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SUPPLEMENTARY ONLINE MATERIAL FOR

The brachyopoid *Hadrokkosaurus bradyi* from the early Middle Triassic of Arizona, and a phylogenetic analysis of lower jaw characters in temnospondyl amphibians

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CHARACTER LIST

All characters that relate to a specific bone or structural complex of the lower jaw are listed together under the same heading (abbreviated with an italicised acronym in brackets). Each acronym is followed by an italicised number and the combination of acronyms and numbers will permit recognition of the same character (i.e. its formulation) in all future versions (amended, expanded, or otherwise) of the data matrix. Bold numbers mark the position of each character in the data matrix below. For each character, we indicate the literature source from which it is taken in the form of capital letters (authors' initials) and a number (position of the character in the original list): BL, Bolt and Lombard 2001; CA, Clack and Ahlberg 2004; RC, Ruta and Coates 2007. A question mark indicates unclear equivalence of characters in the original list with characters in the list below; the *p* symbol indicates only partial equivalence.

Adsymphysial (ADS)

1. *ADS 1.* Adsymphysial present (0) or absent (1). [BL3; CA27; RC188]

2. *ADS 2.* Adsymphysial without (0) or with (1) fangs. [BL16(?*p*); CA32; RC189]

3. *ADS 3.* Adsymphysial without (0) or with (1) row of teeth oriented subparallel to and approximately equal in size to adjacent marginal dentary teeth. [BL17+18; CA31; RC190]

4. *ADS 4.* Adsymphysial with (0) or without (1) either a continuous shagreen or discrete patches of denticles. [BL19(?); CA30; RC191]

5. *ADS 5.* Adsymphysial not contributing (0) or contributing (1) to symphysis. [BL4]

Dentary (DEN)

6. *DEN 2.* Dentary with (0) or without (1) anterior fangs lying close to symphysial region, and either internal (mesial) or in line with marginal dentary teeth. [BL136; CA21; RC193]

7. *DEN 3.* Dentary without (0) or with (1) 'chamfered' ventral margin in lateral aspect. [CA17; RC194]

8. *DEN 5.* In lateral aspect, ventral margin of dentary forming smoothly convex continuous line (0) or with 'stepped' profile (1). [CA52]

9. *DEN 6.* In lateral aspect, dorsal margin of dentary postdental process continuous with (0) or ventral to (1) dorsal margin of surangular. [BL125(*p*)]

10. *DEN 9.* Dentary postdental process extending posteriorly to the level of posterior one-third (0), middle one-third (1), or anterior one-third (2) of total length of adductor fossa. [BL126(*p*)]

11. *DEN 10.* Dentary postdental process not extending (0) or extending (1) posteriorly to the level of the surangular crest (if present).

12. *DEN 11.* In lateral aspect, projected depth of dentary at the level of symphysial region larger than (0), smaller than (1), or subequal to (2) projected depth of dentary at the level of its rearmost tooth-bearing portion.

13. *DEN 12.* Dentary posterior extremity extending (0) or not extending (1) posteriorly to the level of the rearmost surface of the angular in lateral aspect.

14. *DEN 13.* Symphysial articulation region of dentary not brassicate (0) or brassicate (1). [BL107(*p*)]

15. *DEN 14.* Dentary postdental process extending posterior to (0), anterior to (1), or to the level of (2) surangular mid length in lateral aspect.

16. *DEN 15.* In lateral aspect, dentary postdental process extending to the level of/posterior to (0) or anterior to (1) rearmost part of lateral exposure of coronoid 3, if present.

17. *DEN 16.* Dentary oral sulcus absent (0) or present (1). [BL144]

18. *DEN 17.* Unsculptured dorsal strip on labial surface of dentary absent (0) or present (1). [BL133]

19. *DEN 18.* In lateral aspect, marked upward curvature of anteriormost part of dentary present (0) or absent (1) when the angular is oriented approximately horizontally.

20. *DEN 19.* In lateral aspect, strongly sinuous dorsal margin of dentary absent (0) or present (1).

