McCord, R.D. and Boaz, D. eds.
Southwest Paleontological Symposium - Proceedings 2000
Mesa Southwest Museum Bulletin No. 7
Mesa Southwest Museum and Southwest Paleontological Society
Mesa, Arizona Copyright 2000

# THE FIRST TREMATOSAURID AMPHIBIAN FROM THE MIDDLE TRIASSIC OF THE UNITED STATES

Adrian P. Hunt
Mesalands Dinosaur Museum
Mesa Technical College
911 South Tenth Street
Tucumcari, NM 88401

Vincent L. Santucci
Fosssil Butte Nat. Monument
PO Box 592
Kemmerer, WY 83101

T. Olson
Dept. of Geology
Northern Arizona University
PO Box 6030
Flagstaff, AZ 86011

## ABSTRACT

PEFO 5077 is a partial skull of a temnospondyl amphibian from the Holbrook Member of the Moenkopi Formation (Middle Triassic: Anisian) of northeastern Arizona. This specimen represents the first trematosaurid from the Middle Triassic of the United States. It pertains to a new lonchorhynchine that is distinguished from other taxa by the small size of its interpterygoid vacuities.

## INTRODUCTION

The Trematosauridae is a monophyletic family of Triassic temnospondyls (Hammer, 1979, 1987; Hellrung, 1987; Milner, 1990; Welles, 1993) that are common in Early Triassic strata in Gondwanaland, Spitzbergen and the Germany. Welles (1993) recently reported the first Early Triassic trematosaur from the United States which is a partial skull from the Wupatki Member of the Moenkopi Formation of Arizona. Middle Triassic records of trematosaurs are rare and are limited to indeterminate specimens from Nova Scotia, Canada and India (Welles, 1993). *Hyperokynodon keuperinus* is the only Late Triassic representative of this family (Hellrung, 1987). Here, we report on the first Middle Triassic trematosaur from the United States, a partial skull from the Holbrook Member of the Moenkopi Formation of northeastern Arizona. PEFO refers to Petrified Forest National Park.

## GEOLOGICAL CONTEXT

The Moenkopi Formation in northeastern Arizona consists of up to 150 m of nonmarine redbeds (McKee, 1954; Stewart et al., 1972; Morales, 1987). The lower, Wupatki Member has yielded a diverse temnospondyl fauna, including the holotype of the trematosaur *Cosgriffius campi* (Morales, 1987; Welles, 1993). The medial, Moqui Member is unfossiliferous, but the upper, Holbrook Member has also produced a diverse amphibian fauna (Morales, 1987b). The Wupatki and Moqui members are probably of Spathian (Lower Triassic) age whereas the Holbrook Member is early Anisian (Middle Triassic) in age (Morales, 1987b).

The specimen we describe below is from the base of a sandstone unit in the Holbrook Member from Holbrook, Arizona. The skull derives from an intraformational conglomerate from approximately the middle of the uppermost sandstone unit of the Holbrook Member in this area (Figure. 1). This locality is geographically close to the type locality of *Therapsipus cumminsi* (Hunt et al., 1993), and the Holbrook Member in this area yields a fairly diverse ichnofauna and skeletal fauna.

## SYSTEMATIC PALEONTOLOGY

Monophyletic Hierarchy
Tetrapoda
Batrachomorpha
Temnospondyli
Trematosauridae
Lonchorhynchinae
Gen. et sp. nov.

