was tentatively identified as the tabular bone by Jenkins et al. (2007). However, our comparisons with early tetrapods (e.g. Clack, 2002) indicate that this is more likely the supratemporal bone. Note that the element in question is located lateral to the parietal-postparietal suture, and is completely excluded from the postero-lateral corner of the skull table unlike the tabular of most forms, but similar to the supratemporal. A related problem is the identity of the supratemporal bone of many lepospondyls. This bone may be fused to the tabular in microsaurs, as alluded to by Carroll et al. (1998). The size, shape and position of the Lysorophian and microsaurian “tabular” bone resemble those of a combined tabular and supratemporal, when compared to *Acanthostega* or the nectridean *Ptyonius*. In this situation, coding the tabular as present and the supratemporal as absent makes little biological sense. Notice also that the supratemporal primitively occupied the area between the parietal and the squamosal (Clack, 2002). The fact that this region is open (not covered by dermal elements) in many salamanders (e.g. Hynobiidae and Ambystomatidae) and frogs (e.g. RanidaeandAscaphidae) indicates that the supratemporal is, in fact, absent rather than fused in these forms, as opposed to microsaurs and lysorophians. Although bones are generally coded as present in this matrix if present as a separate element only, stating that the supratemporal is absent (1) in all of these situations may be misleading. Microsaurs, Lysorophia and Adelogyrinidae have been recoded “inapplicable” (-), whereas *Eocaecilia* is coded unknown (?).

**Character 18.** **Tabular: present (0); absent (1).** Given that the supratemporal bone was previously coded as being absent in *Eocaecilia*, the tabular should have been coded as “present” but this was not the case. *Eocaecilia* and *Triadobatrachus* recoded (?), see also Appendix 3 (character 59). The tabular bone of many lepospondyls may be fused to the supratemporal, but has not been recoded here. The large element (tabular-squamosal) present in Adelogyrinidae, with tabular horns, is not similar to the absence of the tabular in, say, salamanders, and has been given a separate state (2).

**Character 19.** **Tabular occipital flange: absent (0); single, extending ventromedially (1); double (2); curved, articulates with postparietal or supratemporal and otic capsule, dorsal flange absent (3).** The temnospondyls in question have only one tabular flange (not two), and are not similar to seymouriamorphs in this respect. The tabular occipital flange seems to be more dependent on the shape of the opisthotic than the authors are aware of. The large paroccipital process of the opisthotic in *Doleserpeton* allows only a short tabular flange in this form. All temnospondyls recoded (1).

**Character 21.** **Ventrally bent, sculptured tabular horn: absent (0); present (1).** *Doleserpeton* and *Amphibamus* have a ventrally bent, but unsculpted horn (0). It appears that this and many other characters are intimately connected with degree of ossification of certain bones. The number of characters associated with the tabular therefore seems to be unnecessary, but has been kept unchanged.

**Character 22.** **Postparietal number: two (paired) (0); single, median (1); none (2).**  Paired postparietals are present (0) in *Eocaecilia* (Jenkins et al., 2007).

**Character 31.** **Temporal emargination: absent, area covered by opercular bones (0); present, bordered by squamosal, tabular, and (sometimes) supratemporal (1); absent, area covered by squamosal, supratemporal, and tabular (2); present, bordered by quadrate (3); present, bordered by squamosal (4).** By coding the presence of the notch differently if it is bordered by the squamosal, tabular, and supratemporal (1) or only the squamosal (4), the resemblance between temnospondyls and salientians was previously erased. New coding: Absent, covered by opercular bones (0); present, bordered by squamosal, and sometimes tabular and supratemporal (1); absent, covered by squamosal, supratemporal and/or tabular (2); present, bordered by the quadrate (3). All forms formerly coded (4) has been recoded (1).

**Character 32. Maxilla-quadratojugal contact: present (0); absent (1).** This feature is present (0) in *Eocaecilia*, contrary to the previous coding (Jenkins et al., 2007). Contrary to the description of this character (but not the coding) the feature is also present (0) in *Doleserpeton*. There is a difference between whether the contact is lost due to the presence of a bony element between the maxilla and quadratojugal (e.g. the jugal in amniotes and microsaurs, coded 1), or due to the presence of an open cheek (e.g. salamanders, coded 2, new state). Lysorophians are unique in that the maxilla contacts the palatine posteriorly, although the cheek could be said to be “open” (coded [12] here). The contact is absent (1) in *Utaherpeton,* Brachystelechidae, and *Rhynchonkos* (Carroll et al., 1998).

**Character 37.** **Lateral palatal tooth row: present, complete (0); incomplete (1); absent (2).** Note that the authors coded lysorophians as having an incomplete (1) row of palatal teeth, based on the dentition of the vomers. This should be the case for salamanders and frogs as well, as these forms possess a row of pedicellate teeth on the vomers. *Apateon* also appears to have an incomplete (1) secondary row. Coding caecilians as having the primitive condition (0) may be misleading as the palatal tooth row extends on the labial side of the choana in these, not the lingual side as in primitive tetrapods. Caecilians have been recoded (3). New character state: palatal tooth rows extending on the labial side of the choanae (3).

**Character 38.** **Posteromedial vomerine tooth row: absent (0); present (1).** The transverse vomerine tooth row mentioned (not always positioned posteriorly in salamanders) actually has a broader distribution within lissamphibia. New coding: transverse row of more than five teeth on vomer: absent (0); present (1). Present in Discoglossidae, Hynobiidae, caecilians and *Doleserpeton*.

**Character 43. Lateral exposure of the palatine: absent (0); present (1).**  *Amphibamus* has a lateral exposure of the palatine (LEP). Recoded (1).

**Character 45. Palatine shagreen of denticles: absent (0); present (1).** *Doleserpeton* does not have a shagreen of denticles on the palatine, rather it has a short row of teeth similar to the marginal dentition. Recoded (0).

**Character 49.** **Transverse flange of pterygoid: absent (0); present (1).** This data set has an unusual interpretation of the transverse flange of the pterygoid (see Laurin 1998a p. 27). However this is interpreted, the condition of *Amphibamus* is more similar to *Doleserpeton* than indicated by the previous coding. *Amphibamus* recoded (0). We prefer the coding of Ruta & Coates (2007) for the flange itself (e.g. the “flange” of *Eryops* is not as sharp and ventrally directed as that of *Limnoscelis*), and change temnospondyls to state 0. However, we retain the separation of the characters describing the flange and the teeth in this region, as opposed to Ruta & Coates (2007). Note that the latter authors describe an additional character covering the lateral aspect of this region.

**Character 55.** **Palatine position: excluded from interpterygoid vacuity (0); borders part of the ectopterygoid vacuity (1).** In discoglossids, the palatine is sometimes fused to the maxilla (Pugener & Maglia, 1997) other times to the vomer (Maree, 1945), but it always borders the interpterygoid vacuity, as in many other anurans (and *Triadobatrachus*). Anurans coded (1).

**Character 61. Post-temporal fenestra: large (0): small, represented by a large foramen (1).** This opening is large (0) in *Doleserpeton*. It has been misleadingly coded as ‘small’ (1) in most modern amphibians, but the character is actually inapplicable because of the lack of roofing bones. Most of these have been recoded (-).

**Character 62.** **Paroccipital processs: absent (0); present (1).** This had been coded absent (0) for all lissamphibians, but Sigurdsen (2008) has shown that the crista parotica of salientians probably is homologous to this structure. This feature is also well-developed in *Eryops*, *Tersomius*, *Dendrerpeton* and *Doleserpeton* (recoded 1).

**Character 63. Otic tube: absent (0); present (1).** The meaning of this character is uncertain, and appears to constitute a simple postero-lateral expansion of the otic capsule. Whether the description of it as a “tube” in seymouriamorphs is warranted, this is certainly not the case in anurans, which had been coded similarly in the matrix. There is a lateral expansion of the otic capsule in anurans, but it appears different from that of seymouriamorphs in that the expansion includes the area of the basicranial articulation, whereas in seymouriamorphs the expansion is behind this level. Until further studies confirm the structure of this region, this character is best left out. Excluded.

**Character 64.** **Exoccipital-dermatocranium contact: absent (0); with postparietal (1); with parietal (2).** *Doleserpeton* has an area of contact between the exoccipital and the postparietal (1).

**Character 67.** **Basioccipital and exoccipital: indistinguishably fused in adults (0); suturally distinct throughout ontogeny (1); basioccipital never distinct (2).** The basioccipital of *Doleserpeton* is indistinguishable from the exoccipital in all specimens. This may mean that it is either fused in the adults (0), since all specimens are at least subadult, or that there is only one center of ossification (2). Recoded (02).

**Character 68.** **Basioccipital position: reaches edge of foramen magnum (0); excluded from edge of foramen magnum by median exoccipital contact (1).** The basioccipital is indistinguishable from the exoccipital in *Doleserpeton*. Recoded (-) for *Doleserpeton*.

**Character 72.** **Epipterygoid ossification: present (0); absent (1).** The epipterygoid is present and ossified (0) in *Doleserpeton*.

**Character 73.** **Epipterygoid and pterygoid: fused in adults (0); suturally distinct in adults (1).** There is a suture (1) between the epipterygoid and pterygoid elements in *Doleserpeton*.

**Character 74.** **Basicranial articulation: not fused, potentially mobile (0); sutured, immobile (1).** The basicranial articulation is no more immobile in *Doleserpeton* and *Tersomius* than in *Dendrerpeton*. Recoded (0) for amphibamids. Too much may be read into this character by various authors.

**Character 75.** **Distal end of stapes: robust, links braincase to quadrate (0); slender, without contact with the quadrate (1).** *Amphibamus* has the same type of stapes (1) as other temnospondyls (pers. obs.). The stapes of salamanders is not particularly close to the primitive condition, contrary to the previous coding. Its distal parts are not robust and it only rarely, if ever, contacts the quadrate, although it may sometimes contact the squamosal. In specimens investigated by the present authors, the stapes did not contact the quadrate in either *Hynobius*, *Ambystoma* or *Necturus*. Even in Sirenidae the contact was not clear, and could be interpreted either way. The stapes shaft of salamanders is usually oriented dorsolaterally towards the squamosal. We chose to code salamanders conservatively, keeping both options open until further studies are undertaken (01). Based on Robinson et al. (2005), we code *Dendrerpeton* as derived (1).

**Character 76.** **Dorsal process of stapes: absent (0); confluent with the footplate (1); separated from the footplate by a deep notch (2).** *Amphibamus* has no dorsal process of the stapes (0) (pers. obs.).

**Character 79.** **Mandibular fenestrae: absent (0); small fenestrae present in splenial, postsplenial, and angular (1); large fenestra(e) present between angular, postsplenial, splenial, and prearticular (2).** There is a small intramandibular fenestra between the pre-articular (called the cornoid by Reese, 1906) and the dentary of many salamanders. In cryptobranchids (and apparently hynobiids), this opening is located between the pre-articular and the angular. It appears to pierce the dentary only in *Salamandra* (Francis, 1934), but this is not the case in any of the specimens investigated by the present author (*Cryptobranchus*, *Necturus*, *Ambystoma*, see also digimorph.org). The situation seen in salamanders (and particularly in cryptobranchids and hynobiids) is very similar to the condition of *Doleserpeton*, in which a small fenestra is present between the pre-articular and the angular. New character state: small fenestra present between pre-articular and angular (if present) or dentary (3). Salamanders and *Doleserpeton* recoded (3). The intramandibular foramen of the pseudoangular of *Eocaecilia* may or may not be the same feature (*Eocaecilia* left unchanged).

**Characters 80, 81, and 82.** [80]**Anterior coronoid: present (0); fused or absent (1).** [81] **Middle coronoid: present (0); fused or absent (1).** [82] **Posterior coronoid: present (0); fused or absent (1).** There are three characters coding the presence or absence of the coronoids. It leads to many character similarities of the lower jaw shared by lysorophians and lissamphibians, and yet the lower jaws of these forms are very dissimilar in general shape and proportions (not coded). In contrast, Ruta & Coates (2007) coded not only the presence/absence of each individual element, but also a number of characters describing the shape and position of the bones. Noting that the homologies of postdentary bones are not entirely clear in comparisons of ancient and modern amphibians, we here prefer the somewhat simplified description of Anderson et al. (2008). Suggested character coding: number of coronoids: three (0); two (1); one (2); none (3). Characters 81 and 82 excluded. However, a separate bootstrap analysis was run in PAUP of the modified supermatrix, but with these characters unchanged. The result was almost identical to the run in which the characters were excluded.

**Characters 83 and 84.** [83] **Anterior splenial: present (0); fused or absent (1).** [84] **Postsplenial: present (0); fused or absent (1).** As with the coronoids it is probably better to have one character representing the number of splenials. New character 83: number of splenials: two (0); one (1); none (2). Character 84 excluded.

