APPENDIX I. Character list of the phylogenetic analysis of eureptiles, including autapomorphies. Characters #57-#133 represent an expansion to previous eureptilian character sets and are either new or modified from Laurin and Reisz (1995).

(1) Premaxilla: ventral margin aligned antero-posteriorly (0) or antero-ventrally (1) in lateral view.

(2) Maxilla: relatively straight (0) or posterior end flexed laterally (1).

(3) Maxilla: posteriormost tooth positioned at level of posterior margin of orbit (0) or positioned more anteriorly (1).

(4) Lacrimal: suture with jugal small (0) or well developed (1).

(5) Snout: broad, equal to or greater than 35 % of skull length (0) or narrow, equal to or less than 25 % of skull length (1).

(6) Prefrontal: anterior process short and tall, approximately equal to the posterodorsal process in antero-posterior length (0) or long and narrow, approximately twice the antero-posterior length of the posterodorsal process (1).

(7) Frontal: anterior process short, less than 40 % of the frontal sagittal length (0) or long, approximately 55 % of the frontal sagittal length (1).

(8) Jugal: alary process absent (0), present and positioned no higher than the midpoint of the suborbital process of the jugal and distinct from orbital margin (1), or positioned dorsally on the medial surface of the jugal and flush with orbital margin (2).

(9) Quadratojugal: antero-posteriorly elongate (0) or short, not extending anteriorly beyond midpoint of postorbital margin (1).

(10) Quadratojugal: acuminate (0) or square-tipped (1) anteriorly.

(11) Postorbital cheek: relatively straight (0) or expanded laterally (1).

(12) Supratemporal: contact with postparietal tenuous or absent (0) or well developed (1).

(13) Pineal foramen: positioned at (0) or anterior (1) or posterior (2) to midpoint of

interparietal suture.

(14) Postparietal: contacts mate fully along height (0) or dorsally only, postparietals separated slightly ventrally by supraoccipital (1).

(15) Postparietal: transversely short with tabular present (0) or transversely elongate with tabular absent (1), or postparietal absent (2).

(16) Skull table occipital margin: embayed bilaterally (0), straight (1), or with single median embayment (2).

(17) Ectopterygoid: present (0) or absent (1).

(18) Pterygoid: transverse flange broad-based and distinctly angular (0) or narrow and tongue-like (1) in ventral view.

(19) Parasphenoid: deep ventral groove absent (0) or present (1) between cristae ventrolateralis.

(20) Cultriform process: extends anteriorly (0), extends slightly dorsally at roughly 15 degrees to the basal plane (1), or extends anterodorsally at more than 45 degrees to the basal plane (2).

(21) Supraoccipital: slopes anterodorsally (0), or vertically or rather posterodorsally (1).

(22) Supraoccipital: lateral ascending processes account for half or less (0) or two-thirds or more (1) of the height of the bone.

(23) Occipital condyle: at level of (0) or immediately anterior to (1) quadrate condyles.

(24) Paroccipital process: broad (0) or narrow (1).

(25) Sculpturing: skull surface smooth, with only small honeycombing pits or grooves (0) or with pits and grooves with notably larger, randomly positioned pits on posterior skull table (1).

(26) Mandibular ramus: relatively straight (0) or sigmoidal (1) in ventral view.

(27) Mandibular ramus: narrow, 8 % or less of total jaw length (0) or broad, no less than 14 % of total jaw length (1).

(28) Mandibular ramus: posterior end rectilinear (0) or acuminate (1) in lateral view.

(29) Mandibular ramus: lateral shelf absent (0) or present (1) below coronoid process.

(30) Coronoid: anterior process short (0) or elongate (1).

(31) Meckelian foramen: small, antero-posterior length roughly 9 % or less of total jaw length (0) or large, antero-posterior length greater than or equal to 14 % of total jaw length (1).

(32) Coronoid posterodorsal process: slender, forms dorsalmost quarter of lateral wall of adductor fossa (0) or deep, forms dorsalmost third of lateral wall of adductor fossa (1).

(33) Retroarticular process: absent (0), present and broader transversely than long (1), or present and longer anteroposteriorly than broad (2).

(34) Maxillary dentition: tooth stations number 30 teeth or more (0) or 25 or less (1): for multiple-rowed taxa, only those teeth with unobstructed profiles when viewed laterally are considered.

(35) Maxillary caniniform teeth: present (0) or absent (1).