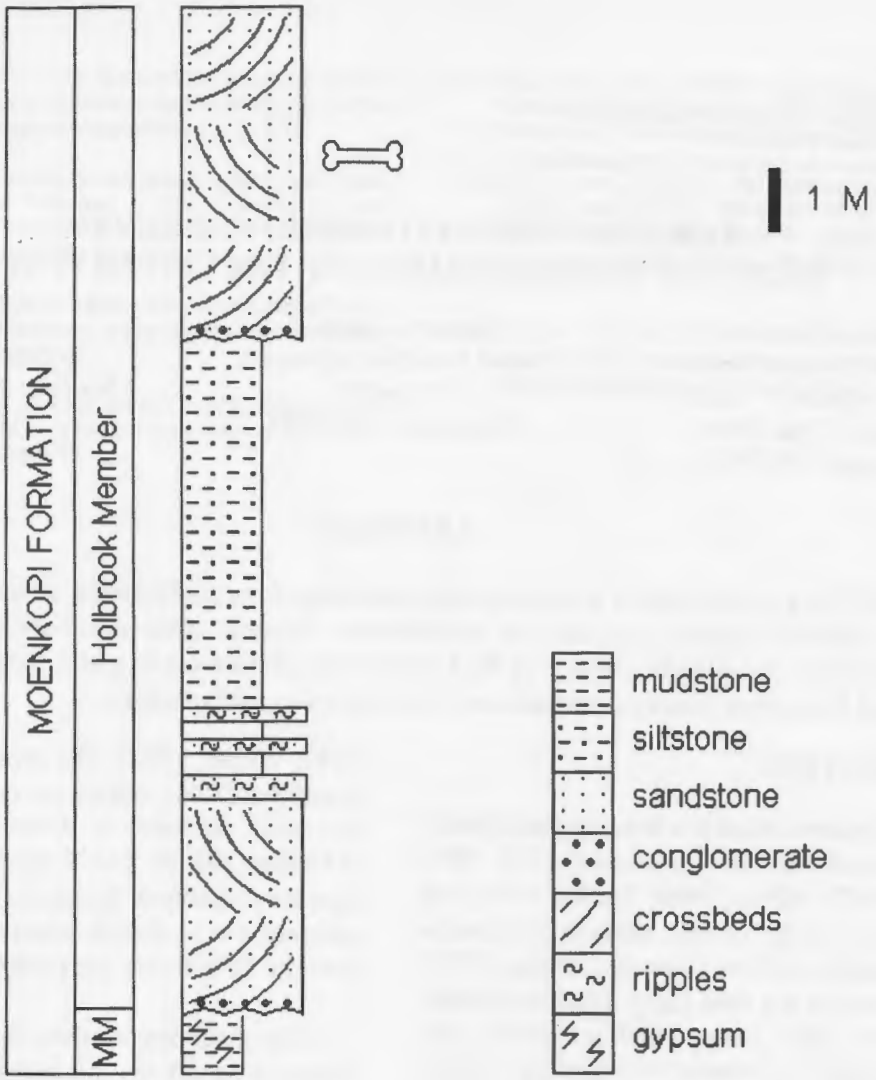



**FIGURE 1.** Stratigraphic section of the upper Moenkopi Formation, Holbrook, AZ showing the stratigraphic level of PEFO 5077. MM is Moqui Member.

Referred specimen: PEFO 5077, partial skull (Figure. 2).

## DESCRIPTION

PEFO 5077 is a skull fragment which is visible in dorsal view. Much of the dorsal skull roof is absent, so portions of the palate are visible in dorsal view. The specimen is inclined into the matrix such that the anterior portion of the specimen reveals part of the skull roof whereas the posterior portion is approximately at the level of the palate. The skull fragment is 120 mm long with estimated maximum anterior and posterior widths of 60 mm and 97 mm, respectively. The specimen is preserved in a medium grained sandstone which varies from grayish yellow green (5 GY 7/2) to pale red (5 R 6/2) in color (Goddard et al., 1979). Calcareous calcrete clasts and coprolites are associated with the skull fragment. The calcrete clasts are up 20 mm in length and are subrounded. The coprolites have a spiral internal structure and average 11 mm in diameter. A coprolite exposed in longitudinal section at the posterior end of the skull fragment has a length of 25 mm.






A

B

**FIGURE 2.** Photograph (A) and interpretative drawing (B) of PEFO 5077. Abbreviations are: t, teeth, c, cultriform process, p, posterior margin of interpterygoid vacuity.