21. *DEN 20.* Absence (0) or presence (1) of condition: in lateral aspect, dorsal and ventral margins of dentary subparallel for most of the length of the bone.

Splenial (SPL)

22. *SPL 2.* In mesial aspect, rearmost portion of splenial closer to posterior margin of symphysial articulation region (0) or to anterior margin of adductor fossa (1). [BL207(?*p*); RC198]

23. *SPL 5.* Splenial contribution to symphysis present (0) or absent (1). [BL203]

24. *SPL 6.* Lateral line on splenial present (0) or absent (1). [BL213; CA45(*p*); RC121(*p*)]

25. *SPL 7.* Degree of enclosure of splenial lateral line canal: entirely enclosed (0); short sections only in open grooves (1); mostly in open grooves (2); entirely in open grooves (3). [BL214; CA46(*p*); RC121(*p*)]

26. *SPL 8.* In mesial aspect, medially directed, free anterior ventral flange of splenial present (0) or absent (1). [BL206; CA43]

27. *SPL 9.* Splenial ventrolateral exposure conspicuous (0) or barely visible (1). [BL208(*p*)]

28. *SPL 10.* In lateral aspect, splenial contact with postsplenial simple (0) or interdigitating (1).

29. *SPL 11.* Splenial mesial lamina not expanding (0) or expanding (1) rapidly in depth anteroposteriorly, thus forming a wedge-like, approximately triangular sheet of bone.

30. *SPL 12.* Splenial mesial lamina with (1) or without (0) longitudinal ridge situated immediately posterior to symphysis and running approximately anteroposteriorly along the dorsal margin of the lamina, close to its sutural contact with the coronoids.

Postsplenial (PTS)

31. *PTS 2.* Postsplenial mesial lamina absent (0) or present (1). [BL176; CA34; RC202]

32. *PTS 3.* Pit line on postsplenial present (0) or absent (1). [CA48; RC203]

33. *PTS 4.* Postsplenial ventrolateral exposure comparable in length with (0) or greater than (1) splenial ventrolateral exposure. [BL207(*p*)]

34. *PTS 5.* In lateral aspect, postsplenial ventrolateral exposure comparable in depth (0), larger than (1), or smaller than (2) depth of the dentary at the triple joint between dentary, postsplenial, and angular.

35. *PTS 6.* Lateral line on postsplenial present (0) or absent (1). [BL185; CA45(*p*); RC121(*p*)]

36. *PTS 7.* Degree of enclosure of postsplenial lateral line canal: entirely enclosed (0); short sections only in open grooves (1); mostly in open grooves (2); entirely in open grooves (3). [BL186; CA46(*p*); RC121(*p*)]

37. *PTS 8.* In lateral aspect, postsplenial contact with angular simple (0) or interdigitating (1).

Angular (ANG)

38. *ANG 2.* Angular mesial lamina absent (0) or present (1). [BL28; CA3; RC205]

39. *ANG 5.* In lateral aspect, ventral margin of angular smoothly curved (0) or nearly straight for most of its length (1).

40. *ANG 6.* Intense sculpture of incipient node-like protuberances or spines on angular ventrolateral surface absent (0) or present (1).

41. *ANG 7.* In lateral aspect, projected ventrolateral margin of angular less than (0) or more than/equal to (1) half of the jaw length.

42. *ANG 8.* Maximum depth of angular mesial lamina more (0) or less (1) than one-third of depth of adjacent surface of prearticular. [BL29(*p*)]

43. *ANG 9.* In lateral aspect, maximum depth of angular located in the middle one-third (0), posterior one-third (1), or anterior one-third (2) of the bone.

44. *ANG 10.* In lateral aspect, maximum depth of angular subequal to/smaller than (0) or greater than (1) maximum depth of surangular. [BL29(*p*); RC210(*p*)]

45. *ANG 11.* In lateral aspect, posterior margin of angular (i.e. portion of the lateral profile of the bone that lies immediately posterodorsal to its point of greatest curvature) smoothly convex (0) or straight (1).

