

JOURNAL OF VERTEBRATE PALEONTOLOGY

SUPPLEMENTARY INFORMATION

A new aetosaur (Archosauria, Stagonolepididae) from the Upper Triassic Pekin Formation, Deep River Basin, North Carolina, U.S.A. and its implications for early aetosaur evolution

ANDREW B. HECKERT,<sup>\*1</sup> VINCENT P. SCHNEIDER,<sup>2</sup> NICHOLAS C. FRASER,<sup>3,4</sup>  
and RICHARD A. WEBB<sup>2</sup>

<sup>1</sup>Department of Geology, Appalachian State University, ASU Box 32067, Boone, North Carolina 28608-2067, U.S.A., heckertab@appstate.edu;

<sup>2</sup>North Carolina Museum of Natural Sciences, 11 West Jones Street, Raleigh, North Carolina, 27601, U.S.A., vince.schneider@ncdenr.gov;

<sup>3</sup>National Museums Scotland, Chambers Street, Edinburgh EH1 1JF, U.K.,  
Nick.Fraser@nms.ac.us;

<sup>4</sup>Virginia Museum of Natural History, 23 Starling Avenue, Martinsville, VA 24112, U.S.A., [Nick.Fraser@vmnh.virginia.gov](mailto:Nick.Fraser@vmnh.virginia.gov)

\*Corresponding author.

## DESCRIPTION OF MODIFICATIONS AND ADDITIONS TO THE PARKER (2007)

### DATA MATRIX

As noted in the text, we accepted the scoring of *Sierritasuchus* by Parker et al. (2008), the scoring of *Aetobarbakinoides*, and the character state scoring modifications proposed by Desojo et al. (2012) for the matrices presented by Parker (2007) and Parker et al. (2008). We then made the following character state scoring modifications, based on our interpretation of the text and figures of Parker and Martz (2010), our examination of casts of *Longosuchus* and *Lucasuchus*, and our ongoing evaluation of a specimen of *Coahomasuchus* (NCSM 23168) under study by the authors (Fraser et al., 2006; Schneider et al., 2011; Heckert et al., 2012). Additionally, we modified several character state scorings for *Typothorax* based on A.B.H.'s observations of many specimens of *T. coccinarum*, including the 'Badlands Ranch' specimen (NMMNH P-56299) described by Heckert et al. (2010); some of these changes were confirmed by consulting with W. Parker (pers. comm., 2013). These changes are outlined in the following paragraphs.

**Institutional Abbreviations**—**AMNH**, American Museum of Natural History, New York; **NCSM**, North Carolina Museum of Natural Sciences, Raleigh; **NMMNH**, New Mexico Museum of Natural History and Science, Albuquerque; **TMM**, Texas Memorial Museum, Austin.

### ***Lucasuchus***

We make the following scoring change to *Lucasuchus* in the matrix based on our reading of Parker and Martz (2010) and our own observations of casts of TMM specimens and the literature.

Character 19 (Parker, 2007 coded as ?). The boss on paramedian osteoderms assigned to *Lucasuchus* is larger than that of *Longosuchus* (coded as 1 by Parker, 2007) according to Parker and Martz (2010), so we change the coding of this character from '?' to '1' in *Lucasuchus*.

### ***Longosuchus***

We make the following scoring changes to *Longosuchus* in the matrix based on our reading of Parker and Martz (2010) and our own observations of casts of TMM specimens and the literature.

Character 16 (Parker, 2007 scored as 0). The presence of radiate (0) or random (1) ornamentation on the dorsal paramedians was identified as random by Parker and Martz (2010), so we change the coding of this character from '0' to '1' in *Longosuchus*.

Character 17 (Parker, 2007 scored as 0). The presence of pits and grooves (0) or pits (1) on the dorsal paramedian osteoderms was scored as '0' by Parker (2007) but appears to be '1' (see also Parker and Martz, 2010), so we change the coding of this character from '0' to '1' in *Longosuchus*.