**Character 87.** **Parasymphysial fangs: present (0); absent (1).** The parasymphyseal “fangs” of *Doleserpeton* are actually a short row of pedicellate teeth similar to the marginal dentition, recoded (1). See also character 92 below.

**Character 88.** **Coronoid fangs: present (0); absent (1).** Coronoid fangs are absent (1) in *Doleserpeton*.

**Character 89.** **Coronoid denticles: absent (0); present (1).** Coronoid denticles appear to be present in *Doleserpeton*, but the denticles are large enough to create some uncertainty. Coded (?).

**Character 91.** **Retroarticular process: small, directed posteriorly (0); large (1); mid-sized, extends posteroventrally (2).** The retroarticular process is small (0) in *Doleserpeton*.

**Character 92. Medial mandibular tooth row: on coronoids (0); absent (1); on pseudodentary (2).** *Doleserpeton* has a short row of pedicellate teeth near the symphysis, which is remarkably similar to that of the Cretaceous caecilian *Rubricacaecilia* (Evans & Sigogneau-Russell, 2001). *Doleserpeton* recoded (12).

**Character 94. Marginal teeth: non-pedicellate (0); pedicellate (1).** Our observations indicate that the marginal teeth of *Tersomius* are non-pedicellate (0), those of *Amphibamus* are uncertain (?) at best. Some branchiosaurids may be pedicellate, and are coded “either-or” (01).

**Character 95. Maxillary teeth: at least as large as dentary teeth (0); much smaller than dentary teeth (1).** The maxillary teeth of *Doleserpeton* are similar in size to those on the dentary (0).

**Character 96.** **Labyrinthine infolding: present (0); absent (1).** *Amphibamus* does not have labyrinthine folding of the dentine (1).

**Character 100.** **Neural arches and centra: discrete elements throughout ontogeny (0); fuse late in ontogeny (1); indistinguishably fused early in ontogeny (2).** Coding lissamphibian vertebral elements as being fully fused early in ontogeny (2) appears to be incorrect (Duellman & Trueb, 1994; Pugener & Maglia, 1997; Carroll et al., 2004). Lissamphibians recoded (1).

**Character 106.** **Anterior articular surface of atlantal centrum: no broader than posterior surface (0); broader than posterior surface (1).** The anterior atlantal articulating surface is wider than the posterior one in *Doleserpeton*, recoded (1).

**Character 109.** **Atlantal intercentrum: present (0); absent (1).** The atlantal intercentrum is absent (1) in *Doleserpeton*.

**Character 111.** **Transverse process in mid-presacral vertebrae: absent (0); short (1); long (2).** The length of the transverse process in *Doleserpeton* and *Amphibamus* is best described as short (1).

**Character 112.** **Parapophysis: short, small facets (0); almost as long as the diapophysis (transverse process) (1); absent or not distinct from diapophysis (2).** The parapophysis (transverse process of centrum) is small in *Doleserpeton* (0).

**Character 113.** **Capitulum articulation in mid-presacrals: on intercentrum of its segment (0); on intercentrum and pleurocentrum of its segment (1); on pleurocentrum of its segment (2); on pleurocentrum of segment in front (3); on the transverse process (4).** The capitulum of the rib articulates with the parapophysis on the intercentrum in *Doleserpeton* (0).

**Character 114.** **Number of presacral vertebrae: 23 to 32 (0); fewer than 23 (1); 33 to 60 (2); more than 60 (3).** The number of presacrals in *Doleserpeton* is uncertain, but it can be narrowed down to between 22 and 25 presacrals. Recoded (01).

**Character 116.** **Rib length: less than four centra (segments) long (0); at least four centra long (1).** This character fails to show the difference between the rib morphologies of tetrapods. There appears to be a tendency for relatively longer ribs in larger animals, so equally sized specimens should be compared. Amniotes and anthracosaurs have relatively long ribs with strong ventral curvature (1). This condition is also seen in most lepospondyls, except Adelogyrinidae (Carroll et al., 1998). In modern amphibians (including *Eocaecilia* and *Triadobatrachus*) the ribs are very short and slightly posteriorly curved. Modern amphibian ribs lack the strong ventral curvature seen in amniotes and most lepospondyls. This is also true for amphibamids and the early tetrapod *Acanthostega*, and probably represents the primitive condition (0). In *Doleserpeton*, the longest ribs are less than three centra long, and most are even shorter. New coding for rib morphology: Short ribs (shorter than three centra in small animals), curved slightly posteriorly (0); long ribs with strong ventral curvature (1). *Ichthyostega*, *Eryops* and seymouriamorphs appear to have an intermediate condition (01).

**Character 119.** **Uncinate processes: absent (0); present (1).** Uncinate processes are absent (0) in *Doleserpeton* and *Dendrerpeton*.

**Character 120.** **Interclavicle: without a parasternal process (0); with a parasternal process (1); absent (2).** The interclavicle apparently had no parasternal process in *Doleserpeton* (0).

**Character 121.** **Clavicle: present (0); absent (1).** The clavicle is present (0) in *Doleserpeton*.

**Character 122.** **Clavicle shape: with a ventral plate (expansion) (0); without a ventral plate (1).** Although the clavicle has a ventral plate (0) in *Doleserpeton*, it is relatively slender. According to Wellstead (1991), this feature is also present in lysorophians, and *Asaphestera* also appears to have the primitive condition (Carroll & Gaskill, 1978). All of these are recoded (0) here. The clavicle of brachystelechids is unclear (?), and *Pantylus* appears to be somewhere in between {01}.

**Character 123.** **Cleithrum: with a dorsal expansion (0); slender, without a discrete dorsal expansion (1); with a ventral expansion (2); absent (3).** The cleithrum of *Doleserpeton* has a moderate dorsal expansion (0).

**Character 124.** **Postbranchial lamina: present (0); absent (1).** The postbranchial lamina of the cleithrum is absent (1) in *Doleserpeton*.

**Character 129.** **Scapulocoracoid and cleithrum: coossified (at least in adults) (0); discrete elements (1).** The scapulocoracoid and cleithrum are not coossified in *Doleserpeton* (1).

**Character 131.** **Supinator process: low, indistinct (0): high, well defined (1).** The supinator process is absent (0) in *Doleserpeton*, *Amphibamus*, *Apateon*, *Eocaecilia* and *Triadobatrachus*.

**Character 132.** **Anterior humeral ridge: present (0); absent (1).** The anterior humeral ridge (anterior keel of Coates, 1996) is absent (1) in amphibamids and *Eocaecilia*.

**Character 133.** **Ectepicondyle: low, indistinct (0); high, well defined (1).** Given the previous coding of the ectepicondyle as being “low and indistinct” (0) in salamanders and frogs, it should be coded as such in *Eocaecilia* and *Triadobatrachus* as well (pers. obs.).

**Character 134.** **Pectoral tubercle: separated from proximal articular surface by finished (periosteal) bone (0); confluent with proximal articular surface (not separated from it by periosteal bone) (1).** The homologies of this character are not clear. The pectoral (humeral) tubercle is a term that is most often used for mammals, and is rarely used for early amniotes and amphibians. The infraspinatus and supraspinatus muscles inserting on the tubercle are probably homologous with the supracoracoideus muscle of amphibians (Romer & Parsons, 1986). This muscle inserts on the deltopectoral crest in amphibians and reptiles. The authors are presumably referring to the presence or absence of a dorsal humeral process (crista dorsalis) which is the insertion point of the subscapularis muscle (Francis, 1934). This process is often, but not always, present in salamanders (absent in *Necturus*, *Cryptobranchus* and probably also in hynobiids), and never present in anurans. It is absent in *Doleserpeton*. Given the uncertainties of this character, and that much variation may stem from poor preservation, this character has been excluded.

**Character 135.** **Entepicondyle: broad (0); narrow (1).** The relative width of the entepicondyle (see description in Laurin [1998b]) is generally highly variable in tetrapods, because of the great variation in shaft length. Also, the entepicondyles of lissamphibians (including *Eocaecilia*) and most dissorophoids are directed distally. This has been introduced as a new character state (3). That of *Acanthostega* appears to be intermediate (03). The states of *Amphibamus,* Lysorophia and *Rhynchonkos* are uncertain (?).

**Character 139.** **Olecranon process: absent or cartilaginous (0); ossified (1).** A highly developed olecranon is found in *Eocaecilia*, *Ecolsonia*, *Rhynchonkos* and others. Most forms are actually intermediate. This character is confusing because of the highly variable degree of ossification of the olecranon. The olecranon of salamanders is variable, and that of *Doleserpeton* varies from completely unossified to almost completely ossified due to ontogenetic differences. Excluded.

**Character 140.** **Ulna length: shorter than radius (0); equal or longer than radius (1).** The ulnae of *Doleserpeton* and *Amphibamus* are about the same length as the radii (1).

**Character 141.** **Number of digits in manus: none (0); eight (1): five (2); four (3).** There are four digits in the manus of *Doleserpeton* (3).

**Character 142.** **Number of pelvic ossifications: one (0); three (1); two (2).** Modern anurans are actually very similar to *Triadobatrachus* in having two ossified elements in the pelvis, whereas the third element (the pubis) remains cartilaginous (2). Carroll et al. (1998) clearly show three ossifications (1) in *Cardiocephalus*, *Microbrachis* and *Utaherpeton*.

**Character 143.** **Iliac blade: very short (0); with discrete dorsal and posterior flanges (1); with a single, posterodorsal flange (2); with a single, dorsal flange (3); with a long anterodorsal flange (4).** The iliac blade of *Doleserpeton* has a single posterodorsal flange (2).

**Character 144. Internal trochanter: absent or not represented by a discrete structure (0); present, separated from proximal articular surface by finished (periosteal) bone (1): not separated from proximal articular surface by finished bone (2).** The internal trochanter of the femur of *Westlothiana* should not be coded as confluent with the articulating surface (2) as in anurans, but as separated (1) (Smithson et al., 1994). This is true for *Hynobius* (Carroll & Holmes, 2007), *Eocaecilia* (Jenkins et al. 2007), *Doleserpeton* and *Amphibamus* as well. The internal trochanter is not absent in *Acanthostega* (Coates, 1996). There are numerous problems with this character, and small changes in ossification can result in large differences in the way this character is coded. Excluded.

**Character 145.** **Intertrochanteric fossa: present, proximal femoral head concave ventrally (0); absent, proximal femoral head flat or convex ventrally (1).** Although not as prominent as in some other tetrapods, salamanders and *Eocaecilia* do have an “intertrochanteric fossa” (0) unlike the previous coding. The femora of modern salamanders are, in fact very similar to those of *Doleserpeton*. It is also present in *Acanthostega* (Coates, 1996). Only salientians should be coded as lacking this fossa (1).

**Character 146.** **Femoral adductor blade: absent (0); present, long (1); present, reduced distally.** Presumably the latter state is coded (2).The adductor blade is weakly ossified but present (2) in *Doleserpeton*. This is also the case for most salamanders (e.g. Francis, 1934; Carroll & Holmes, 2007).

**Character 151.** **Number of phalanges in second pedal digit: two (0); three (1).** *Doleserpeton* has two (0) phalanges in the second pedal digit. The detail with which the pes is coded seems excessive compared to the manus, but has been left unchanged.

**Character 159.** **Humeral length: equivalent to at least four dorsal centra (0); shorter than four dorsal centra (1).** The humeri of *Doleserpeton* are longer than four centra (roughly five centra long). This is true for *Triadobatrachus* as well. Both recoded (0).

**Character 160. Posterior margin of skull: concave (0); straight (1); convex (2); undulating (concave on each side, extends posteriorly in the midline) (3).** This character is extremely problematic when applied to such diverse animals, as the elements constituting the posterior margin of the skull are not the same. It is unclear why *Doleserpeton* and *Amphibamus* have been coded differently when they are, in fact, nearly identical in this respect. Excluded.

**Character 161.** **Number of premaxillary teeth: more than 12 (0); 6 to 11 (1); 5 or fewer (2).** The character state (0) should presumably have been phrased “12 or more”, as species with 12 teeth would otherwise not be included. Unchanged.

**APPENDIX 2**

**Comments and changes to the characters listed by Ruta & Coates (2007).**

Character numbers and descriptions (in bold) are from Ruta & Coates (2007). These are followed by comments and changes made by the present authors. Note that some of the taxa discussed here were not included in the other matrices of this study, and are therefore not covered in the supermatrix (Appendix 4).

**Character 9.** **Septomaxilla a detached ossification inside nostril: no (0); yes (1).** The septomaxilla is a separate ossification in *Doleserpeton* (1).

**Character 21. Prefrontal contributes to more (0) or less than (1) half of orbit anteromesial margin.** Despite the full explanation of this character, it remains confusing. It does not seem to be correctly coded for either *Doleserpeton* or *Eocaecilia*. Excluded.

**Character 28.** **Maxilla contributing to orbit margin: no (0); yes (1).** It is uncertain (?) if the maxilla contributes to the orbit rim in *Amphibamus*.