46. *ANG 12.* In lateral aspect, maximum depth of angular greater than (0) or subequal to/smaller than (1) maximum depth of dentary.

47. *ANG 13.* In lateral aspect, angular contact with dentary simple and smooth (0) or irregular and interdigitating (1). [BL27(?*p*)]

48. *ANG 14.* In lateral aspect, angular contact with dentary shorter than (0), subequal to (1), or longer than (2) angular contact with surangular.

49. *ANG 15.* Lateral line on angular present (0) or absent (1). [BL43; CA45(*p*); RC121(*p*)]

50. *ANG 16.* Degree of enclosure of angular lateral line canal: entirely enclosed (0); short sections only in open grooves (1); mostly in open grooves (2); entirely in open grooves (3). [BL44; CA46(*p*); RC121(*p*)]

51. *ANG 17.* In lateral aspect, angular contact with surangular simple (0) or interdigitating (1).

Surangular (SAN)

52. *SAN 6.* Surangular crest absent (0) or present (1). [BL149(*p*)+217(*p*); CA44]

53. *SAN 7.* In lateral aspect, anteriormost portion of surangular (ventral to dentary postdental process) extending (0) or not extending (1) as far anteriorly as dentigerous portion of dentary.

54. *SAN 8.* In lateral aspect, surangular surface occupying more (0) or less (1) than 40 per cent of total projected length of lower jaw.

55. *SAN 9.* In lateral aspect, anteroposterior profile of surangular crest asymmetrical (0) or symmetrical (1).

56. *SAN 10.* Participation of dentary in the formation of surangular crest present (0) or absent (1).

57. *SAN 11.* In lateral aspect, rearmost portion of surangular dorsal margin lying dorsal to (0), at the same level as (1), or ventral to (2) posterior end of dentary postdental process.

58. *SAN 12.* In lateral aspect, dorsal profile of surangular posterior to crest (if present) sloping anteroventrally and straight (0), smoothly convex upwards in at least its anterior tract (1), straight for most of its length and sloping slightly posteroventrally (2), or gently concave (3).

59. *SAN 13.* Mandibular lateral line canal on surangular present (0) or absent (1). [BL225; CA45(*p*); RC121(*p*)]

60. *SAN 14.* Enclosure of surangular lateral line canal: entirely enclosed (0); short sections only in open grooves (1); mostly in open grooves (2); entirely in open grooves (3). [BL226; CA46(*p*); RC121(*p*)]

61. *SAN 15.* Accessory lateral line sulcus on surangular absent (0) or present (1). [CA45(*p*); RC121(*p*)]

62. *SAN 16.* Oral lateral line sulcus on surangular absent (0) or present (1). [CA45(*p*); RC121(*p*)]

Prearticular (PEA)

63. *PEA 1.* Prearticular centre of radiation situated at the level of posterior end of coronoid 3 (0), coinciding approximately with the middle of adductor fossa length (1), or situated at the level of posterior end of adductor fossa (2). [CA36]

64. *PEA 2.* In medial aspect, prearticular extending anteriorly at least as far as the level of mid point of coronoid 2 (0) or not extending/barely extending anterior to the level of contact between coronoids 2 and 3 (1).

65. *PEA 4.* Prearticular-surangular contact absent (0) or present (1). [BL191; CA39]

66. *PEA 5.* Prearticular-splenial contact present (0) or absent (1). [BL188; CA40; RC211]

67. *PEA 6.* Denticle field on prearticular consisting of scattered patches (0), defined edges (1), or absent (2). [BL201(*p*); CA41+42]

68. *PEA 7.* Strong flange-like medial inflection along upper part of prearticular mesial surface absent (0) or present (1). [CA38]

69. *PEA 8.* Hamate process on prearticular absent (0) or present (1).

70. *PEA 9.* Constriction between dorsal and ventral margins in the posterior part of prearticular mesial surface absent (0) or present (1).