(36) Multiple tooth rows: absent (0) or present (1).

(37) Marginal dentition: “cheek” teeth conical (0) or chisel-shaped (1).

(38) Dentary: teeth isodont (0), caniniform region present anteriorly (1), or caniniform tooth present anteriorly with caniniform region absent (2).

(39) Dentary: first tooth oriented mainly vertically (0) or leans strongly anteriorly (1).

(40) Antorbital area: mainly formed by lacrimal and prefrontal (0) or mostly by lacrimal due to a strong dorsal expansion of the bone (1).

(41) Orientation of supratemporal: obliquely oriented into anteromedial direction, thereby lying within a facet of the parietal (0) or positioned mediolaterally at the posterior edge of the parietal (1).

(42) Parasphenoid: with (0) or without (1) teeth.

(43) Vomer: with (0) or without (1) teeth.

(44) Palatine: with (0) or without (1) teeth.

(45) Parietal: does not strongly project between postfrontal and postorbital (0) or a distinct anterolateral process partially separates postfrontal and postorbital from one another (1).

(46) Stapes: distal process is short (0) or elongate (1).

(47) Supratemporal: large and mediolaterally expanded (0) or small and narrow (1).

(48) Posterolateral corner of the skull roof: formed mostly by the supratemporal (0) or both by the parietal and the supratemporal (1).

(49) Squamosal contribution to posttemporal fenestra: absent (0), present (1).

(50) Swelling of the dorsal neural arches: present (0), absent (1).

(51) Stylo- and zeugopodium: shaft massive and with proximal and distal heads significantly expanded, resulting in an overall stout impression (0), or shaft slender and heads only moderately expanded (1).

(52) Manus and pes: elements short and broad (0), or long and slender (1).

(53) Neural spines of dorsal vertebrae: tall (0) or low (1).

(54) Nasolacrimal suture: straight (0), or interdigitating (1).

(55) Dentition on pterygoid flange: shagreen of denticles (0), or includes at least one row of functional teeth (1).

(56) Alternation of neural spine height: present (0), absent (1).

(57) Posterolateral frontal process: absent (0), present (1).

(58) Quadratojugal shape: posteriorly straight or decreasing in height (0), or expanded dorsally (1).

(59) Shape of sacral ribs: first sacral rib larger than second rib (0), or both ribs of roughly equal size (1).

(60) Shape of iliac blade: expanded dorsally (0), narrow dorsally (1).

(61) Ectopterygoid: with (0) or without (1) teeth.

(62) Upper temporal fenestra: absent (0), present (1).

(63) Contact between prefrontal and postfrontal: present (0), absent (1).

(64) Anterior extent of jugal: reaches beyond anterior orbital margin (0), or not (1).

(65) Posteriorly facing occipital flange of squamosal: absent (0), present (1).

(66) Supinator process of humerus: not parallel to shaft (0), parallel (1), absent (2).

(67) Presence of only a single coronoid: no (0), yes (1).

(68) Presence of only a single pedal centrale: no (0), yes (1).

(69) Tabular size: well-developed anteroposteriorly (0), narrow and confined to posterior edge of skull roof (1).

(70) Post-temporal fenestra: small or absent (0), well-developed (1).

(71) Postorbital-supratemporal contact: absent (0), present (1).

(72) Supraglenoid foramen: present (0), absent (1).

(73) Axis neural arch: tall (0), or low (1).

(74) Nasal/frontal relationship: nasal longer (0) or equal or shorter (1) than frontal.

(75) Postorbital extent of jugal: shorter than remaining anterior extent (0), or equal or longer (1).

(76) Anteroposterior extent of squamosal: longer than dorsoventral extent (0), or equal or shorter than dorsoventral extent (1).

(77) Ratio between humerus and radius: radius length at about two thirds of humerus length (0), radius length only at about one half of humerus length or less (1), or both roughly equal in length (2).

(78) Ratio between femur and tibia: tibia length at about two thirds of femur length (0), tibia length only at about one half of humerus length or less (1), or both roughly equal in length (2).

(79) Ratio between humerus and femur: femur longer than humerus (0), or humerus and femur at least equal in length (1).

(80) Dorsal expansion of maxilla reducing the contact between lacrimal and naris: absent (0), present (1).

(81) Anterior dorsal centra strongly ventrolaterally constricted: no (0), yes (1).

(82) Ratio between tibia and 4th metatarsal: 4th metatarsal less than half the length of tibia (0), or more than half the length (1).

