

MICROVERTEBRATE FOSSILS FROM THE PETRIFIED FOREST AND OWL ROCK MEMBERS (CHINLE FORMATION) IN PETRIFIED FOREST NATIONAL PARK AND VICINITY, ARIZONA

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Abstract-Seven microvertebrate sites were discovered at different stratigraphic horizons within Petrified Forest National Park, Arizona. Three microfaunas (Dying Grounds, Crocodile Hill, Jasper Forest) were from below the Sonsela Sandstone, one fauna (Crystal Forest) from within the unit and three faunas (Flattops, Dinosaur Hill ["Lacey Point"], Lungfish Locality) sampled above the Sonsela. At the Crocodile Hill and Dying Grounds localities, numerous teeth of the freshwater shark Xenacanthus were found (the most abundant elements in the lower unit faunas) and fin spines of Lissodus have also been recovered from the localities identical to those from the Dockum Group of West Texas and the Chinle Formation near St. Johns, Arizona. Fish remains from these localities include the rostral bones and scales from redfieldiids, several colobodontid toothplate morphotypes, a variety of other fish scale morphotypes and a possible lungfish vomerine from the Dying Grounds locality. Isolated Trilophosaurus teeth from the Dying Grounds locality are similar to those on the type specimen of T. buettneri.

The faunas of the Sonsela Sandstone and upper Petrified Forest Member in the park appear to be quite different from those within the lower portion of the Petrified Forest Member. No xenacanth or Lissodus specimens were recovered at any locality, some of the colobodontid toothplates are of different morphology, and analysis of ridge counts on Turseodus-like scales reveals dissimilarities between the upper and lower unit faunas. A new species of Acrodus is present at the Crystal Forest (Sonsela Sandstone) and Lungfish (upper Petrified Forest Member) localities within Petrified Forest National Park and in the Owl Rock Member of the Chinle Formation at Ward Terrace. Redfieldiid fishes are present at most localities in Petrified Forest National Park, represented by rostral bones and scales. A large sample of lungfish toothplates was obtained from the Lungfish Locality that allowed analysis of a relatively large population of arganodontid toothplates from a single locality. Small metoposaur vertebrae and dermal bone fragments with finely reticulate sculpture from the Lungfish locality are of different morphology than those seen within adults of Metoposaurus fraasi. A sphenodontid dentary from the Lungfish locality is similar to the British Planocephalosaurus and Sigmala and is of different morphology than those previously reported from the lower Petrified Forest Member and lower portion of the Dockum Formation.

INTRODUCTION

During May-June, 1988, field parties from Tarleton State University quarried microvertebrate localities discovered in Petrified Forest National Park, Arizona. Localities were from within both the lower and upper units of the Petrified Forest Member of the Chinle Formation. The geology and paleontology of these localities is discussed elsewhere in this volume by Murry and Long.

Most of the teeth referable to a new Acrodus species discussed herein were recovered by Will Downs of Southern Methodist University and the University of Northern Arizona at a locality in the Owl Rock Member (Chinle Formation) at Ward Terrace, Arizona. This locality (SMU # 134) is situated just north of Landmark Wash on the top of Ward Terrace in the Navajo Nation, Coconino County, Arizona. According to Downs (unpublished SMU locality documentation) the fossils were recovered from a purple fine-grained mudstone.

Only the smaller vertebrate fossils collected from the Chinle Formation are discussed herein. Murry and Long analyze the stratigraphy and sedimentology of these localities and review the distribution of larger vertebrates of the Chinle and Dockum Formations elsewhere in this volume.

The fossils discussed herein are repositied in the vertebrate paleontology collections at Petrified Forest National Park, Arizona (PEFO) and the Shuler Museum of Paleontology, Southern Methodist University, Dallas, Texas (SMU).

SYSTEMATIC PALEONTOLOGY

Class Chondrichthyes
Subclass Elasmobranchii
Order Xenacanthiformes
Family Xenacanthidae
Xenacanthus moorei (Woodward, 1889)

Referred specimens: PEFO 3821, 208 teeth, Crocodile Hill locality; PEFO 3822 tooth, PEFO 3897 tooth, PEFO 3823, 168 teeth, Dying Grounds locality; ?PEFO 3284, 3847, 3848 denticles, Crocodile Hill Locality; ?PEFO 3896, denticles, Dying Grounds locality; lower Petrified Forest Member, Chinle Formation, Petrified Forest National Park, Arizona.

Discussion: Jacobs (1981) noted the presence of xenacanth in Petrified Forest National Park recovered from a small sample of blue-gray shale of unknown provenance. The numerous teeth (Fig. 1 A-C) recovered from the Crocodile Hill and Dying Grounds localities indicate that Xenacanthus moorei specimens constitute a prominent portion of the lower Petrified Forest Member faunal elements.