71. *PEA 10.* Prearticular extending in front of adductor fossa anterior margin for more (0) or less (1) than 50 percent of entire prearticular length. [BL192(?*p*)]

72. *PEA 11.* Length of portion of prearticular in front of anterior margin of adductor fossa occupying more than half (0), approximately half (1), or less than half (2) of jaw ramus projected length in front of the fossa (0). [BL192(?*p*)]

73. *PEA 12.* Length of portion of prearticular in front of anterior margin of adductor fossa longer (0) or shorter (1) than adductor fossa. [BL192(?*p*)]

74. *PEA 13.* Chorda tympani foramen not discernible (0), present and straddling articular-prearticular suture (1), present on prearticular only (2), or present on articular only (3).

75. *PEA 14.* Longitudinal dorsal ridge on prearticular absent (0) or present (1). [CA37]

76. *PEA 15.* Mesially projecting flange close to dorsal edge of prearticular along posteromesial border of adductor fossa absent (0) or present (1). [CA38]

77. *PEA 16.* Prearticular border to adductor fossa convex (0), straight (1), or concave (2) for most of its length. [BL194(*p*)]

Coronoid 1 (CO1)

78. *CO1 2.* Fangs on coronoid 1 present (0) or absent (1). [BL70; CA11(?*p*); RC213]

79. *CO1 3.* Denticles on coronoid 1 present (0) or absent (1). [BL73; CA8(*p*); RC214]

80. *CO1 4.* Coronoid 1 with (0) or without (1) anteroposterior row of teeth oriented subparallel to marginal dentary teeth and the size of which is 30 per cent or more than that of marginal dentary teeth and twice or more than that of denticles, if present. [BL72; CA9(*p*); RC215]

81. *CO1 5.* Coronoid 1-prearticular contact present (0) or absent (1). [BL64]

82. *CO1 6.* Coronoid 1-splenial contact absent (0) or present (1). [BL66; CA5; RC199]

83. *CO1 7.* Coronoid 1-coronoid 2 contact smooth (0) or interdigitating (1). [BL59]

Coronoid 2 (CO2)

84. *CO2 2.* Fangs on coronoid 2 present (0) or absent (1). [BL86; CA12(?*p*); RC217]

85. *CO2 3.* Denticles on coronoid 2 present (0) or absent (1). [BL89; CA8(*p*); RC218]

86. *CO2 4.* Coronoid 2 with (0) or without (1) anteroposterior row of teeth oriented subparallel to marginal dentary teeth and the size of which is 30 per cent or more than that of marginal dentary teeth and twice or more than that of denticles, if present. [BL87; CA9(*p*); RC219]

87. *CO2 5.* Coronoid 2-splenial contact absent (0) or present (1). [CA6; RC200]

88. *CO2 6.* Coronoid 2-coronoid 3 contact smooth (0) or interdigitating (1). [BL77]

89. *CO2 7.* Denticle-bearing blade-like ridge on coronoid 2 absent (0) or present (1).

Coronoid 3 (CO3)

90. *CO3 3.* Denticles on coronoid 3 present (0) or absent (1). [BL99; CA8(*p*); RC222]

91. *CO3 4.* Coronoid 3 with (0) or without (1) anteroposterior row of teeth oriented subparallel to marginal dentary teeth and the size of which is 30 per cent or more than that of marginal dentary teeth and twice or more than that of denticles, if present. [BL97; CA9(*p*); RC223]

92. *CO3 5.* Posterodorsal process of coronoid 3 absent (0) or present (1). [BL101(?*p*); CA7; RC224]

93. *CO3 6.* In lateral aspect, coronoid 3 not visible (0) or visible (1). [BL102(?*p*); RC225]

94. *CO3 7.* Posterodorsal process of coronoid 3 not contributing (0) or contributing (1) to tallest point of adductor fossa lateral margin (‘surangular’ crest). [BL102(?*p*); RC226]

95. *CO3 8.* Posterodorsal process of coronoid 3 not extending (0) or extending (1) posteriorly for more than half of adductor fossa length.