(83) Ratio between 4th metacarpal and 1st metacarpal: 1st metacarpal more than half the length of 4th metacarpal (0), or less than half the length (1).

(84) Ratio between 4th metatarsal and 5th metatarsal: 5th metatarsal more than half the length of 4th metatarsal (0), or less than half the length (1).

(85) Cervical centra: short (0), or elongate (1).

(86) Well-developed suborbital fenestra: absent (0), present (1).

(87) Lower temporal fenestra: absent (0), present (1).

(88) Enlargement of anterior lateral maxillary foramen: absent (0), present (1).

(89) Temporal emargination formed by squamosal and quadratojugal: absent (0), present (1).

(90) Paroccipital process in contact with supratemporal: no (0), yes (1).

Autapomorphies:

Coelostegus: (91) deep grooves on frontal and parietal.

Brouffia: -

Anthracodromeus: (92) Neural arches anteroposteriorly elongate.

(93) Lateral surface of neural spines sculptured.

Cephalerpeton: -

Protorothyris: -.

Paleothyris: -

Hylonomus: -

Araeoscelis: (94) Teeth enlarged.

Petrolacosaurus: -.

Thuringothyris: -

Concordia: (95) Posterolateral keel on the mandible.

Romeria texana: -

Rhiodenticulatus: -.

Protocaptorhinus: -

Saurorictus: (96) Supratemporal lost.

Labidosaurus: (97) Premaxilla extremely angulated at an angle of 45 degrees.

Labidosaurikos: (98) Premaxillary posterodorsal process short.

(99) Well-developed supratemporal/postparietal contact.

(100) Paroccipital process stutured to stapedial columella.

Millerettidae: (101) Quadrate exposed laterally.

(102) Presence of ventral cranial fissure between basisphenoid and basioccipital.

Procolophonidae: (103) Cranio-quadrate space large.

(104) Pterygoid palatal ramus short.

(105) Cultriform process short.

(106) Supraoccipital plate reduced.

(107) Quadrate condyle articular surfaces flat.

(108) Short Meckelian fossa.

(109) Surangular not reaching coronoid eminence.

(110) Anterior prearticular extent short.

(111) T-shaped interclavicle.

(112) Astragalus and calcaneum suturally fused.

(113) Fifth distal tarsal lost.

(114) Narial shelf present.

(115) Orbit enlarged posteriorly.

(116) Two midventral keels on dorsal vertebral centra.

Mesosauridae: (117) Rostrum elongated.

(118) Teeth extremely slender and elongate.

(119) Neck distinctly elongated.

(120) Ribs pachyostotic.

(121) Additional articulation facets on vertebrae.

Caseidae: (122) Quadratojugal reaches maxilla.

(123) External naris elongated with external narial shelf

(124) Pointed rostrum formed by dorsal process of premaxilla.

(125) External naris tall.

(126) Leaf-shaped tooth crowns.

(127) Phalangeal formula reduced.

Diadectomorpha: (128) Median postparietal.

(129) Otic trough in ventral flange of squamosal.

(130) Axial intercentrum with strong anterior process.

(131) Dorsolateral shelf on iliac blade.

Seymouriamorpha: (132) Presence of otic tube comprised of opisthotic, prootic, and parasphenoid.

(133) Lamina ascendens on pterygoid.

APPENDIX II. Data matrix of the phylogenetic analysis.