**Characters 44, 45, 60, 66, and 71.** These characters are based on the presence or absence of “strongly interdigitating” sutures between bony elements. Such sutures are (as admitted by the authors) highly variable between individuals and taxa, and also prone to misinterpretation, particularly in small specimens. These characters have been excluded.

**Character 50.** **Postparietal/exoccipital suture: absent(0); present (1).** There is probably a slight overlap of the postparietals and exoccipitals in *Doleserpeton*, but no suture. Unchanged.

**Character 63.** **Separately ossified supratemporal: present (0); absent (1).** The “tabular” of *Eocaecilia* may in fact be a separately ossified supratemporal (Jenkins et al. 2007), and should be coded as uncertain (?). Interpreting this bone as a supratemporal is actually more in line with the descriptions of both primitive tetrapods (e.g. Clack, 2002) and temnospondyls. Coding the supratemporal as absent in some lepospondyls may cause problems, so these are coded inapplicable (-). See also Appendix 1 (character 17).

**Character 67.** **Separately ossified tabular: present (0); absent (1).** The “tabular” of *Eocaecilia* may in fact be the supratemporal (see above), and should be coded as uncertain (?). See also Appendix 1 (character 18).

**Character 91. Jugal not contributing (0) or contributing (1) to skull table ventral margin.** This character was not understood, although it seems to be similar to characters describing the position of the jugal between the maxilla and quadratojugal in amniotes and some other tetrapods. However, this does not constitute the ventral margin of the skull table, and no reference to the maxilla is made. Excluded.

**Character 113.** **Posttemporal fossa occurring at occiput dorsolateral corner, delimited dorsally by skull table, not bordered laterally and floored by dorsolateral extension of opisthotic (0); fossa present near occiput dorsolateral corner, delimited dorsally by occipital flanges of tabular and postparietal and bordered laterally as well as ventrally by dorsolateral extension of opisthotic meeting tabular ventromedial flange (1); small fossa present near occiput ventrolateral corner, bordered laterally by tabular ventromedial flange, delimited dorsally by dorsal portion of the lateralmargin of the supraoccipital–opisthotic complex and floored by lateral extension of opisthotic (2); absence of fossa (3).**  The posttemporal fossa of *Doleserpeton* is bordered (and closed laterally) by the opisthotic, tabular and postparietal elements (1).

**Character 123.** **Vomer with (0) or without (1) fangs comparable in size to, or larger than, marginal teeth (premaxillary or maxillary).** *Doleserpeton* has no fangs on the vomers, but it does have rows pedicellate teeth on this element, as do modern amphibians. It should be coded similar to lissamphibians (1).

**Character 132. Vomers shaped like broad and flat plates of bone, approximately as long as wide: absent (0); present (1).** *Acanthostega* is actually much closer to state 1 than state 2 (Clack, 2002). We suspect that the wide vomer (1), sometimes with fenestra in the middle, is a primitive tetrapod trait, which is also found in modern amphibians. *Acanthostega* recoded (1). *Eryops* has a long and wide vomer (coded [01]). *Cardiocephalus* and *Proterogyrinus* recoded (0), Colosteidae recoded (1), *Dendrerpeton* (1), *Ecolsonia* (1), *Eryops* (01). Some nectrideans have wide vomers (coded {01}).

**Character 167.** **Separately ossified supraoccipital: absent (0); present (1).** *Doleserpeton* lacks a supraoccipital bone (0).

**Character 175.** **Opisthotic forming a thickened plate together with the supraoccipital, preventing the exoccipitals from contacting the skull table: absent (0); present (1).**  The exoccipital contacts the skull table (0) in *Doleserpeton.*

**Character 183. Basipterygoid processes of the basisphenoid shaped like anterolaterally directed stalks, subtriangular or rectangular in ventral view and projecting anterior to the insertion of the cultriform process: absent (0); present (1).** Although this character is fully described, it remains unclear. Excluded.

**Character 186. Outline of posterior ventral plate of parasphenoid subrectangular: absent (0); present (1).** The character state distribution of this character is identical to that of character 185, which also discusses the shape of the parasphenoid. There may be reason to believe that these characters are not independent. Excluded.

**Character 198. Posteriormost extension of splenial mesial lamina closer to anterior margin of adductor fossa than to anterior extremity of jaw, when the lower jaw ramus is observed in mesial aspect and in anatomical connection (i.e. symphysial region orientated towards the observer): absent (0); present (1).** Although the splenial is now known in *Doleserpeton* (Sigurdsen, 2009), the relationship of this bone to the features in question (adductor fossa, coronoids) is still uncertain (?). This is true for characters 199-200 as well. For the coding of postdentary elements in the supermatrix, we preferred the simplified coding of Anderson et al. (2008). See also Appendix 1 (characters 80-84). Otherwise unchanged.

**Character 199. Splenial/anterior coronoid suture: absent (0); present (1).** See character 198 above.

**Character 200. Splenial/middle coronoid suture: absent (0); present (1).** See character 198 above.

**Character 205.** **Angular without (0) or with (1) mesial lamina.** The angular is not extensive medially in *Doleserpeton*, but it is visible in medial view. Recoded (1).

**Character 206.** **Angular/prearticular suture: present (0); absent (1).** The angular-prearticular suture is present (0) in *Doleserpeton.*

**Character 208.** **Separately ossified surangular: present (0); absent (1).** The surangular is at least partially fused to the articular in *Doleserpeton*. Coded (01).

**Character 211.** **Prearticular/splenial suture: present (0); absent (1).**  A presplenial-prearticular suture is absent (1) in *Doleserpeton*.

**Character 217.** **Middle coronoid with (0) or without (1) fangs comparable in size to or larger than marginal dentary teeth.**  The middle coronoid of *Doleserpeton* lacks fangs (1). In the reanalysis of the data matrix of Ruta and Coates (2007), we kept the original coding of the coronoids. However, we preferred the simplified coding of Anderson et al. (2008) for the supermatrix, partly to avoid character inflation in an area of uncertain homology, such as the postdentary region of modern amphibians.

**Characters 218-219.** [218] **Middle coronoid with (0) or without (1) small teeth (denticles) forming continuous shagreen or discrete patches and the basal diameter and/or height of which is less than 30% of that of adjacent marginal dentary teeth.** [219] **Middle coronoid with (0) or without (1) anteroposterior tooth row orientated subparallel to marginal dentary teeth and the basal diameter and/or height of which is 30% or greater than that of marginal teeth and twice or more that of denticles, if present.**  The middle coronoid of *Doleserpeton* has either large denticles or small teeth. Coding (?) is appropriate.

**Character 221.** **Posterior coronoid with (0) or without (1) fangs comparable in size to or larger than marginal dentary teeth.** There are no fangs (1) on the posterior coronoid of *Doleserpeton*.

**Character 222.** **Posterior coronoid with (0) or without (1) small teeth (denticles) forming continuous**

**shagreen or discrete patches and the basal diameter and/or height of which is less than 30% of that of adjacent marginal dentary teeth.** There are no denticles (1) on the posterior coronoid in *Doleserpeton*.

**Character 223.** **Posterior coronoid with (0) or without (1) anteroposterior tooth row orientated subparallel to the marginal dentary teeth and the basal diameter and/or height of which is 30% or greater than that of marginal teeth and twice or more that of denticles, if present.**  The posterior coronoid of *Doleserpeton* lacks a tooth row (1).

**Character 224.** **Posterior coronoid without (0) or with (1) posterodorsal process.**  The posterior coronoid of *Doleserpeton* appears to have a posterodorsal process (1).

**Character 225.** **Posterior coronoid exposed in lateral view: no (0); yes (1).**  The posterior coronoid of *Doleserpeton* is exposed (1) in lateral view.

**Character 226.** **Posterodorsal process of posterior coronoid contributing to tallest point of lateral margin of adductor fossa: no (0); yes (1).**  The posterodorsal process of the posterior coronoid contributes to the the tallest point of the lateral margin of the adductor fossa (1) in *Doleserpeton*.

**Character 227.** **Adductor fossa facing dorsally (0) or mesially (1).** The adductor fossa actually faces dorsomesially in *Doleserpeton*. As this is probably what was meant by “mesial exposure” it has been coded as for other temnospondyls (1).

**Character 228.** **Marginal tooth pedicely: absent (0); present (1).**  The pedicelly of the teeth of *Amphibamus* is uncertain (?). See also Appendix 1 (character 94), and Appendix 3 (character 99).

**Character 236.** **T-shaped dorsal expansion of cleithrum: absent (0); present (1).** The dorsal expansion of the cleithrum of *Doleserpeton* is not T-shaped (0).

**Character 237.** **Cleithrum with (0) or without (1) postbranchial lamina.** The cleithrum of *Doleserpeton* lacks a postbranchial lamina (1).

**Character 240. Interclavicle posterior margin not drawn out into parasternal process (0), with parasternal process that is not parallel-sided (1), or with elongate, slender process that is parallel-sided for most of its length (2).** The interclavicle apparently had no parasternal process in *Doleserpeton* (0).

**Character 241. Interclavicle wider than long (excluding parasternal process, if present): absent (0); present (1).** The interclavicle of *Doleserpeton* is too damaged laterally to be coded with any certainty (unchanged).

**Character 242. Interclavicle rhomboidal with posterior part longer (0) or shorter (1) than anterior part.** Note that Ruta & Coates (2007) measure the anterior and posterior lengths relative to an imagined line through the lateral corners of the bone. Following this system, we disagree with the previous coding of this character. For example, the temnospondyls *Eryops* and *Micropholis* both have interclavicles that are shorter posteriorly than anteriorly (Pawley & Warren, 2006; Schoch & Rubidge, 2005) corresponding to character state (1), as opposed to the previous coding (0). It is also uncertain how this character can be independent of character 240. Excluded.

**Character 243.** **Transversely elongate grooves and ridges on central part of interclavicle ventral surface: absent (0); present (1).**  There are no transverse ridges (0) on the medial part of the interclavicle of *Doleserpeton*.

**Character 245.** **Glenoid subterminal: yes (0); no (1).**  The presence of a “subterminal glenoid” is highly dependent on the degree of ossification and ontogenetic stage of the animal in question, as evidenced by the numerous *Doleserpeton* scapulocorocoids available. Excluded.

**Character 246. Enlarged glenoid foramen: absent (0); present (1).**  The glenoid foramen of *Doleserpeton* is not enlarged (0) relative to that of other temnospondyls.

**Character 247.** **Ventromesially extended infraglenoid buttress: absent (0); present (1).** *Doleserpeton* has an infraglenoid buttress similar to that of *Eryops* (1).

**Character 250.** **Distinct supinator process projecting anteriorly: absent (0); present (1).**  The supinator process is absent (0) in *Doleserpeton*.

**Character 251.** **Sharp-edged, ventral humeral ridge: present (0); absent (1).** Not to be confused with the crista ventralis humeri of modern amphibians, this primitive feature is absent (1) in *Doleserpeton* and *Eocaecilia*. In contrast, the crista ventralis of frogs, salamanders and *Eocaecilia* is homologous with the deltopectoral crest of other tetrapods (Sigurdsen & Bolt, 2009).

**Character 256.** **Ectepicondyle ridge reaching distal humeral end: no (0); yes (1).**  The ectepicondyle reaches distally (1) in *Doleserpeton*.

**Character 258. Humerus without (0) or with (1) waisted shaft.** *Limnoscelis* lacks a humeral shaft (pers. obs.) and *Seymouria* has a very porrly developed shaft. Coded (0) and (01) respectively.

**Character 259.** **Position of radial condyle: terminal (0); ventral (1).**  The radial condyle (capitulum) of lissamphibians and *Doleserpeton* is large, and could be said to be situated terminally and ventrally. However, based on how this character was coded previously (only the most primitive forms, with a clearly distally positioned condyle coded 0), the radial condyle of *Doleserpeton*, *Eocaecilia* and batrachians should be coded as ventral (1). Close studies of the humeri of *Triadobatrachus* shows that the radial condyle in this form would have been situated in similar position, and this is clearly seen in the related *Czatkobatrachus*. All of the above are recoded (1).

**Character 266.** **Humerus length greater (0) or smaller (1) than combined length of two and a half mid-trunk vertebrae.**  The humeral length of *Doleserpeton* is greater (0) than two and a half vertebrae.

**Character 267. Process ‘2’ on humerus: absent (0); present (1).** The process identified as process ‘2’ in *Proterogyrinus* could well be the latissimus dorsi process found in other tetrapods, such as *Eryops* (Pawley and Warren, 2006). *Proterogyrinus* recoded (01).

**Character 268.** **Radius longer (0) or shorter (1) than humerus.**  The radius of *Doleserpeton* is shorter (1) than the humerus.

**Character 269.** **Radius longer than (0), as long as (1), or shorter than (2) ulna.** The radius and ulna of *Doleserpeton* are approximately equal (1) in length.