The distribution of matrix relative to bone indicates that the skull suffered much damage before burial. Missing areas of the skull are posterior to the anterolateral wing of the pterygoid, anterior to the ?medial vomers, most of the skull roof between these areas and portions of the palate. Bone and/or impressions of bone are preserved on the right and left margins of the skull and along the midline. The only undamaged bone surface that is preserved is in the medial area.

The left margin of the specimen (right side of skull) consists of an anterior area of bone 18 mm long, an impression of bone about 27 mm long and a posterior portion that is about 45 mm long and consists of the impression of bone, bone and partial teeth. The anterior area of bone represents a portion of the lateral margin of the skull that has been eroded ventrally and is presumably a portion of the left maxilla and lachrymal or prefrontal.

The medial area of bone impression preserves the contour of part of the margin of the lateral skull wall and the width of the palate lateral to the interpterygoid vacuity. The lateral skull wall was vertical in its ventral portion, giving a high profile to the narrow skull. There are no teeth, or impressions of teeth, in this area of the skull. There was evidently only a narrow bar formed by the maxilla, ectopterygoid, ?pterygoid and ?palatine lateral to the interpterygoid vacuity. This bar was approximately 3.5 mm wide which is less than 10% of the skull width at this point.

The posterior portion of the left margin is eroded down to the level of the palate. A posteriorly and medioposteriorly expanding bone is represented by an impression and two bone slivers. This must represent the pterygoid posterior to the interpterygoid vacuity.

The sutures between the pterygoid, maxilla and ectopterygoid are not clear. Along the posterolateral margin of the skull fragment, the palate is eroded down to the level of the teeth. Eight teeth are visible in cross section; they have apparently posteriorly decreasing diameters, but are not truncated on a flat plane.