Character 20 (Parker, 2007 scored as 0). Ventral keel absent (0) or present (1) casts of *Longosuchus* show an incipient keel, and the character is probably problematic due to positional variation. We follow Desojo et al. (2012) and restrict the scoring of this

character as (1) to taxa where the keel is a well-developed strut that greatly thickens the dorsoventral thickness of the paramedian osteoderm as in *Typothorax* and *Redondasuchus*, and code other taxa with a minimal keel, including *Longosuchus*, as ‘?’.

Character 29 (Parker, 2007 scored as ?). The position of the dorsal eminence or boss on the paramedian osteoderm as a centralized (0), slightly offset medially (1), or strongly offset medially (2) boss; casts of *Longosuchus* show the boss clearly medially offset, so we change the coding of this character from ‘?’ to ‘1’ in *Longosuchus*.

### ***Coahomasuchus***

Based on material of *Coahomasuchus* available to us and under study (e.g., Fraser et al., 2006; Schneider et al., 2011; Heckert et al., 2012), principally NCSM 23168, we amend the scoring of *Coahomasuchus* as follows:

Character 2 (Parker, 2007 scored as ?). Teeth mediolaterally compressed and recurved (0); teeth bulbous and conical with recurved tips (1); teeth bulbous and conical lacking recurved tips (2). Teeth of *Coahomasuchus* found associated with the skull of NCSM 23168 include those that are bulbous and conical with recurved tips, thus we change the coding from ‘?’ to ‘1’ in *Coahomasuchus*.

Character 20 (Parker, 2007 scored as ?). Ventral keel absent (0); or present (1). We have also followed Desojo et al. (2012) in coding this as ‘?’ in *Coahomasuchus*, as specimens available to us show the occasional presence of a weak keel, but never a strongly developed strut (see discussion previously for *Longosuchus*). Thus, although there is sometimes a weakly developed keel, we have not changed the coding from ‘?’ following Desojo et al. (2012).

## *Typothorax*

After initial runs of the revised matrix and tracing characters with Mesquite (Maddison and Maddison, 2011), it became apparent that there were issues with the scoring of *Typothorax* (which is based entirely on *T. coccinarum*, as *T. antiquum* is much less well-known). Accordingly, we changed scores for *Typothorax* in characters 12, 22, and 30.

Character 12 (Parker, 2007 scored as 1). Cervical centra keeled ventrally (0) or unkeeled (1). *Typothorax* had previously been coded as lacking ventral keels on the cervical vertebrae ('1'), but some are clearly present in the specimen described by Heckert et al. (2010:fig. 4a). The character may vary as other specimens lack them (W. Parker, pers. comm., 2013), but we have changed the coding from '1' to '0' to reflect the presence of ventral keels on at least some cervical centra.

Character 22 (Parker, 2007 scored as 0). Lateral cervical armor lacks (0); or possesses spikes or horns (1); that may be extremely elongate (2). Parker's (2007) character 22 is a restatement of the presence of lateral spikes used by Heckert and Lucas (1999, 2000), specifying that the lateral spikes must be present in the anterior (cervical) portion of the carapace and adding a third character state ('2') for extremely elongated spikes such as seen in *Desmatosuchus*. Because *Typothorax* definitely has cervical spikes (e.g., Heckert et al., 2010), we have changed that character coding from '0' to '1' for *Typothorax*.

Character 30 (Parker, 2007 scored as 0). Lateral spikes in anterior and mid-dorsal regions: not present (0); form a dorsoventrally flattened 'horn' (1); or form a conical spine (2). Throughout the carapace of *Typothorax coccinarum* the lateral spikes consist of

flattened horns (as opposed to conical spines), so we change the coding of character 30 from '0' to '1' as well.

***Redondasuchus***

We made the following change to the scoring of *Redondasuchus*.