**Character 271.** **Olecranon process: absent (0); present (1).**  The olecranon is hardly ossified in *Karaurus*, intermediate in *Doleserpeton*, *Triadobatrachus* and most anurans and caudates, and well-developed in *Eocaecilia*. The coding of this character is somewhat misleading, and it may be too dependent on small individual differences in relative ossification. Excluded.

**Character 278.** **Ischium contributing to pelvic symphysis: no (0); yes (1).**  The ischium contributes to the pelvic symphysis (1) in *Doleserpeton*.

**Character 279.** **Number of pubic obturator foramina: multiple (0), single (1), or absent (2).** *Doleserpeton* and *Eryops* have one (1) obturator foramen.

**Character 280. Internal trochanter raised as a distinct protuberance: absent (0); present (1). The internal trochanter may appear either as a weakly developed, indistinct area, or as a conspicuous, blunt or digitiform protuberance.** This character is highly variable, depending on the ontogenetic stage of the individual specimen, and this may explain the incongruous way this character has been coded by different authors. Excluded.

**Character 281. Internal trochanter separated from the general surface of the femur shaft by a distinct, trough-like space: absent (0); present (1).** We found an intertrochanteric fossa in nearly all tetrapods we examined, except anurans and *Triadobatrachus*. For instance, the trough-like space is clearly present in *Eocaecilia* (Jenkins et al., 2007), *Proterogyrinus* (Holmes, 1984), and *Eryops* (Pawley & Warren, 2006). All taxa for which the features is known coded (1) except salientians, which are coded (0).

**Character 284.** **Femur shorter than (0), as long as (1), or longer than humerus (2).**  The femur is longer than the humerus (2) in *Doleserpeton*.

**Characters 286-287.** [286] **Outline of tibia medial margin shaped like a distinct, subsemicircular embayment contributing to interepipodial space and the diameter of which is less than one-third of bone length: absent (0); present (1).**  [287] **Tibia without (0) or with (1) flange along its posterior edge.**  The tibia of *Doleserpeton* is of the same type as other temnospondyls (0).

**Character 288.** **Fibula waisted: no (0); yes (1).**  The fibula of *Doleserpeton* is waisted (1).

**Character 289.** **Ridge near posterior edge of fibula flexor surface: absent (0); present (1).**  There is a low posterior ridge (1) on the fibula of *Doleserpeton*. This ridge is frequently quite pronounced in salamanders, and *Valdotriton* is probably best recoded (?).

**Character 290.** **Rows of tubercles near posterior edge of fibula flexor surface: absent (0); present (1).**  There are no tubercles (0) on the fibula of *Doleserpeton*.

**Character 296. Cervical ribs with (0) or without (1) flattened distal ends.**  The cervical (anterior) ribs of *Doleserpeton* are flattened (0) distally.

**Character 303.** **Axis arch not fused (0) or fused (1) to axis (pleuro)centrum.**  In subadult *Doleserpeton* specimens the axis arch is not fused to the centrum, although it may be fused in fully adult individuals. Unchanged.

**Character 312. Trunk pleurocentra fused middorsally: no (0); yes (1).** The pleurocentra of *Proterogyrinus* are tightly appressed dorsally, and therefore close to the derived condition, recoded (01).

**Characters 338-339.** [338] **Ossified lepidotrichia in caudal fin: present (0); absent (1).** [339] **Ossified epidotrichia in caudal fin: present (0); absent (1).**  Lepidotrichia are absent (1) in *Doleserpeton*.

**APPENDIX 3**

**Comments and changes to the character matrix of Anderson et al. (2008).**

The character numbering and descriptions (in bold) are shown as found in the on-line appendix of Anderson et al. (2008), with character states separated by a space. These are followed by comments by the present authors. Note that some of the taxa discussed here were not included in the other matrices of this study, and are therefore not covered in the supermatrix (Appendix 4).

**Character 2. 'Skull:trunk' / '>=0.45' '0.30-0.45' '0.20-0.29' '<0.20', 3 Skull\_proportions / longer\_than\_wide wider\_than\_long.** The skull of *Doleserpeton* is about 40% of the trunk length (1).

**Character 3. Skull\_proportions / longer\_than\_wide wider\_than\_long.** Some anurans have skulls that are longer than wide (e.g. *Leptodactylus bolivianus* and *Rana pipiens*, see Trueb, 1973), although their skulls tend to be wider than most tetrapods (unchanged).

**Character 5. Supratemporal / present absent.** There is a bone bordered by the parietal, postparietal and squamosal elements in *Eocaecilia*, which is similar to the supratemporal bone in Amphibamidae and primitive tetrapods (Clack, 2002). Therefore, this element should be coded as uncertain (?) in *Eocaecilia*. The tabular bone in microsaurs and lysorophians may be a fusion of the tabular and supratemporal of primitive tetrapods, judging from its bordering bones (coded [-]). See Appendix 1 (character 17) for details.

**Character 6. ST\_exposure\_on\_occiput / absent present.** This character is also linked to the supratemporal (Character 5), and should be coded as uncertain (?) in *Eocaecilia*.

**Character 8. 'T-PF' / absent present.** This character seems to be related to a simple fusion of the supratemporal and tabular bones mentioned above (Character 5). *Eocaecilia* recoded (?).

**Character 9. Postfrontal\_shape / broadly\_quadrangular falciform.** The postfrontal of *Amphibamus* is closer to being falciform (1) than quadrangular.

**Character 10. 'Squamosal-Tabular' / absent present fused.** This character is also related to the possible fusion of the supratemporal and tabular bones. There may be a fusion of the tabular and squamosal in *Eocaecilia*, recoded (?).

**Character 16.** **Lacrimal\_orbital\_processes / only\_ventral\_present dorsal\_and\_ventral\_present neither\_present.** Changes suggested by Marjanovic & Laurin (2009) were inserted.

**Character 22. Frontal\_into\_orbit / no yes**. Marjanovic & Laurin (2009) suggested the use of a different coding: **Prefrontal-postfrontal suture (0); frontal participates in margin of orbit (1).** This is reasonable, and also points to the fact that several taxa could be coded as inapplicable due to the lack of some of the circumorbital dermal bones. However, the purpose of this character was presumably to reflect the medially expanded orbits that are typical of some temnospondyls and modern amphibians. This is better reflected in the original coding by Anderson et al. (2008). We left this character unchanged, as there is no other character that covers this feature.

**Character 26. Alary\_processes\_of\_premax / absent present.** *Eocaecilia* was described as having a flange of the premaxilla fitting into a slot in the nasal bone. This is more similar to the presence of an alary process found in *Doleserpeton* than the lack of any process in *Rhynchonkos*. *Eocaecilia* has been recoded (01). Marjanovic & Laurin (2009) suggested the following coding: **Dorsal process of premaxilla: broad, low, indistinct (0); alary process (broad, vaguely triangular) (1); moderately high, vaguely rectangular, or acutely triangular linked directly to base (2); narrow and long, along the sagittal plane or parasagittal (3) (unordered).** However, this coding is even more confusing, as state 2 is too similar to state 1. It is also not clear what “linked directly to base” means. The alary process is not always broad and vaguely triangular (e.g. Holmes, 2000). Furthermore, the condition seen in *Micropholis* (Schoch & Rubidge, 2005) is so variable as to put the value of this character in serious doubt. We have chosen to follow the original coding for the most part. Using *Eryops* as the “benchmark” for what an alary process should look like (i.e. a pointed process fitting into a notch in the nasal, dorsal to the nasal-premaxilla suture), we note that primitive salamanders (e.g. Gao & Shubin, 2003), often have an almost identical structure (coded 1), whereas *Eocaecilia,* the microsaur *Hapsidopareion* and anurans are not quite identical in this feature, but can be interpreted either way (01).

**Character 28. Septomaxilla / ossified unossified.** The septomaxilla is ossified (0) in *Doleserpeton*.

**Character 30. External\_naris\_in\_dorsal\_view / exposed not\_exposed.** Although the naris are unexposed dorsally in some modern caecilians, they are exposed (0) in *Eocaecilia* (Jenkins et al., 2007).

**Character 32. Dorsal\_exposure\_of\_premax / broad narrow none.** It is not clear how the dorsal exposure of the premaxilla differs in *Doleserpeton* and *Eocaecilia*, as the latter has a significantly broader dorsal exposure than most microsaurs. *Eocaecilia* recoded (0).

**Character 33. Dorsal\_shape\_of\_skull / triangular diamond rounded.** Many anuran skulls are more triangular than rounded (e.g. many *Rana*, and *Discoglossus* species), but these have been left as coded previously. However, as *Amphibamus* is regarded as having a rounded skull in the previous coding, then *Doleserpeton* should also be coded as such (recoded 2). *Tersomius* is variable (Carroll, 1964), recoded (02).

**Character 34. Posterior\_skull\_margin / concave straight convex undulating.** This character is far more problematic than it may seem, due to intraspecific variation, distortion and variable bony elements making up the skull margin. Excluded.

**Character 39. Large\_otic\_notch\_approaching\_orbit / absent intermediate close.** We agree with Marjanovic & Laurin (2009), inapplicable (-) in Albanerpetontidae.

**Character 44. Raised\_orbital\_rim / absent present.** *Doleserpeton* has raised orbital rims (1).

**Character 51. Parietal-squamosal contact / absent present.** We disagree with Marjanovic & Laurin (2009) in that a parietal-squamosal contact AND a supratemporal may both be present in *Eocaecilia*. The “tabular” bone of this taxon is likely to be the supratemporal (see Character 5), a possibility noted by Jenkins et al. (2007). However, due to the numerous problems with this character (see Appendix 1, character 13), we choose to exclude it.

**Character 52. 'Parietal-tabular contact' / absent present.** This character again relates to the problem of the identity of the “tabular” of *Eocaecilia*. This form recoded (?).

**Character 55. Postparietals / moderate large.** This is a problematic character. There seems to be no reason to base two characters on an apparent resemblance between the postparietals of *Eocaecilia* and microsaurs. The postparietal of *Eocaecilia* (previously coded 1) is actually very similar in shape and size to that of *Acanthostega*, which was coded ‘moderate’ (0). Recoded (0) in *Eocaecilia*.

**Character 57. Postparietal\_length / 'large,\_quadrangular' 'abbreviated\_anteroposteriorly,\_elongate\_lateral\_rectangle'.** The bone is wide in *Doleserpeton*, slightly elongated in *Eocaecilia*, but wide AND long in *Rhynchonkos*. Unchanged.

**Character 59. Tabular / present absent.** We agree with Anderson et al. (2008) in that the tabular may well be present in *Triadobatrachus*. However, we also acknowledge the uncertainty noted by Marjanovic & Laurin (2009). The “tabular” of *Eocaecilia* is also far from certain (Character 5, above). *Eocaecilia* and *Triadobatrachus* recoded (?).

**Character 60. Posterolateral\_projection\_from\_lateral\_margin \_of\_tabular\_above \_squamosal\_embayment / absent present.** A similar projection is present (1) in *Doleserpeton*.

**Character 65. Dermal\_sculpturing / circular\_pits shallow\_ridges\_and\_grooves little\_to\_none.** *Doleserpeton* has little to no dermal sculpturing (2).

**Character 74. Number\_of\_premax\_teeth / '>=10' '5-9' '<5'.** Following Marjanovic & Laurin (2009), we recode frogs (0). Other taxa are left unchanged.

**Character 84. Occipital\_condyle / concave convex.** This character is similar (and convex) in *Doleserpeton*, *Platyrhinops* (Clack & Milner, 2010), *Tersomius*, *Eocaecilia* and *Rhynchonkos*. As the latter two were coded as state 1 the former three were recoded (1). It is unclear (?) in *Amphibamus*. Marjanovic & Laurin (2009) note that the feature is unpreserved in *Gerobatrachus*, but we keep the previous coding (which seems likely to be correct) until further details are available.

**Character 85. Occipital\_condyle / 'single,\_with\_basioccipital' double.** This feature is more problematic than it seems, as there is a continuum of conditions between a single crescentic condyle, and the presence of two distinct condyles. Marjanovic & Laurin (2009) argue for an extensive recoding of this character. However, we choose to stick as closely to the original coding as possible. For instance *Asaphestera*, which was suggested by Marjanovic & Laurin (2009) to have two condyles (1), is somewhat similar to the condition of *Dendrerpeton* (Robinson et al. 2005) which was described as being similar to *Edops* (Romer and Witter, 1942). *Dendrerpeton* was coded as primitive by Anderson et al. (2008) and remained unchanged by Marjanovic & Laurin (2009). The condition seen in these forms is a generally concave, crescentic area with a slight protrusion of the basioccipital. Note that Anderson et al. (2008) emphasized the importance of the basioccipital. *Cardiocephalus sternbergi* appears to have a concavity in the area of the basioccipital but was described as having a “typical strap-shaped condyle” (Carroll and Gaskill, 1978). We code both *Cardiocephalus* species as uncertain (?). Following Marjanovic & Laurin (2009) we recode *Ecolsonia* (1). We also note that *Acheloma* has two condyles (1).