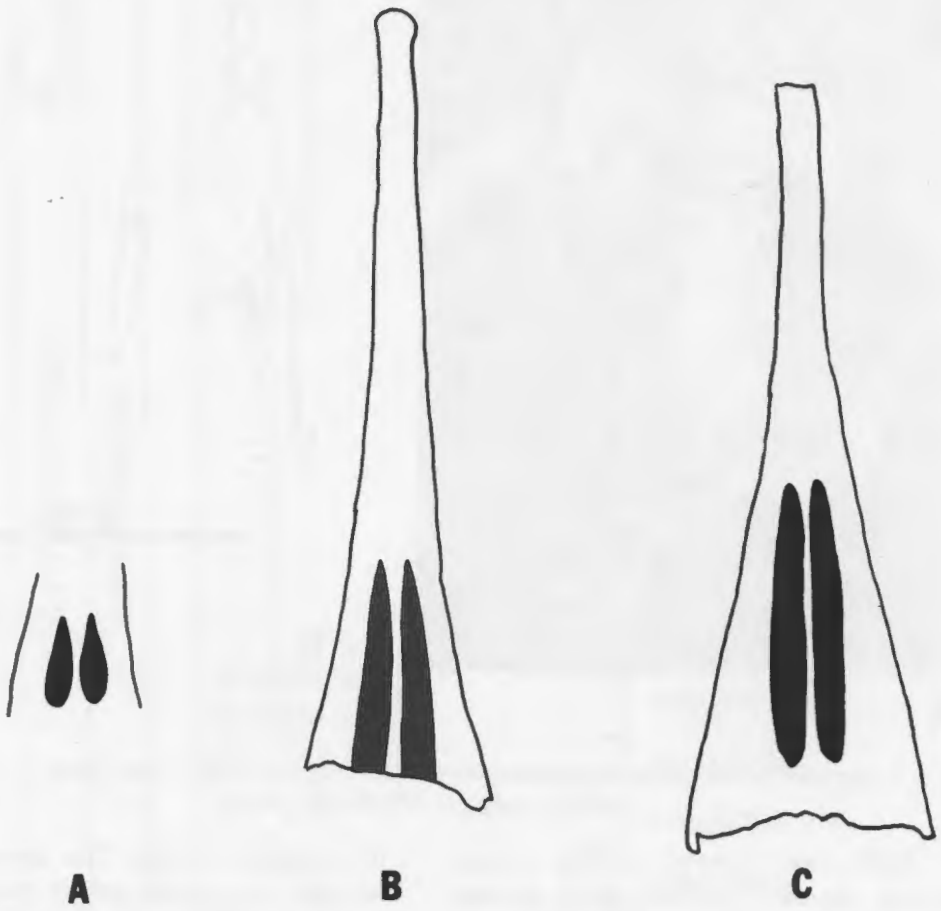



**FIGURE 3.** Comparison of lonchorhynchine trematosaur skulls in palatal view. Not to scale. Interpterygoid vacuities are shaded. A, PEFO 5077, gen. et. sp. nov (size of interpterygoid vacuities is inferred). B, *Cosgriffius campi* (after Welles, 1983, fig. 4B). C, *Aphaneramma rostratum* (after Save Soderbergh, 1936, fig. 33).

The medial element of the skull consists of a deep, narrow bone with a flat dorsal margin that narrows dorsally by at least 50%. It also broadens slightly anteriorly. Anteriorly this bone is apparently truncated.

The right margin of the specimen (left side of skull) consists of an anterior, roughly triangular area (23 mm anteroposterior length) and a medial segment that preserves teeth in cross section and a few slivers of bone.

The orientation of bone fibers suggests that three bones comprise the anterior segment; a marginal anteroposterior oriented bone and a more medial, anteriorly-flaring element. Medial to these two bones there is a third anteroposteriorly directed bone. These bones are presumably the maxilla, ?prefrontal and??nasal respectively and thus this area of the skull is anterior to the interpterygoid vacuity.

The medial portion of the right side of the specimen preserves the cross-sections or partial cross-sections of six teeth. Bone slivers define the lateral margin of the interpterygoid vacuity.

## DISCUSSION

PEFO 5077 is a temnospondyl amphibian because it possesses large interpterygoid vacuities (Milner, 1990; note that we utilize Temnospondyli as a monphyletic taxon that includes Lissamphibia).The vertical lateral wall of the skull indicates a skull height that is consistent with this assignment. Furthermore, PEFO 5077 represents a trematosaur because the cultriform process of the

parasphenoid is narrow, relative to the skull width, and high (Hammer, 1979, 1987). The narrowness of the skull indicates that it pertains to the subfamily Lonchorhynchinae (Welles, 1993). The straight sides of the skull in the region of the interpterygoid vacuities and its extreme narrowness indicate that the Holbrook specimen is most closely related to *Cosgriffius* (Welles, 1993, figs. 4A-4B) and *Aphaneramma* (Wiman, 1916, pls. 4-5). We follow Wiman (1910) and Welles (1993) in considering *Lonchorhynchus* to be a junior subjective synonym of *Aphaneramma*. PEFO 5077 differs from these genera in having anteroposteriorly shorter interpterygoid vacuities and undoubtedly represents a new taxon (Figure. 3). However, the specimen under study is too poor to be a holotype and so we assign PEFO 5077 to Lonchorhynchinae gen et sp. nov.

The small size of PEFO 5077 might indicate that it represents the juvenile of a different form of temnospondyl. Brachyopoids and capitosauroids are also known from the Moenkopi Formation (Morales, 1987b). However, brachyopoid skulls are very broad and whereas capitosauroid adults have relatively narrow skulls, juvenile specimens are also broad (Morales, 1987a; Warren and Hutchinson, 1988; Warren and Schroeder, 1992). In fact, no adults or juveniles of any Triassic amphibians have narrow straight-sided skulls like PEFO 5077, except lonchorhynchine trematosaurs.

This specimen represents only the fourth occurrence of a Middle Triassic lonchorhynchine trematosaur (Welles, 1993). The other records are of indeterminate specimens from Nova Scotia, Canada and India (Welles, 1993). Thus, this is the first occurrence of a Middle Triassic trematosaur from the United States.