Character 14 (Parker, 2007 scored as 1). Width to length ratio of widest dorsal paramedian plates: maximum of less than 3.5/1 (0), 3.5/1 or more (1). There are no published specimens of extremely wide *Redondasuchus* paramedian osteoderms, so we re-scored *Redondasuchus* as (0). W. Parker (pers. comm., 2013) maintains that unpublished specimens in the Yale Peabody Museum (YPM) are wide enough to retain this scoring. Retaining the scoring simply unites *Redondasuchus* with other typhothoracines more strongly.

***Gorgetosuchus***

After making the preceding changes we scored NCSM 21723, the holotype of *Gorgetosuchus* for 15 characters following the Parker (2007) matrix as modified by Parker et al. (2008), Desojo et al. (2012), and outlined previously.

	5	10	15	20	25	30	35	
<i>Gorgetosuchus pekinensis</i>	?????	?????	??2?0	11011	1111?	???11	???0?	0?

## LITERATURE CITED

- Desojo, J. B., M. D. Ezcurra, and E.-E. Kischlat. 2012. A new aetosaur genus (Archosauria: Pseudosuchia) from the early Late Triassic of southern Brazil. *Zootaxa* 3166:1–33.
- Fraser, N. C., A. B. Heckert, V. P. Schneider, and S. G. Lucas. 2006. The first record of *Coahomasuchus* (Archosauria: Stagonolepididae) from the Carnian of eastern North America. *Journal of Vertebrate Paleontology* 26(3, Suppl.):63A.
- Heckert, A. B., and S. G. Lucas. 1999. A new aetosaur (Reptilia: Archosauria) from the Upper Triassic of Texas and the phylogeny of aetosaurs. *Journal of Vertebrate Paleontology* 19:50–68.
- Heckert, A. B., and S. G. Lucas. 2000. Taxonomy, phylogeny, biostratigraphy, biochronology, paleobiogeography, and evolution of the Late Triassic Aetosauria (Archosauria: Crurotarsi). *Zentralblatt für Geologie und Paläontologie, Teil I* 1998:1539–1587.
- Heckert, A. B., V. P. Schneider, and N. C. Fraser. 2012. Two new aetosaurs (Reptilia: Archosauria) from the Upper Triassic Pekin Formation (Deep River Basin: Newark Supergroup) of North Carolina and the phylogeny and distribution of aetosaurs. *Geological Society of America Abstracts with Programs* 44(7):233.
- Heckert, A. B., S. G. Lucas, L. F. Rinehart, M. D. Celleskey, J. A. Spielmann, and A. P. Hunt. 2010. Articulated skeletons of the aetosaur *Tyothorax coccinarum* Cope (Archosauria: Stagonolepididae) from the Upper Triassic Bull Canyon Formation (Revueltian: early-mid Norian), eastern New Mexico, USA. *Journal of Vertebrate*

- Paleontology 30:619–642.
- Maddison, W. P., and D. R. Maddison. 2011. Mesquite: A modular system for evolutionary analysis. 2.75. [www.mesquiteproject.org](http://www.mesquiteproject.org).
- Parker, W. G. 2007. Reassessment of the aetosaur '*Desmotosuchus*' *chamaensis* with a reanalysis of the phylogeny of the Aetosauria (Archosauria: Pseudosuchia). *Journal of Systematic Palaeontology* 5:41–68.
- Parker, W. G., and J. W. Martz. 2010. Using positional homology in aetosaur (Archosauria: Pseudosuchia) osteoderms to evaluate the taxonomic status of *Lucasuchus hunti*. *Journal of Vertebrate Paleontology* 30:1100–1108.
- Parker, W. G., M. R. Stocker, and R. B. Irmis. 2008. A new desmotosuchine aetosaur (Archosauria: Suchia) from the Upper Triassic Tecovas Formation (Dockum Group) of Texas. *Journal of Vertebrate Paleontology* 28:692–701.
- Schneider, V., A. B. Heckert, and N. C. Fraser. 2011. Diversity of aetosaurs (Archosauria: Stagonolepididae) from the Upper Triassic Pekin Formation (Deep River Basin), North Carolina. *Journal of Vertebrate Paleontology, Program and Abstracts* 2011:188.