Articular (ART)

96. *ART 1.* Glenoid surface of articular with subcentral anteroposterior ridge delimiting lateral and mesial depressions (0) or with simple trough between condyloid processes (1). [BL53]

Adductor fossa (ADF)

97. *ADF 1.* Lateral and mesial margins of adductor fossa lying approximately at the same horizontal level (0) or mesial margin ventral to lateral margin (1). [CA50; RC227]

Jaw articulation (JAT)

98. *JAT 2.* Absence (0) or presence (1) of postglenoid area, that is an extension of lower jaw dorsal surface behind articular posterior margin. [BL160]

99. *JAT 3.* Postglenoid area length less than (0) or at least two-thirds (1) of glenoid length.

100. *JAT 4.* In lateral aspect, postglenoid area without (0) or with (1) transversely oriented dorsal trough. [BL161]

Teeth (TEE)

101. *TEE 1.* Pedicely on dentary teeth absent (0) or present (1). [RC228]

102. *TEE 3.* Dentary teeth without (0) or with (1) two labiolingually arranged cuspules. [RC229]

103. *TEE 5.* Dentary teeth not larger (0) or larger (1) than maxillary teeth. [RC231]

104. *TEE 6.* Dentary teeth without (0) or with (1) chisel-shaped crown tip. [RC232]

105. *TEE 10.* Dentary teeth homodont (0) or heterodont (1) crown morphology. [CA19; BL142]

106. *TEE 11.* Dentary teeth not exhibiting (0) or exhibiting (1) pseudocanine peak in anterior end of bone.

107. *TEE 12.* Number of dentary teeth: more than 70 (0); between 50 and 70 (1); between 30 and 50 (2); fewer than 30 (3).

108. *TEE 13.* Accessory tooth row posterior to dentary fangs absent (0) or present (1). [CA20]

Posterior Meckelian foramen (PMF)

109. *PMF 1.* Length of posterior Meckelian foramen/fenestra less (0) or more (1) than two-thirds of adductor fossa length.

110. *PMF 2.* Dorsal margin of posterior Meckelian foramen bordered by: Meckelian bone (0); prearticular only (1); infradentary only (2); prearticular plus coronoid 3 (3). [BL184(*p*)+199(*p*); CA25(*p*)]

111. *PMF 3.* Depth of posterior Meckelian foramen less than (0) or equal to/greater than (1) depth of adjacent portion of prearticular. [CA26]

112. *PMF 4.* Posterior Meckelian foramen subcircular to elliptical (0) or greatly elongate and slit-like (1).

113. *PMF 5.* Ventral margin of posterior Meckelian foramen not delimited by infradentaries (0), involving angular only (1), involving angular plus postsplenial (2), opening inside infradentary (3), or involving postsplenial only (4). [BL184(*p*); CA25(*p*)]

114. *PMF 6.* Depth of posterior Meckelian foramen less than (0) or equal to/greater than (1) two-thirds of depth of rearmost part of lower jaw dentigerous portion.

Anterior Meckelian Foramen (AMF)

115. *AMF 1.* Anterior Meckelian foramen/fenestra on postsplenial mesial lamina present (0) or absent (1). [BL158(*p*)]

116. *AMF 2.* Anterior Meckelian foramen situated on middle one-third (0) or anterior one-third (1) of postsplenial mesial lamina.

117. *AMF 3.* Depth of anterior Meckelian foramen less (0) or more than (1) half of depth of postsplenial mesial lamina at the same level.

118. *AMF 4.* Anterior Meckelian foramen not forming (0) or forming (1) notch in posterior part of splenial (1).