## ACKNOWLEDGMENTS

We thank Petrified Forest National Park and Mesa Technical College for support, Robert Heward for access to his land, Jeremiah Wright for assistance with drafting and Spencer Lucas and an anonymous reviewer for their helpful comments.

**REFERENCES**

GODDARD, E. N., Trask, P. D., Deford, R. K., Rove, O. N., Singewald, Jr., J.T., and Overbeck, R.M., 1979. Rock-Color chart. Geological Society of America.

HAMMER, W.R., 1979. A revision of the temnospondyl amphibian family Trematosauridae. Unpub. Ph.D. diss.: Wayne State Univ., Detroit, 117 p.

HAMMER, W.R., 1987. Paleoecology and phylogeny of the Trematosauridae: American Geophysical Union, Geophysical. Monograph, 41:73-83.

HELLRUNG, H., 1987. Revision von Hyperokynodon keuperinus Plieninger Amphibia: Temnospondyli) aus dem Schilfsandstein von Heilbronn (Baden-Wurtemberg): Stuttgarter Beitrage zur Naturkunde, Series B (Geologie und Palaontologie), 136:1-28.

HUNT, A.P., Santucci, V.I., Lockley, M.G., and Olson, T.J., 1993. Dicynodont trackways from the Holbrook Member of the Moenkopi Formation (Middle Triassic: Anisian), Arizona, USA. New Mex. Museum of Nat. Hist. and Sci. Bulletin, 3: 213-218.

MCKEE, E.D., 1954. Stratigraphy and history of the Moenkopi Formation of Triassic age: Geol. Soc. of Am., memoir 61, 133 p.

MILNER, A. R., 1990. The radiations of temnospondyl amphibians. The Systematics Association Special Volume, 42: 321-349.

MORALES, M., 1987a. Skull variation in two species of capitosaauroid labyrinthodonts from the Moenkopi Formation (early to Middle Triassic) of Arizona, USA. Unpub. Ph.D. diss.: Univ. of Calif. Berkeley, Berkeley, 284 p.

MORALES, M., 1987b. Terrestrial fauna and flora from the Triassic Moenkopi Formation of the southwestern United States. Journal of he Arizona-Nevada Academy of Sciences, 22:1-19.

SAVE SODERBERGH, G., 1936. On the morphology of Triassic stegocephalians from Spitzbergen, and the interpretation of the endocranium in the Labyrithodontia. Kungl Svenska Vetenskapsakademiens Handlingar Series 3, 16: 1-181.

STEWART, J.H., Poole, F.G. and Wilson, R.F., 1972. Stratigraphy and origin of the Triassic Moenkopi Formation and related strata in the Colorado Plateau region: U.S.G.S. Prof. Paper 691, 195 p.

WARREN, A.A. and Hutchinson, M.N., 1988. A new capitosaurid amphibian from the Early Triassic of Queensland, and the ontogeny of the capitosaur skull. Palaeontology, 31(3): 857-876.

WARREN, A.A. and Schroeder, N., 1992. Changes in the capitosaur skull with growth: an extension of the growth series of *Parotosuchus aliciae* (Amphibia: Temnospondyli) with comments on the otic area of capitosaurs. Alcheringia, 19: 41-46.

WELLES, S. P. 1993. A revision of the lonchorhynchine trematosaurs (Labyrinthodontia), and a description of a new genus and species from the lower Moenkopi Formation of Arizona. PaleoBios, 14(2): 1-24.