1) Diadectomorpha	10110000(01)0	0020020000	0000000000	1001000110	01(01)10?0000
	00110(01)0(01)00	100(01)00(01)000	1000100000	0010000000	0000000000
	0000000000	0000000000	000000111100		
2) Seymouriamorpha	0011000000	0000010000	??10000000	0000000100	0100000?00
	0011?00000	1000000000	0000000000	0000000000	0000000000
	0000000000	0000000000	000000000011		
3) Caseidae	1000000000	0010000000	0000000001	000110?000	0000000001
	0000110010	0011100000	1000110011	0010001000	0000000000
	0000000000	0000000000	111111000000		
4) Mesosauridae	0010000000	000?221000	000?000100	??10100010	0100100000
	1000011010	?011121101	1100001101	0100000000	0000000000
	0000000000	0000011111	000000000000		
5) Millerettidae	0010000011	0020020000	0000000000	0011100000	0000100001
	011011(01)100	1011111111	1101010001	001100(01)111	0000000000
	1100000000	0000000000	000000000000		
6) Procolophonidae	0111000000	1010100100	0000000100	0011100000	0100(01)10000
	0010?11100	10101111?1	1101010011	0011000111	0000000000
	0011111111	1111100000	000000000000		
7) *Romeria texana*	110?010?10	001010?000	0?0??0000?	??01000100	0?10111111?
	????0?01??	?0111????1	0??111???0	?????00000	0000000000
	0000000000	?0?0?0000?	00000?00??00		
8) *Protocaptorhinus*	1101000110	001111?000	000000000?	??11000?00	1???011110
	0011000(01)?1	?01012???1	000111???0	????000000	0??0000000
	0000000000	?0?0000000	00000?000?00		
9) *Rhiodenticulatus*	1101010101	0011111000	?00??00001	???1000101	?1?1111110
	00110?(01)01?	?01012111?1	0??111?100	0???000000	0000000000
	0000000000	0000000000	000000000000		
10) *Captorhinus laticeps*	1111000201	1011121111	0000000101	0021001110	1110111110
	0011000000	?01012111?1	0001110000	0000000000	0000000000

	0000000000	0000000000	000000000000		
11) *Captorhinus aguti*	1111000201	1011121111	0000000101	0021011110	1110111110
	0011000000	?01012l1?1	0001110000	0000000000	0000000000
	0000000000	0000000000	000000000000		
12) *Labidosaurus*	1111111101	1111121112	1111111111	1111101200	1???011110
	0011000000	?01012l1?1	0001111000	0010000000	0000001000
	0000000000	0000000000	000000000000		
13) *Labidosaurikos*	1111111101	1111121112	1111111110	1111111200	1111011111
	???10?00??	?0101?1??1	0??111???0	?????00000	0??0000111
	0000000000	???0?00???	00000000??00		
14) *Saurorictus*	?111000?01	0?011?????	0???00????	???1000100	????0??11?
	??????00??	?0101????1	0??101???0	??????0100	0??00100??
	0?0??00?0?	???0?00000	00000?00????		
15) *Concordia*	001101000?	0010101000	000000000?	??01000001	000010111?
	???10?0???	?0101?1??1	0??111???0	?????00000	0??0100000
	0000000?0?	???0?00???	00000?00??00		
16) *Protorothyris*	0000000000	0001000000	0000000000	0000000000	0100101111
	1100111111	1011111?11	000101???1	1???000000	0000000000
	0000000000	0000000000	000000000000		
17) *Paleothyris*	0000010000	002000?000	000000000?	??00000000	0010001111
	1110110011	?011111111	0011010000	1111000000	000000000?
	0000000000	0000000000	000000000000		
18) *Cephalerpeton*	0000000001	0????000??	?0????00??	??11000100	??000????1
	110011?1??	00111????1	0001010??0	1???000?0?	0000?0??0?
	0?0??00000	???0000000	00000?000???		
19) *Anthracodromeus*	????????00	000000????	00000??1??	??0???????	0?????1111
	110??1?100	?0??1??11?	0?0??1111?	11000?0?00	011?00??0?
	0?0??00???	?0000??000	0?????0000??		
20) *Brouffia*	00100?0000	0020010000	000000000?	??01000000	00?01?1111
	111?1110?1	00111???11	00?1110000	1?0?000?00	000000??0?
	0?0000??0?	0??0000000	000000000000		

21) *Coelostegus*	?0??010?10	002002????	00100?????	????00???0	0???100001
	??00?11001	?01?1???11	0000?0???0	1???0?000?	1000?0??0?
	000??00?0?	0??0000000	00000?00000?		
22) *Hylonomus*	00100000??	0??001?00?	000?0000?0	??00000100	?000?0???1
	111?0????1	?011111111	0?11010100	11?0000000	000000000?
	0?00000?0?	0000000000	000000000000		
23) *Thuringothyris*	0001010010	0011000000	00000000??	??01100??1	01?0101111
	00100100??	001011?111	0??1010000	1110000000	000000000?
	0000000?00	0000000000	000000000000		
24) *Petrolacosaurus*	001000000?	000000011?	0000000000	0000000000	0000001110
	1100101?01	1111111111	0011012200	1011111000	0000000000
	0000000000	0000000000	000000000000		
25) *Araeoscelis*	0010000000	001000011?	0000000000	0001000000	01?1001110
	1100101101	0111111111	0011012200	1011110000	0001000000
	0000000?00	0000000000	000000000000		