Meckelian ossification (MEC)

119. *MEC 1.* Meckelian element ossified in middle part of lower jaw (0) or poorly/not ossified (1) in this location. [BL174; CA23]

Sculpture (SCU)

120. *SCU 1.* Lower jaw external sculpture consisting mostly of vermicular, low ornament (0), forming a pit-and-ridge pattern (1; ‘temnospondyl-like type’), forming shallow grooves and ridges (2; ‘anthracosaur-like’ type), or almost absent (3). [BL21+22+131+132+133+162+163+182+183+209+210+220+221+222; CA49(*p*)]

General lower jaw features (GEN)

121. *GEN 1.* Length of adductor fossa more than (0) or less than/equal to (1) two-thirds of length of jaw ramus anterior to fossa. [BL165]

122. *GEN 2.* In lateral aspect, profile of postglenoid region positive (1), null (0) or negative (2); i.e. posterior extremity of process lying above, level with, or below mid line of process, respectively; the mid line is perpendicular to, and bisects, a vertical line passing through the posterior margin of the glenoid when the jaw ramus is observed in mesial view (Jupp and Warren 1986).

123. *GEN 3.* Dorsal apex of hamate process not situated (0) or situated (1) above the level of the postglenoid area in mesial view.

124. *GEN 4.* Hamate process dorsal margin smoothly curved (0) or irregular/acuminate (1).

125. *GEN 5.* Absence (0) or presence (1) of *crista muscularis* on postglenoid area (Damiani 2001; Morales and Shishkin 2002).

126. *GEN 6.* Absence (0) or presence (1) of *crista medialis* on postglenoid area (Damiani 2001; Morales and Shishkin 2002).

127. *GEN 7.* Absence (0) or presence (1) of condition: in mesial aspect, articular glenoid surface forming deep excavation along adjacent part of prearticular dorsal margin.

128. *GEN 8.* Combined length of coronoids 1 and 2 greater than (0) or subequal to/less than (1) length of coronoid 3.

129. *GEN 9.* Absence (0) or presence (1) of anterior and posterior carinae on dentary teeth.

130. *GEN 10.* Outline of adductor fossa: subelliptical (0) or tapering rapidly anteriorly and subtriangular (1).

131. *GEN 11.* Absence (0) or presence (1) of posterior triangular projection of articular deeply wedged between surangular and prearticular on postglenoid area (Jupp and Warren 1986).

132. *GEN 12.* In lateral view, absence (0) or presence (1) of flange-like bony sheet projecting from dorsal surface of posterodorsal process of coronoid 3.

DATA MATRIX

All characters are arranged in groups of 10 and numbered from left to right. Unknown and inapplicable character-states are indicated by '?'. Letters replace polymorphic and uncertain character-state assignments; thus, denoting polymorphism with the '&' separator and uncertainty with the '/' separator, the following replacements were made: 0&1 = a; 0/1 = b; 0&2 = c; 0/2 = d; 0&3 = e; 1&2 = f; 1/2 = g; 1&3 = h; 2/3 = i; 2/4 = j; 1/2/3/4 = k.

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0000001000 0000101110 0001100001 000???00?? 0000001001 0000????10
1?????0000 ??

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0?????0000 ?0
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Balanerpeton woodi

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Bathignathus poikilops

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Benthosuchus sushkini

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Cheliderpeton latirostre

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Chomatobatrachus halei

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Cochleosaurus bohemicus

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Cochleosaurus florensis

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Compsocerops cosgriffi

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Dutuitosaurus ouazzoui

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Dvinosaurus primus

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Ecolsonia cutlerensis

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Edops craigi

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Eryops megacephalus

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Hadrokkosaurus bradyi

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Inflectosaurus amplus

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Karroosuchus haughtoni

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Koolasuchus cleelandi

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Kupferzellia wildi

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Lydekkerina huxleyi

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Mastodonsaurus giganteus

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Micromelerpeton credneri

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Onchiodon labyrinthicus

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Phonerpeton pricei

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Rhineceps nyasaensis

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Sclerocephalus haeuseri

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Siderops kehli

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Thoosuchus yakovlevi

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Trimerorhachis insignis

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Tryphosuchus paucidens

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Vanastega plurimidens

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Xenotosuchus africanus

1????00111 ?110200?00 1101?11000 11121?0100 1010000203 0011??2103
1121012010 1211002111 1101111?01 111?001110 0000000101 0021010111
10??110000 00