**Character 86. Jugular\_foramen / between\_opistotic\_and\_exoccipit through\_exoccipital.** We support the view of Marjanovic & Laurin (2009) who note that the exoccipitals and opisthotics are thoroughly fused in anurans, and that the position of the jugular foramen is therefore uncertain (?). However, we also note that Anderson et al.’s (2008) coding for *Doleserpeton* (0) is correct.

**Character 87. Jaw\_articulation / posterior\_to\_occiput even\_with\_occiput anterior\_to\_occiput.** Only three character states are described, but a fourth (state 3) has been used in the coding. When comparing*Eocaecilia* to modern caecilians, microsaurs, and temnospondyls, it becomes clear that *Eocaecilia* is actually intermediate in this character. It is notable that the jaw articulation of this early form is posterior to that of modern forms, whereas *Rhynchonkos* is at the same level as modern caecilians. The jaw articulation of *Eocaecilia*, with its postero-medially slanting angle, does not compare comfortably to any of the other taxa, but is recoded as state 2. All other taxa that were previously coded 3 have also been recoded 2. Marjanovic & Laurin (2009) correctly pointed out that frogs can have either state 0, 1 or 2 (for state 2, see e.g. Pugener & Maglia, 1997). We code Adeogyrinidae (01), *Asaphestera* (1), *Microbrachis* (1), and *Seymouria* (1).

**Character 89. Palatal\_teeth / present absent.** Marjanovic & Laurin (2009) correctly noted that this character probably refers to palatine teeth. We have chosen not to redefine characters 89 and 90, in contrast to Marjanovic & Laurin (2009). Unchanged.

**Character 90. Palatine\_teeth / 'single\_pit-pairs' multiple\_in\_rows multiple\_random.** *Micropholis* is actually described as having rows of teeth AND a fang-and-pit pair {01} on the palatine (Schoch & Rubidge, 2005).

**Character 94. Vomer\_teeth / single\_pit\_pairs Multiple\_in\_rows Multiple\_random.** We disagree with the observations by Marjanovic & Laurin (2009). *Doleserpeton* has multiple teeth in rows (1) close to the choanae. *Amphibamus grandiceps* may have the same condition, but it sometimes (specimen YPM794) appears to have small fang and pit pairs on the vomers rather than tooth rows. Amphibamus recoded (01). The denticles on the vomers of *Doleserpeton* and *Amphibamus* are smaller than in the tooth rows (marginal and on the vomer). The vomerine teeth of *Gerobatrachus* are probably best regarded as denticles (personal observations, see also Anderson et al. [2008] fig. 2a), and has been coded as uncertain (?) here.

**Character 95. Intervomerine\_depression / absent present.** A slight depression is present (1) in *Doleserpeton* and *Amphibamus* (pers. obs), and *Eryops*. Two depressions appear to be present in *Eocaecilia* (coded ?). The intervomerine fenestration of anurans is sometimes ossified to form a depression (rather than a fenestra), coded (01). Caudates, and other taxa with fenestration (character 96), should be coded as inapplicable (-).

**Character 96. Intervomerine\_rostral\_fenestration / absent present.** The area in question is often poorly ossified in anurans, but sometimes a partly ossified depression of the vomer occurs in this region of the vomer (e.g. mature *Rana catesbeiana*), coded (01). However, it is regrettable that the character matrix does not reflect the shape of the vomer, which is similar in *Doleserpeton* and *Eocaecilia*, when compared to microsaurs. Unchanged.

**Character 99. Tooth\_pedicely / absent present.** After a careful comparison of the dentition of *Doleserpeton, Gerobatrachus,* and modern amphibians, it becomes clear that *Doleserpeton* has a far more lissamphibian-like dentition than does *Gerobatrachus*. The tooth bases of the latter should not be described as pedicels, and has been recoded (0). Marjanovic & Laurin (2009) suggest coding *Oestocephalus*, *Phlegethontia*, and *Scincosaurus* as unknown. *Scincosaurus* was not described as having a line of weakness between crown and base (Milner, 1980), but *Oestocephalus* and *Phlegethontia* are here recoded as uncertain (?). We should point out, however, that these forms are unlikely to represent true pedicelly. Reexamination of *Amphibamus grandiceps* throws some doubt on the condition in this form as well. The latter is recoded as uncertain (?).

**Character 100. Denticles\_on\_vomers / present absent.** We agree with Marjanovic & Laurin (2009), and code *Gerobatrachus* as present (0).

**Character 101. Denticles\_on\_palatines / present absent.** *Doleserpeton* has no denticles on the palatines, but it does have a row of pedicellate teeth on this bone, as in *Eocaecilia*. *Doleserpeton* recoded (1). Frogs should also be coded as lacking denticles (1) rather than inapplicable.

**Character 102 Denticles\_on\_parasphenoid / present absent.** We agree with Marjanovic & Laurin (2009), and code *Triadobatrachus* as absent (1). We also recode frogs and salamanders (1).

**Character 103. Palatal\_teeth / larger\_than\_marginals equal\_to\_marginals smaller\_than\_marginals.** Except for the shagreen of denticles, the palatal teeth of *Doleserpeton* are the same size as the marginal teeth (previously coded polymorphic). Recoded (1).

**Character 105. Parasphenoid\_basal\_plate / 'roughly\_quadrangular,\_basipterygoid\_articulations\_narrowly\_spaced' 'rectangular\_laterally,\_anteroposteriorly\_narow,\_basipterygoid\_articulations\_distant'.** Salamanders, frogs and some derived temnospondyls were coded “1”, whereas *Eocaecilia* and microsaurs were originally coded as primitive. The basicranial articulation of *Eocaecilia* is indistinct (Jenkins et al., 2007). It is equally correct to say that *Rhynchonkos* and *Doleserpeton* are more similar in this trait, as they both have more prominent basipterygoid articulation areas on the parasphenoid. The shape of the basal plate is similar in all. *Eocaecilia* is here recoded with a new character state (2) to reflect its unique structure. Marjanovic & Laurin (2009) suggest elaborate changes, but their description of some taxa as having “moderately distant” articulations does not add clarity. Apart from the change above, we have kept the original coding.

**Character 108. Stapes / perforated\_stem imperforate\_stem no\_stem.** *Doleserpeton* has a stapedial foramen (0).

**Character 109. Stapes\_orientation / 'lateral,\_towards\_quadrate' 'dorsal,\_towards\_squamosal\_embayment,\_elongate\_columella'.** We disagree with Marjanovic & Laurin (2009) in that we could not find a single salamander in which the stapes is oriented towards the quadrate, except, perhaps Sirenidae. Even in the latter case this was not clear, and could be interpreted either way. The stapes shaft of salamanders is usually oriented dorsolaterally towards the squamosal. Salamanders conservatively recoded (01). *Eryops* and *Ecolsonia* should be coded as derived (1).

**Character 111. Dorsal\_process\_of\_stapes / absent present.** The process is absent (0) in *Doleserpeton* and *Amphibamus*.

**Character 115. Interpterygoid\_vaccuities** (sic) **/ 'narrow\_("closed")' wide fused\_at\_midline.** The vacuities of *Eocaecilia* are wider than those of most microsaurs. They are also bordered by the same bones as those of amphibamid temnospondyls. The vacuities of caecilians are dissimilar from microsaurs in that the palatine bones border them. *Eocaecilia* recoded (1).

**Character 118. 'Pterygoid-palatine suture' / present absent.** This feature is similar in *Eocaecilia, Platyrhinops* and *Doleserpeton* in that the contact is at the posterolateral tip of the palatine, whereas in most primitive tetrapods there is an elongate suture between these elements medal to the palatine. To indicate the condition in *Doleserpeton,* *Platyrhinops* and *Eocaecilia*, these have been recoded (2). Anurans sometimes have a similar contact, coded (12).

**Character 120. Lat\_process\_of\_pt\_into\_posttemp / absent present.** This character was not understood. Marjanovic & Laurin (2009) reinterpreted this character, and noted errors in the coding. Due to the uncertainties, we prefer to exclude this character.

**Character 121. Ectopterygoid / 'present\_with\_fang-pit\_pair' 'present\_lacking\_fang-pit\_pair' absent.** This element is possibly absent in*Doleserpeton* and *Eocaecilia* (12). Frogs and salamanders should be coded ‘absent’ (2). Marjanovic & Laurin (2009) correctly points out the possible retention of this bone in some caecilians.

**Character 130. Meckelian\_fossae / 2\_or\_more 1 0**. *Doleserpeton* has one Meckelian fossa (1). All salamanders examined by the present authors had one small meckelian fossa in the lower jaw, contrary to the previous coding (“canalis cordae tympani” of Reese, 1906). See Appendix 1 (character 79). Salamanders were recoded (1).

**Character 131. 'Ventral border of Meckel''s foss' / splenal (sic) angular.** In *Doleserpeton* the ventral border of the fossa consists of the angular. A fossa borders the angular in cryptobranchid salamanders (Reese, 1906). Salamanders and *Doleserpeton* recoded (1).

**Character 132. Retroarticular\_process / absent present.** Carroll (2000, 2007) described the retroarticular process of *Rhynchonkos*. This is far shorter than in caecilians, and is similar to a projection of the lower jaw sometimes seen in salamanders (e.g. Reese, 1906). A slight protrusion beyond the articulation area is common in many tetrapods, and the process of *Rhynchonkos* is only slightly longer than that of *Doleserpeton*, making this character problematic. Salamanders recoded (01).

**Character 134. Articulation\_to\_tooth\_row / above equal below.** The articulation is level with, or slightly above, the tooth row in *Doleserpeton*. Coded (01).

**Character 139. Symphysis / dentary\_and\_splenal (sic) dentary\_alone.** The figures of Carroll & Gaskill (1978) show a splenial bone in the symphyseal region of several microsaurs previously coded as derived, incuding *Rhynchonkos* and *Micraroter*. *Doleserpeton* and *Tersomius* also had the primitive condition. All of the above were recoded (0). Modern amphibians do not have a separate splenial, although they commonly have a different ossification in the symphyseal region: the mentomeckelian. They should be coded as inapplicable (-).

**Character 140. Jaw\_sculpture / present absent.** There is hardly any sculpturing of the lower jaw in *Doleserpeton*. Recoded (1).

**Character 145. Number\_of\_presacrals / '25-35' '20-24' '>35' '<20'.** Salamanders were previously coded 3, but can have anywhere from 10 to 60 trunk vertebrae (Duellman & Trueb, 1994). Conservatively recoded (13). *Doleserpeton* has 22-25 vertebrae, coded (01).

**Character 146. Vertebral\_development / 'arches,\_then\_centra' centra\_and\_arches\_simultaneously.** The objections of Marjanovic & Laurin (2009) are reasonable, and the character has been excluded.

**Character 163. Trunk\_arches / paired fused.** The objections of Marjanovic & Laurin (2009) are followed here. The character has been excluded.

**Character 168. Atlas\_Anterior\_centrum / same\_size\_as\_posterior laterally\_expanded.** The anterior part of the atlas centrum is expanded (1) in *Doleserpeton*. *Sauropleura scalaris, Ptyonius, Urocordylus,* and *Brachydectes* are all recoded (1) following Marjanovic & Laurin (2009).

**Character 172. Atlas\_neural\_arch / paired sutured\_at\_midline fused\_at\_midline.** The atlantal neural arch is paired (0) in *Doleserpeton*. *Amphibamus* is probably similar, but coded uncertain (?).

**Character 174. Proatlantes / present absent.** The proatlas is probably absent (1) in *Doleserpeton*.

**Character 175. Second\_cervical\_arch / expanded\_to\_more\_posterior equal\_to\_more\_posterior shorter\_than\_more\_posterior.** The second arch is expanded (0) in *Doleserpeton*.

**Character 177. Cervical\_rib\_distal\_shape / spatulate pointed.** The first rib is more or less spatulate (0) in *Doleserpeton*. It is not clearly described in *Eocaecilia* (Jenkins et al. 2007). The latter form has been recoded (?). See character 179 for more on the ribs of Eocaecilia.

**Character 179. Ribs / elongated\_and\_sometimes\_curved straight 'short,\_simple\_rod'.** The ribs of *Doleserpeton* are short compared to microsaurs and even to *Dendrerpeton*, but those of *Eocaecilia* are shorter still, contrary to the previous coding. The posterior curvature of the ribs of caecilians is closer to that of temnospondyls and salamanders, contrary to the situation seen in microsaurs, in which the ribs curve sharply ventrally (as in amniotes). The old description of lissamphibian ribs as ‘short straight rods’ is slightly misleading, but the fact remains that their ribs are very different from those of microsaurs and amniotes. *Eocaecilia* recoded (2). We take state 1 to mean relatively long ribs that have little of the strong ventral curvature seen in, for instance, most amniotes. It was previously used for *Acheloma*, but is true for *Eryops* as well. Micromelerpetontidae and *Balanerpeton* are also recoded (2) here.