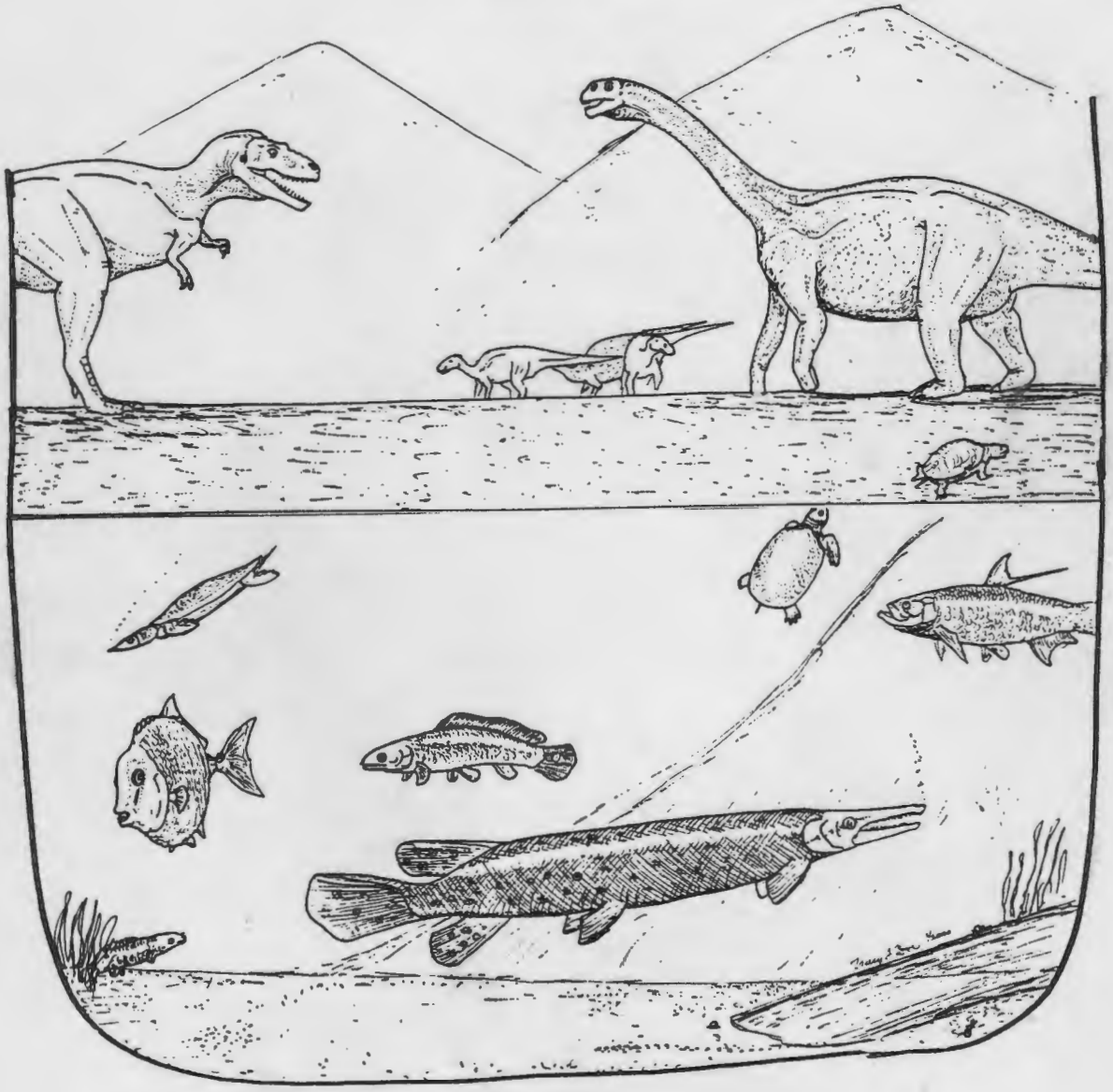
WIMAN, C.J.J.E., 1910. Ein paarLabyrinthodontenreste aus der Trias Spitzbergens. Bull. Geol. Instn. Upsala,IX, 34-40, 2 figs. pls. I, II.

WIMAN, C.J.J.E., 1916. Neue Stegocephalenfunde aus dem Posidonomyaschiefer Spitzbergens. Bull. Geol. Instn. Upsala, XIII, 209-222, 4 figs., pls. XV, XVI.



# SOUTHWEST PALEONTOLOGICAL SYMPOSIUM

MESA SOUTHWEST MUSEUM
Bulletin No. 7
February 26, 2000



Presented by
Mesa Southwest Museum
and
Southwest Paleontological Society