Zatrachys serratus

1????10112 011?110010 10?1??1000 11121?1111 0?00101 01? 111101121?
00????200? 12120?2101 ???101??00 11110?10?? 0000002?01 0010010011
1?????0000 ?0

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Micromelerpeton credneri (Boy 1995); NMS987GF65.1 (Godfrey and Holmes 1989); *Occidens portlocki* (Clack and Ahlberg 2004); *Onchiodon labyrinthicus* (Boy 1990); *Panderichthys rhombolepis* (Ahlberg and Clack 1998); *Pantylus cordatus* (Carroll and Gaskill 1978); **Pholiderpeton scutigerum* (Clack 1987); **Phonerpeton pricei* (Dilkes 1990); *QMF14493 (Damiani and Warren 1996); **Rhineceps nyasaensis* (Watson 1962); *Sclerocephalus haeuseri* (Boy 1988); *Siderops kehli* (Warren and Hutchinson 1983); **Sigournea multidentata* (Bolt and Lombard 2006); **Spathicephalus mirus* (Beaumont and Smithson 1998); *Thoosuchus yakovlevi* (Efremov 1940); **Trimerorhachis insignis* (Case 1935); *Tryphosuchus paucidens* (Konzhukova 1955); *Vanastega plurimidens* (Damiani and Kitching 2003); *Ventastega curonica* (Ahlberg et al. 1994); **Whatcheeria deltae* (Ahlberg and Clack 1998; Lombard and Bolt 2006); *Xenotosuchus africanus* (Morales and Shishkin 2002); *Zatrachys serratus* (Langston 1953).

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SUPPLEMENTARY INFORMATION ON PHYLOGENETIC ANALYSIS

Character-state changes subtending temnospondyl node – Postdental process of dentary lying ventral to dorsal margin of surangular; rearmost portion of splenial mesial lamina closer to symphysis than to adductor fossa in mesial aspect; anteriormost part of lateral surface of surangular (ventral to posterior ramus of dentary) not extending anteriorly to level of tooth-bearing portion of dentary; in lateral aspect, dorsal profile of surangular gently concave posterior to level of surangular crest (if present); posterodorsal process of coronoid 3 not contributing to tallest point of lateral margin of adductor fossa; anterior Meckelian foramen not opening on posterior part of mesial lamina of splenial.

Experiments with topological constraints. – If we constrain brachyopids (including *Hadrokkosaurus*) to form a clade, and search for the shortest trees that are compatible with this constraint, then PAUP* finds 132 trees at

748 steps, the topology of which does not differ significantly from that of the shortest trees overall (Templeton's test; $p >> 0.05$). In each of these suboptimal trees, chigutisaurids are paraphyletic, with *Siderops* and a clade formed by *Compsocerops* and *Koolasuchus* as successive sister taxa to brachyopids; furthermore, *Bathignathus* is sister taxon to remaining brachyopids, which are collapsed in a trichotomy in the strict consensus. If we enforce monophyly for both brachyopids and chigutisaurids, then PAUP* delivers 322 trees 750 steps long that are not significantly different from the shortest trees. In the strict consensus of these 322 trees, brachyopids and chigutisaurids are unresolved sister groups. Also, there are 31 trees at 748 steps that do not show brachyopoids as a monophyletic group. In all experiments with suboptimal trees, the basic tree statistics are similar to those of the most parsimonious trees and thus are not reported for brevity. Finally, after imposing topological constraints on the data set in order to reflect Milner's (1990) and Schoch and Milner's (2000) phylogenetic arrangement for major clades of temnospondyls, we re-ran a PAUP* analysis. This new analysis found five trees at 800 steps (C.I. = 0.201; R.I. = 0.537; R.C. = 0.108). These trees represent a significantly worse fit for the data than the 38 most parsimonious trees (Templeton's test; $p < 0.0001$).