**Character 181. Number\_of\_sacrals / 1 2 3.** Marjanovic & Laurin (2009) questioned whether any of the “microsaurs” have two sacral vertebrae, but they do accept that at least some of them have three, while others have only one. Given this situation, it seems likely that two sacrals may be present in some taxa. We prefer to retain the original coding until further studies elucidate the matter.

**Character 182. Sacral\_parapophysis / on\_centrum on\_transverse\_process.** The capitulum (parapophysis) of the sacral rib almost certainly articulated with the centrum (0) in *Doleserpeton*.

**Character 184. Interclavicle\_posterior\_stem / no\_or\_short long.** *Doleserpeton* recoded (0).

**Character 186. Interclavicle / diamond\_shaped 't-shaped'.** The interclavicle is diamond shaped (0) in *Doleserpeton*.

**Character 187. Interclavicle\_anterior\_plate / broad narrow.** Broad (0) in *Doleserpeton*.

**Character 188. 'Interclavicle shape-diamond' / broad\_diamond narrow\_diamond**. The interclavicle is broad (0) in *Doleserpeton*.

**Character 189. Interclavicle\_anterior\_fimbrati / present absent.** Present (0) in *Doleserpeton*.

**Character 190. Interclavicle\_sculpture / present absent.** Absent (1) in *Doleserpeton*.

**Character 191. Cleithrum\_head / aligned\_along\_anterior\_rim\_of\_scapula posterodorsally\_enlarged\_head\_wrapping\_around\_dorsal\_scapula.** *Sauropleura scalaris* and *Brachydectes* were given state 1, following Marjanovic & Laurin (2009).

**Character 192. Cleithrum\_head / 'dorsally\_greatly\_expanded,\_much\_wider\_than\_shaft' simple\_rod\_without\_or\_slight\_dorsal\_expansion.** *Sauropleura scalaris, Ptyonius* and *Brachydectes* were given state 1, following Marjanovic & Laurin (2009).

**Character 193. Cleithrum / ossified unossified.** The cleithrum may be either ossified or unossified (01) in anurans (personal observation). It is apparently present (0) in *Triadobatrachus* (Rage & Roček, 1989).

**Character 194. Cleithrum / rounded\_or\_pointed\_dorsally 't-\_or\_y-shaped'**. Rounded (0) in *Doleserpeton*.

**Character 196. Supraglenoid\_foramen / present absent.** The foramen is present (0) in *Doleserpeton*.

**Character 197. Number\_coracoid\_foramina / 0 1 2.** *Doleserpeton* has 1 coracoid foramen (1).

**Character 198. Scapulocoracoid\_occification** (sic) **/ both scapula\_only absent.** Both are ossified (0) in *Doleserpeton*.

**Character 199. Entepicondylar\_foramen / present absent.** Absent (1) in *Doleserpeton*, *Amphibamus*, *Platyrhinops*, *Tersomius* and *Eryops*.

**Character 200. Tortion** (sic)**\_in\_humerus / absent less\_than\_80\_degrees more\_than\_80\_degrees.** More than 80 degrees in *Doleserpeton*, *Amphibamus*, *Platyrhinops* (Carroll, 1964), *Acheloma,* and *Eryops* (Pawley and Warren, 2006), as well as in most frogs (incl. *Triadobatrachus*) and salamanders. All of these have been recoded (2).

**Character 201. Deltapectoral\_crest / weak intermediate prominant** (sic)**.** We strongly disagree with the recoding of Marjanovic & Laurin (2009). The deltopectoral crest of *Chunerpeton* (Gao & Shubin, 2003) appears weak because the bone is figured with the crest pointing directly towards the observer. This is clearly seen when comparing with the humeri of modern salamanders. Also, when adjusting for size, it becomes clear that the deltopectoral crest of *Acanthostega* is less developed than modern amphibians, temnospondyls and most amniotes. The deltopectoral crest of *Doleserpeton* is similar to that of microsaurs and salamanders. Frogs were coded as intermediate in the original matrix, although the crest is, in fact, longer in this group than in salamanders. The crest also leans laterally rather than medially in salientians, which appears to be a unique salientian feature. *Doleserpeton* recoded (2), new state introduced for salientians (3). Finally, the deltopectoral crest of *Proterogyrinus* (Holmes, 1984) is considerably more prominent than that of *Acanthostega* (the former coded 1).

**Character 202. Supinator\_process / absent present.** This process is absent (0) in *Doleserpeton, Amphibamus,* and *Platyrhinops*. It is present (1) in *Eryops* (Pawley & Warren, 2006) and *Acheloma* (Olson, 1941). Daly (1994) reported a supinator process in *Tersomius*, but this is more likely the ectepicondyle.

**Character 203. Humerus\_length / 'long\_(>4\_trunk\_centra)' short.** The humerus is long (0) in *Doleserpeton*. It is sometimes shortened in salamanders, which is recoded (01). *Acanthostega* is actually close to the cut-off point and has been recoded {01}. Marjanovic & Laurin (2009) are followed in coding Albanerpetontidae as short (1). Salamander limbs are often short, and these have been coded as polymorphic (01).

**Character 204. 'Radius:humerus' / '>=0.7' '0.5-0.7' '<0.5'.** The radius is slightly less than half the humeral length in *Doleserpeton* (recoded 2), this is sometimes the case in salamanders as well (recoded polymorphic [12]).

**Character 205. Olecranon\_process / unossified ossified.** The olecranon of *Doleserpeton* is often poorly ossified (0), but can be intermediate. It is sometimes well ossified in salamanders (01) such as *Ambystoma* (pers. obs.). Due to the ontogenetic variability of this character, it is perhaps best excluded.

**Character 206. Carpals / fully\_or\_partially\_ossified unossified.** Carpals are ossified (0) in *Doleserpeton*. Albanerpetontidae coded 0 (McGowan, 2002).

**Character 207. Basale\_commune / absent present.**  Marjanovic & Laurin (2009) correctly points to some uncertainties concerning the identity of the bone in *Gerobatrachus* (many surrounding bones being missing). However, we keep the original coding until a more detailed study of this form is available.

**Character 208. 'Number digits-manus' / 5\_or\_more 4 3.** *Doleserpeton* has 4 (1). Marjanovic & Laurin (2009) suggest coding *Rhynchonkos,* *Dendrerpeton* and *Acheloma* as either state 0 or 1. This may be seen as overly cautious, as related taxa have four fingers, but has been followed here. *Micropholis* and *Urocordylus* were recoded (1 and 0 respectively). *Diceratosaurus* is recoded {01}.

**Character 209. Pelvis / fused sutured poorly\_ossified.** Fused (0) in *Doleserpeton*.

**Character 211. Illiac\_blade / 2\_dorsal\_processes narrowly\_bifurcate single\_blade.** Single blade in *Doleserpeton* (2).

**Character 212. 'Internal trochanter-articulatio'** (sic)**/ disctinct continuous.** This character is somewhat problematic. We interpret this as the trochanter being set off from the proximal head of the femur in the primitive condition. If so, both *Doleserpeton* and salamanders should be coded (0). Note that subadult specimens often appear to have the derived condition, due to lack of ossification. It may therefore be best to avoid this character. Excluded.

**Character 213. Femoral\_shaft / robust slender.** The femoral shaft of *Doleserpeton* is as slender as that of salamanders. Recoded (1).

**Character 214. Femur / long short.** The exact length is not indicated in the character coding, but the length of the bone in *Doleserpeton* and *Amphibamus* (about 4 centra long) is clearly longer than in *Eocaecilia*, and similar to modern salamanders. *Doleserpeton* and *Amphibamus* recoded (0).

**Character 215. Tarsals / ossified unossified.** *Doleserpeton* specimen FMNH UR1320 preserves some ossified tarsal elements. Recoded (0).

**Character 217. Number\_of\_distal\_tarsals / 6 5\_or\_fewer.** Marjanovic & Laurin (2009) suggested eliminating this character due to problems with the identity of some of the tarsal elements. This is followed here. Excluded.

**Character 219. 'Number of digits, pes' / 5\_or\_more 4\_or\_less.** *Doleserpeton* has five digits (0).

**APPENDIX 4**

**Modified supermatrix**

Characters 1-161 are from Vallin and Laurin (2004), characters 162-500 from Ruta and Coates (2007), characters 501-719 from Anderson et al. (2008). Character 720 is new (see below). The original order of the characters has been kept. For instance, character 10 from Ruta and Coates (2007) is equivalent to character 171 (10+161) here. See appendices 1-3 for individual character changes.

Some taxa are composite (Campbell & Laponte, 2009). Thus, the taxon Anura had to be constructed using a combination of data from the taxa Discoglossidae, *Notobatrachus* and “frogs” (the latter from Anderson et al., 2008). Similarly, the taxon Caudata had to be constructed using Hynobiidae, *Valdotriton*, and “salamanders”. Other “composite” taxa include forms that are in part coded based on individual subtaxa: Lysorophia (*Brachydectes*), Brachystelechidae (*Batropetes*), Nectridea (*Scincosaurus*), Aistopoda (*Oestocephalus*), Adelogyrinidae (*Adelogyrinus*), Colosteidae (*Greerpeton*), Branchiosauridae (*Apateon*).

New character:

**Character 720. Capitulum size: capitulum (radial condyle) small (0); capitulum large and bulbous, covering much of the distal end of the bone (cut-off set to 45% of the distal width).** Modern batrachians, *Eocaecilia*, and *Doleserpeton* all have large and bulbous radial condyles (Sigurdsen and Bolt, 2009). *Eryops* and at least some nectrideans seem to approach this condition. Both of these have been coded as “either-or” (01).

Character state distribution for character 720: *Acanthostega* 0; Adelogyrinidae ?; Aistopoda ?; *Amphibamus* ?; Anura 1; *Asaphestera* ?; Brachystelechidae ?; Branchiosauridae ?; *Cardiocephalus* 0; Caudata 1; Colosteidae 0; *Dendrerpeton* ?; *Doleserpeton* 1; *Ecolsonia* 0; *Eocaecilia* 1; *Eryops* (01); *Limnoscelis* ?; Lysorophia ?; *Microbrachis* ?; Nectridea (01); *Pantylus* 0; *Proterogyrinus* 0; *Rhynchonkos* ?; *Seymouria* 0; *Triadobatrachus* ?.

The following characters were excluded before both the corrected and unmodified supermatrix analyses (using the Exclude command in PAUP and MrBayes). This was done to avoid character repetition:

7 15 20 22 24 26 25 29 31 35 38 39 40 42 48 50 54 60 61 74 79 80 81 82 83 84 86 88 89 93 95 97 98 105 114 119 120 123 124 133 136 137 138 140 141 143 146 149 159 169 172 180 189 196 200 211 212 217 218 220 224 228 231 238 240 248 249 251 258 262 266 281 284 285 294 295 297 300 301 302 308 311 312 327 328 332 336 345 348 353 357 362 365 369 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 389 392 399 404 405 411 414 424 429 442 458 462 463 465 469 472 474 475 477 498 499 504 505 512 513 520 521 522 526 528 545 550 552 553 554 555 559 560 561 564 565 574 578 579 581 583 584 587 589 590 591 597 599 600 602 605 608 609 611 615 621 632 649 652 665 667 668 672 677 679 681 684 695 698 702 703 708 711 718 719

In a separate run, characters 80-84 of Vallin and Laurin (2004) were included (see text). This did not significantly change the outcome of the analysis. Another run excluding characters concerning the shape of the interpterygoid vacuities (characters 322-324, corresponding to Ruta and Coates [2007] characters 161-163), also did not change the resulting phylogeny significantly.

The following characters were of questionable value, and were therefore excluded in the corrected supermatrix analyses (see Appendices 1-3 for justification): 5 10 13 63 134 139 144 160 205 206 221 227 232 252 347 403 406 432 441 534 551 620 646 663 705 712 717

In the weighted analyses the characters were given weights according to their proportion among the characters (after character exclusions) as follows: Characters 1-161: 2.38, characters 162-500 and 720: 1.00, characters 501-719: 1.63

Dimensions: number of taxa = 25, number of characters = 720

Each full line contains 50 characters. Blocks of 100 characters are alternately highlighted.

Acanthostega

0000001001 1000010000 0000010010 1000000010 0000101000 0010000(01)01 ?10??01?00 ?0000010?? 00?0?001?0 000000?01? ?????????? 1???10???0 0000011000 0010{03}00010 101001???? ????000110 00??000000 1000000000 0001000000 0001200001 1110000000 0000000001 ???0001010 0000000000 0011000000 0000001000 0000011100 0000000000 1100000000 0010000000 0100000000 0000000000 0000001000 0000000000 0010000001 1010100000 0001001001 0001100110 011000?000 0000000001 1000001000 0000001000 0110001110 0010000110 1110100001 0000000000 0000000000 1000000000 0011110000 0001000101 0001000001 00000?0000 0000001000 0000000000 0000000001 0000000001 0--0000000 00000000-0 000--00000 0000000000 0000000000 0000000000 0000000000 00-0100000 00000?0000 0000000000 00(01)0000000 0000000000 0000000000 0000000000 00{01}0000000 0010000000

Adelogyrinidae

10000{12}1011 101-01-2-- -00-0?01?0 1(01)00012??1 1001101000 00?0001101 ??01?1???1 1????????? ??00001??0 010001?510 1001?00-11 2033-01110 0001111-11 ---------- 0--------- ----11-1-{03} 10??000?1? 110100000? 100?001010 00?1??01?1 ?10?110000 ?000010?01 ???-???2?? ???0???001 0?000?001? 0??1000000 010?0?1200 00??000000 ?3???????? ??????0??? ?????????? ?????????? ????????00 00101????? ???????1?? ???10000?? ?0010??101 0????????? ????????00 001101011? 0010????1? ?????????? ?????????? ?????????? ?????????? ?????0?101 100?00???? 111?001?1? ??11????10 ?01????1?? 2?01--1002 1-1----000 0000?00110 000300000- 00000010?1 1100000021 0--0101??? 000?0000-0 100001{12}?1- 0?1???0?00 01-0000??? ???00??0?0 000000?00? ?100(01)???10 0000??010? 00102????? ???0001020 220112??00 ???0-00000 ???0???2?? ??????-??? ??????????

Aistopoda

2{12}?00(012)(12)(01)11100-0(01)(01)0?0 0(012)0?010(01)00 2(01)000?1?21 ?001????00 ?0?0001??1 -00-{03}1{02}??1 10?0?01103 1121111--0 010?011{15}12 1101000-11 2023?11112 1-3?111-?1 ---------- 0--------? ----100--3 10??01001? 1101010001 0000001010 000100000? 2100110000 1000010001 ???(01)0100?0 00000001?? ?????00000 0001000000 01000?2100 0001001001 44???????0 ???1000000 ???????000 ?000000000 00?0???000 0010100000 00200001?? ??1?0000?? ?1??010101 00???????? ?????????0 00(01)002011? ????????1? ?????????? ?????????? ?????????? ?????????? ?????10000 00?101???? ???0101?0? 0011111100 1100???11? 2301(01)0-001 0100101011 0000000121 01020001-- 00001---0- 0000100100 0--1201001 00010000-0 120000(012)001 --????10?? 101?0-0??? ?000000000 1000000011 10-003--11 10012?012- 000021---- 0011101012 2200121-01 --0------- --00------ ---------- ---------?

Amphibamus

?2000010?1 100001001? 0000010000 1?00001020 1010100?00 0?011?3001 ????????01 10?010102? ?00000?1?0 011??11(03)10 ?00??????? 1001101100 00111110?0 01???11011 312?020002 00001?0013 0110000?1? 1010001000 01000000?0 0101100000 2110000010 ?000000001 ???00000?? ??010?0000 1000010100 0001000000 1100101100 120?100000 ??01110111 011110?010 0001100000 0001010000 0111012?01 01100?1000 00210110?? ????0000?? ?0??0???01 0?0???0??? 0??????1?1 0000000111 00000??11? 01?111??1? 111111101? 0?0010011? ????2?0010 0????00000 01?0000000 1000000000 0011111100 0001100111 3111000010 1100101000 0000?10000 2020000020 0000000110 0000001001 ???1111000 0000000100 10????0001 100{01}1?00?0 000?110010 0?01110111 010000???? ?0-0?????? 10001??00? 0000200??0 0110000?00 ???1?20020 0?00-00000 010000?012 100100?110 2?1000??0?

Anura

22(04)02(012)2-11 100--111-- -2--1-1222 1000001121 01---1--00 1111113111 -11-122-01 11-1101103 1121111--1 011101-{15}11 1001{02}10-11 2241101102 0121111110 010?311111 3230101012 00031---01 110100001? 1?1?1????? ??1????011 010??11??? ?0?0??1??? ??????1??1 ???1???1?? ???1???1?? ??????0100 1??????1?? ?100000100 130?110000 ??01010111 101??????1 1??????001 01?1100000 011101??01 00????0000 00210112?? ??110010?? ?1??1???1? ??1???1??? 1???????11 0?0000011? ????10111? 01?1110?11 11111100?? 1?00?011?? 000?2????? ?????00001 0111000??? ???0101?0? 0111????01 0001100111 ?1111----- 0-1----1-- {01}100-{01}10-0 0021000020 00101---0- 0-20----1- 0--120100- 0000000100 10011?(012)00(12) 0101{01}{01}1011 11101(01)011{01} 00?0110{12}1(01) 2-0002-{12}12 -0-113---1 001030012- 000021---- -110101112 2201120020 013------- --{01}0110012 3001000101 2110011001

Asaphestera

2{12}40011011 100-01-010 000-010000 210001{01}02? 100?10?100 00??00???? 0??13210?1 1??0?????? ????001??0 010001?512 100??????? {12}0??{12}11?0? 00??111??0 010?01000? ??1??????? ?????01003 10??01001? 1000000000 0000000100 00011?0010 2110000000 1000000101 ???-???0?? 00010?0000 0100100000 0101000010 ?100000000 2001100000 4{01}???????? ????100000 ???????00? ?000000000 0000???100 101000???? ?????????? ???10000?? ????0??101 0????????? ????????00 000002???1 11000111?? 0??010121? 0????110?? 0010?0011? ????{12}????? ?????0?100 00??100??? ???010??0? ?111?????1 ?001???1?1 2201--1101 1100100001 0000?00100 000300010- 0001000010 010000000- 0--{01}100000 01010000-0 1210001001 000???0100 0?0??00??? ?001010000 ?000?0100? ???20????1 10000??12? 00102????? ??10001122 ??011??000 ???1110-?0 ????102002 100?1???20 0?10??????

Brachystelechidae

2{12}4(12)021111 111-01-000 02--0(12)0000 210011?02? 000?001000 10100011(01)1 100-3200(01)1 1010001(01)23 11??0?1--0 01(01)0011512 10??110-11 ?031111101 0?11111010 01?0110011 ?1210201-2 1(01)(01)(02)10(01)10(013) 20??01101? 1000000001 0000001100 00?1210011 21110?1??? ??????0001 ???-???000 0001000000 0100?01000 01?1000??? 0100002200 120?100001 1????????? ?????????? ???????00? ???0000000 0??????100 101000000? 00200002?? ??110001?? ????0????? ?????????? ????????00 0000020?11 210001111? 01?01???11 0111111012 01?0?001?1 1101(12)00010 0?01?00100 00??1000(01)0 111?(01)01?00 0111111111 0001100111 3201--1011 1100100??? 0100000121 02130001-- 0000000001 1120---00- 0--12101-? 1001200110 11110-2??? 00????1001 10-1100100 00000?0??0 ??001??11? ?101????11 10003?0120 0010200100 0010001122 0?01100000 0001110-11 ???0102002 201210?100 20110?110?

Branchiosauridae

??{04}00(01)1111 1000010010 ?000010000 1000001020 0000000000 1001103101 ?????????1 1????????? ?0??00???0 ??1{01}?01??? ??0??????? ???11011?0 001?111010 01?????0?1 3{12}2???0??2 000211001{13} 010100001? 1011001000 0100000010 0101110000 2110000010 ?000000001 ???000100? 1?01000000 1000010100 0001000000 ?110111100 1201100000 ??00010111 0110000110 0101010000 0001110000 0111002??? ??????1000 00210111?? ????0000?? ?0??0???01 0????????? ???????1{01}0 00000?0111 01000??11? 01???1??1? 1111111011 0000?0011? ?1??2?001? ?????00000 01???00000 ???0?00000 0?11111100 0001100111 3111000010 1000121000 0000?10010 0001000020 ???0000(01)10 0000001001 0--1101000 00010000-0 000???(01)00(01) 00001000{01}0 001?100??? ???1110010 010??????? ?0-??????? 020010000? 00?0000?0? 0000000??? ??0?120020 0?00-000?? 000????210 000101?120 211010--0?

Cardiocephalus

2{12}41021011 100-01-010 000-010000 2100012021 1001101100 0010001101 1001?21001 1??000110? ????001?10 010001?311 ?00???0-11 ?0??{12}11?0? ?????11??0 01001110?1 ?1?20?0??? ?????01012 20??011010 1000010000 0000100110 0001000010 2110000000 1010000111 ???-???000 0000100000 01001?1?00 0101000??? 0100000000 020?100101 4{01}11000110 0001000000 0101000000 1000000100 0000??2000 1010000002 00200002?? ??1100001? ?01101?101 1????????? ???????100 100012???? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? ?????????? 3201--1101 1100110001 0000?00011 01121001-- 0001000010 010(01)10000- 0--121000? 1022211101 1000?02??? 0???????0? ?????0??0? ??????0??? ?0?0111?1? ?0-20????1 10002??01? 00102????? ??10000122 0?01100000 10???????? 1000?0-112 1012?0??20 2010?????0

Caudata

2240221-11 111-1111-- -2--011202 2200101121 01---1--00 1001-12111 -00-122-01 11-0{01}01133 1121011--0 0101011{15}11 1101110-11 2121101102 1-3-1110-0 0101311001 312102000(23) 0(01)2210--?1 011100001? 1001001001 111?????11 01010100?? 011?0?1??? ??????1??1 ???1???1?? ???????1?? ?????00000 1??????1?? ?100101100 130?100000 4?01011111 101??????1 1??????010 01?0100011 0111??2001 01100?0000 002001121? ??110000?? ?1??1???1? ??1???1??? 1???????1? 00000???1? ????01111? 01?111??11 1111111011 0000??011? 11?121001? 0????00000 01?1100010 ???011??00 0011111100 0101100111 ?2(01)11----- 000012-011 0100-11000 002{12}0001-- 00001---0- 1-21----1- 0--120100- 000(01)000100 10011?200(12) 020{12}-11011 -110110(01){01}{01} 00?1110-1(01) 2-0002-2-1 -{01}-10{23}{01}1-10(12)00{13}(01)0120 0000201001 0011101122 2201120020 013------- --1--11112 20{01}(12){01}01120 201000{01}001

Colosteidae

1000001001 10000(01)0010 0000020(01)00 20000?0010 0000000000 0001001001 0101110001 100001102? 0000000010 0100101010 0000???000 2002101110 0000111010 0000010011 2102020002 000?100113 10??00011? 1101010101 1000000000 0001100101 2100110000 000001000(01) ???0001001 0100000000 0011000000 0000000000 0100011000 0001000000 2200000110 0010000000 0000000000 1000001000 0000001000 0010011000 0120000001 0110010011 0001010001 0000100101 010111?000 0100000010 0010000111 0010101100 0110010012 0100100111 1111200010 020?101001 1000000000 1000000000 001111??00 00110101?1 0201000001 0001100000 000000012(01) 0003000100 0000000001 0000(01)00000 0--0000000 00000000-0 00000?000(01) 0000000001 10(01)0000000 0000000000 0000000001 00-0010100 10002?0000 0000000000 ??10100000 ?000021110 0000-01000 0000111001 1011110100 201010--00

Dendrerpeton

2{12}00001011 1000000010 1000010000 1000002020 1000100100 0001001001 ?1?1?????1 1??01??02? ??00000110 010000?010 100??????? ?000?01100 00011111?0 011??10011 ?10102000? ????100003 0100000011 1000000000 0000000000 0001000000 2110110010 ?000000000 1000001001 1?00000000 1000010100 000100(01)000 1100002000 020?000000 4?0011?110 0010110000 0010100001 0001000000 0110002?01 00100?1000 00201000?? ????0000?? ?011010001 0?0???0??? 0??????100 0000000111 000000011? 01?0101210 0110011011 0100110111 11?120001? ?201100000 00???00000 1000000000 0011????00 0001100111 0000000000 1100100000 0000?11000 0000000000 0000000100 0000000000 0--1000000 00000000-0 00000?0000 0000000000 0000000010 000?110000 0000000011 10-00???10 10001?0000 0000000001 ??10000000 ?00?0?0010 0000000000 0000001002 2001100{01}00 2?00?0??0?

Doleserpeton

2{12}40001111 1000010010 0000010000 1000001121 101101--00 0101103001 01?112{02}-01 1010101030 0000001110 0{12}11011311 1000010011 100{01}101100 0001111010 0100311001 31210200?2 0???100001 0110000011 1010001000 0100000000 0101110000 2110000010 ?000000001 ???00000?0 0?01000000 1000010100 0001000000 1100111100 1201100000 4401110111 1111001010 1??????001 0111010000 0111012001 0110001000 002111101? ??110000?? ?0??0101(01)1 010???01?? 0111111111 000000011? 0??00?011? 01?111??11 1111110011 0000?00111 11?1200011 0????00000 010?000000 11(01)0100000 0111111100 0001100111 3101000010 1100100000 0100111000 0021000020 0001000110 0000001001 0--1200000 0000000100 1001110001 10011?0010 101?10001? 0?00110211 {12}100000001 10-{01}100201 1000{01}?00(12)? 0000200?0? ?110000112 2001020?20 00?0?00001 0100?01012 2002000100 201000??01

Ecolsonia

2{12}00001111 1000010010 1000020000 1000002020 1010100000 0001003101 110112?001 1?0?1???20 000000?110 0100001010 100??????? 200??01110 0001111010 111031101? ?1?1010?0? ????120000 1110000?11 1000000001 0100000000 0001210000 2110100010 1000000001 ???0001000 0100000000 1000010100 0001000000 0101001200 1101100000 4?0011?110 00101?1000 0011?00001 0001000000 011100?001 0110001000 0020?1101? ??1?000001 001?010101 0101010101 0101???100 0000020111 0100010111 1111101211 011??1?0?? 0100100111 11?1?0??10 0{12}0??0?000 00???00000 1000000000 0011111100 000??????1 0?11000001 1100111000 0100110020 1000000001 1210000000 0000100000 0--1000000 0001{01}010-0 00001?0000 10001?0000 000?000?1? ?00?110001 00000000?0 (01)0-0?00200 ?000??0001 0000000001 011000???? ????????10 0????????? 0000?0101? 11??0?0?10 0110?0???0

Eocaecilia

2240021011 111-11??-- -00-020000 2001003121 000101--00 0001102001 100-?2{02}-11 1??00010?3 1121111--0 1211?1131? ?101110011 10?2?0110? ????111??0 010?3110?1 ???10?0??? ????12--13 00??01001? 100000000? 0100000?10 01010000?? 2011000000 ?000000001 ????????00 00000001?? ?????10000 01?1000000 ?100000000 030?100000 4401011111 0011000000 1??????001 0010110000 0110002?01 01100?0000 002001121? ??1100000? ?1??1???1? ??1???1??? 1???????11 000000???? ????0???1? ?1?111??11 111111101{12} 0????????? 110111001? ?????01000 011?100000 1110?00000 00111111?0 0101???111 3301??-?0? 1-1----000 0000?{01}0120 00121001-- 00011---0-1?010100?- 0--1201000 0000000100 10011-2001 0001?00011 1011200000 0??011021{01} {12}000---2-? ?10103---1 10002?002? 00-02????? 0111010122 -20112?020 013??????? ???????012 20121002?0 ?011001?11

Eryops

2{12}00001011 1000010010 1000010010 1000002020 1000100100 0001001(01)01 0101221001 1011101020 0000000110 0100001010 100010000? 20011{01}1110 0001111010 1110011011 3121010002 ????12-000 0110000011 1000000000 0001000100 00(01)1100000 2110000010 1000000001 ???0001000 1?00000000 1000010100 0000001000 0100001000 0001100010 4400110110 0000110000 0010100001 0001000000 0110002001 0010001000 002000001? ??10000001 0011010001 0101010101 0101111100 1000000111 0000000111 1111101211 0010011012 01001101?1 1111200011 0201100010 00(01)0000000 1000000000 0011111100 0001100111 01010000?1 ?1000-0000 00?001??00 00000100?0 0000000000 0000000000 0--1000000 00000010-0 00001?0000 000?1??00? ??0?001?1? ???0110001 0000?00??? ?0???????0 ?0?01?0000 0000000000 001000???? ??????0010 ??00-000?0 00000??012 ?1???0?10? 1???0?000{01}

Limnoscelis

2{12}31011011 1000010030 0111010000 2100002021 1001101011 0010001001 ?000331?01 1010????2? 0010000110 010000131{12} 10100?110? 20{12}021110? 00{01}1111?10 1110010011 2112020002 1110120100 20??011011 1000000000 0000000100 0001100111 21101001?0 0100000001 ???0000000 1?01001000 1000010000 01?1000000 1100000000 0202100000 4411??011? 0001??0000 010??00201 ?000000000 0000002100 0011010010 00200001?? ??100000?? ?1??010101 00????0101 010????100 100002011? ????0101?0 1110101201 0110011012 0111110111 0110100011 0????00100 0001000000 1111100000 0111111100 0001010111 0101010001 0100100001 0000000000 0000100100 0000000001 0110001000 0--1210000 01022010-0 001000111- 0012000100 0010000?0? ?000010000 0000000101 (01)0-0010201 10000?0000 0100200000 0010000000 0001000000 10011000?? 0100?0?002 2101010010 1110001100

Lysorophia

2240221001 101-11-000 001-021202 2{12}00111021 00-101--00 1000002101 1001321001 11-0001103 1111001--0 0100011{15}20 1000110-11 20331111(01)(01) 0011111010 0101?11000 3122020??2 102210--12 20??00001? 1000010001 0000101?10 001100001? ?100110000 1010001??1 ???-???000 000?0001?? ?????11000 1??????1?? 010000??0? 1301000001 44110?0110 000101?000 1??????000 0000000000 1???002100 1010000000 002000021? ??110001?? ?1??010101 ??1???1??? 1???????00 0000020111 01001???1? 0??111??1? 0111110011 0000?0011? 110120001? ?????01100 100?100000 ???000??10 011111??11 0001??0111 3301-----1 110011-1-- 0000000120 00-20001-- 00001---0- 1101110-00 0--1201000 00012000-0 1210002111 0001001001 111100?101 0010010000 1001100111 110203--11 00002?0110 0010200001 0100101121 2001121000 0031100010 1100010011 001(01)11?120 21110??00?

Microbrachis

10?0011011 101-01-010 000-0?0000 2100012021 1001101100 0010001101 0101321001 1010?01020 0000001110 0100011510 1000110-11 2032111100 0111111010 010?01000? 311{12}020?02 11{01}2100111 10??01001? 1101000000 0000001100 0001000011 211?100010 1000000001 ???-???000 0001000000 0?00110000 0101000000 0100002000 020?100000 {23}311100110 0001110000 0111100001 ?000001000 0000002?00 1010001001 002000011? ??10000011 0011010101 0001010101 0101101100 0000020111 21001????? 01?01???01 0111110011 0010100111 1101200010 0????00100 0001100000 1110001?00 0111111111 0001001111 3201--1001 1101100001 0000?00100 00010001-- 0000000011 110000100- 0--0100000 00(01)11000-0 10?00?101- 001-000000 00-1000000 0001010000 0000101001 1100000210 0100210110 0010200000 0110101121 2101100000 0020110-00 010000-102 001100?210 11110??00?

Nectridea

(12)(01)000(012)(13)(01)11(01)0(01)001(01)0(01)00001020(012)002(01)000(01)0021(01)001(01)(01)1000 (01)0(01)(01)(01)011110101121001 1?1(01)????2(23) 1(01)110011(01)0 0(01)00011{15}12 1001210-11 2(01)2(01)111100 0011111010 111?01(01)0?1 310??201?2 1102100110 10??00001? 1001000001 0000001100 0011000010 21101?1??? ??????0101 ???(01)???00? 000?000000 0110010001 0101001000 0100002000 020?100000 4401???111 00{01}1110000 1??????000 0000000000 0000002?10 00100?0000 00200001?? ?????????? ?????????? ?????????? ????????00 0?00020110 00000?111? 11?0????11 0111110012 0100?00112 1?0120001? ?????0?100 00?1011110 1110101?00 0011111100 1001???111 3301(01)-1101 1100100001 0000?00120 000{13}0011-- 0000000000 0120---000 0--0101000 00012000-0 1??11?(012)01- 001?001001 01-0001??? ??00010000 100?0????? ??????01?0 00011?0121 0001201111 0010001012 22?1121000 0?20-000?0 00002??002 2001000010 201000?10{01}

Pantylus

2{12}01011011 100-11-010 000-010000 2100012021 100111--00 0010003111 0100321001 1010???12? 0?00001110 0100011512 10?1110-11 2030111101 0{01}11111010 0100010011 3101020002 ????111001 20??011010 1101000000 0000000100 1001100010 2110110000 1000000101 ???-???000 0100000000 0110110000 0101101000 0100000000 0301100000 4?11000110 0000010000 1??????000 1000000000 0000002100 1010000002 002000011? ??0000001? ?011010101 001???1??? 01111?1100 1000120110 2100000110 0110101211 0110111012 010010011? 1101?000?? ?{12}01100100 0011100000 1110001?00 0111111111 00011001?1 1001--1101 1100100001 0000000001 01011001-- 0000000000 010110000- 0--1010000 00222010-0 1010001102 0002000000 0111000100 11?0000000 1000100011 (01)102020100 00001?0110 1010200000 0110000122 0201110100 0?01111-10 1000201002 2002100110 2110001100

Proterogyrinus

1(01)20001001 000?000011 0001010000 110?001??? ?0001001?0 0010001001 -000111001 1010????20 0001000010 0100001310 0000000000 ?010111100 0001011010 0010010011 2111020002 1??1100000 20??01001? 1000010000 000?000000 0001100010 2110000001 0000000000 0000000010 1?00000000 1000010000 011100?000 0100001100 2203000000 {12}41??0???0 ??00010000 001?000000 1(01)00000000 0000???000 0010010010 10200000?? ??10000011 ?0?1010001 0?0?0?0101 01010??100 1010000111 1000000111 0010101201 0110011(01)11 0110110110 1111200011 0211100100 0000000000 1100000000 0011111100 0001010111 01000000(01)0 0{01}001?0001 0000000?00 0000000000 0000000000 0100000001 0--0000000 00010000-0 0200000000 00????000? 1000000?0? ?000000000 000000000? 00-00{012}0010 00000?0000 0000200001 ?010000000 0000000?00 0000000010 0000002001 20?1010010 1110001000

Rhynchonkos

2{12}4{12}021011 100-01-010 000-010000 2100??0021 0001001-00 10?00010(01)1 1001321001 1010001(01)21 0000001100 0000011312 1001110011 2??221110? 00???11?10 0100?11011 ?1{02}102000{23} 10??101012 20??011010 1000000000 00000001?0 0001200010 2110000000 1010000111 ???-???000 0000100000 0100110000 0101000??? 0100000000 0(12)0?100000 44?1000110 0001000000 0101000000 0000000100 0000002100 1010000001 002000021? ??1100000? 1011010101 001???0110 01?????100 000002???? ?????????? 01?111??11 0111111012 010010011? 1101200010 02?1101100 0011100??? 111010000? ?11111??01 ?001???111 3301--1101 1100100001 0000?00001 02121001-- 0001000010 010010000- 0--1210000 10012000-0 1011012101 0001001001 1011000000 011001000{01} 0000100001 1101010101 10002??02? 00102????? ??10000122 -201121000 1?3??????? ???0????12 2012100{01}10 20100010??

Seymouria

2{12}00011011 1001000020 1001010000 1100002020 1000101110 0012--3111 1111111001 1000102100 0000001110 0100001311 1010000000 2010(12){01}1101 0011111110 1110010001 2112020002 ????12000(01) 20??010011 1000000000 0000000100 0001100010 21100000(01)0 1000000000 1100001000 1?01000000 1000010000 0101001000 1100002000 0201100000 4410100110 0000110000 011110?101 1000000000 0000002000 0010000?12 002000011? ??11000011 1011010101 0001010101 0101111100 1000020110 2?00110111 11101012(01)1 0110011012 0111110111 0110200011 0201100000 0000000000 1111100000 0111111100 0001010111 0100000000 0100100000 0000000000 0001000010 0000000000 0100000000 0--0000000 00012010-0 0000001000 0000000000 001010011? ?010200000 0000000000 (01){01}-2000200 01001?0000 00(01)0200001 0010000000 0001100000 1001100010 0100102002 2101000000 111100?000

Triadobatrachus

2{12}30202-?1 101-011?-- -2--0?12?2 1?0??0???? ?00101-?00 11?1113101 ?11-??2?01 11-?101103 112111?--1 ?-?????{15}11 1001010-11 222110110? 0?11111?10 010?311011 ?23010000? ????1?--01 ?????????? 1????????? ????????11 01???11??? ?0?1??1??? ??????1??1 ???1???1?? ???1???1?? ??????0100 1????????? ?1????11?0 1?0?100000 ?????????1 ???101??10 1??????000 0101100000 0111????01 01100?0000 00210110?? ??????10?? ?1??1???1? ??1???1??? 1????????? ??????011? ????1???1? 01?111??11 1111110011 0100?0111? 000?200010 0{12}0??00000 011?000000 ???0101?00 01111111?1 0001???111 31111---1- -??????0-- 0100?????? ??21???020 -0101---0- 0?20--?-?0 0--12?1??? ?????????? ?0011?0??? ?1????10?? ?1?01?01?0 001011-??{01} 2?0??????? ?0???????? 00103?012- 00?021---- 011010?1?? ?20{01}1?0020 01{03}------- ?-00???012 3001100?{12}1 2-1001?0??

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