Xenacanthus moorei teeth are characterized by the presence of two slightly diverging principal cusps ornamented with cristae and a much smaller unornamented intermediate cusp placed between the other two (Johnson, 1980a, b). On the coronal surface of the teeth, a prominent apical button is present. Along the lingual

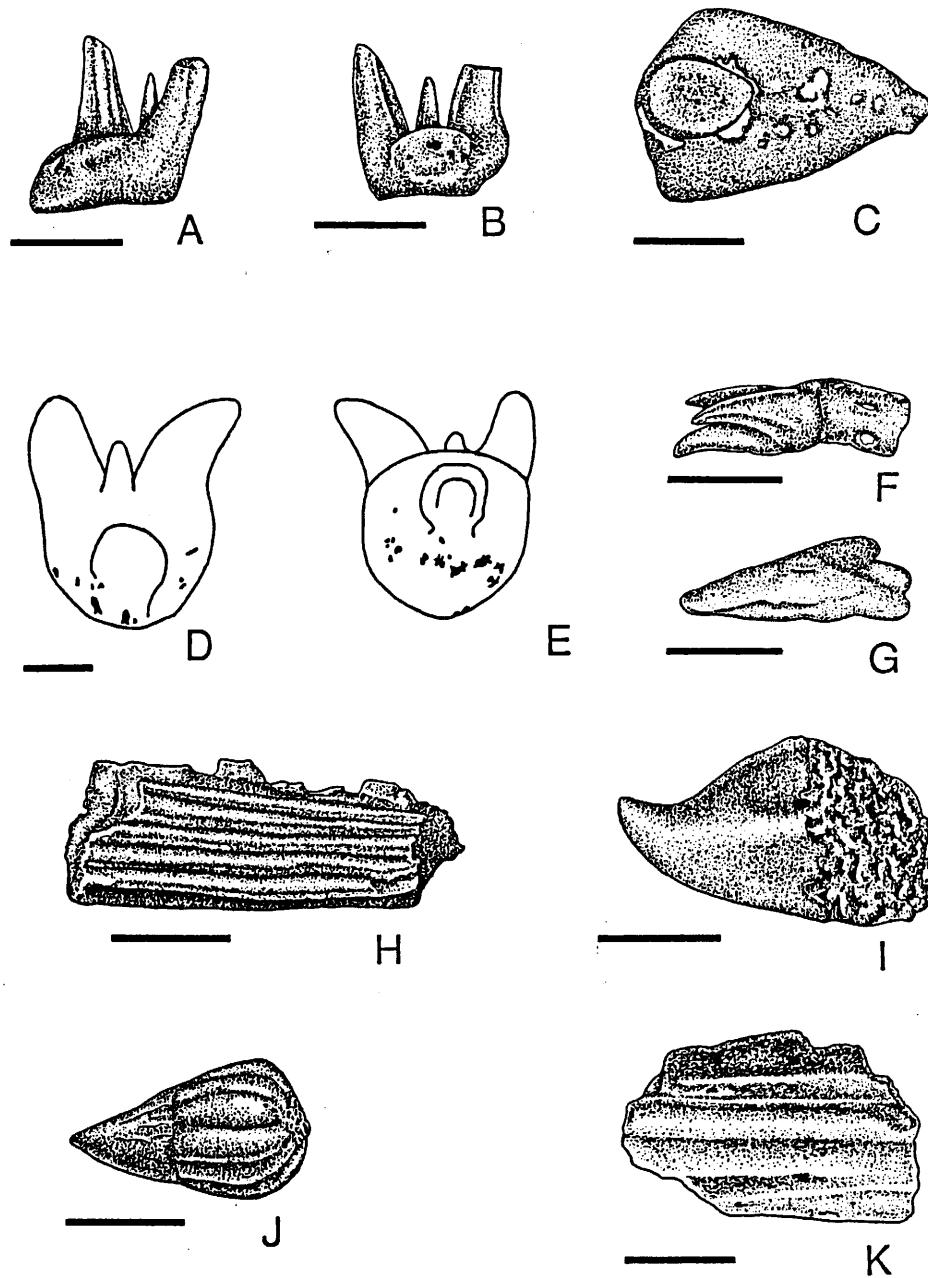


FIGURE 1. A-B, Xenacanthus moorei tooth (PEFO 3822) in oblique lingual (A) and lingual (B) views; lower Petrified Forest Member (Chinle Formation); Dying Grounds locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm. C, Xenacanthus moorei tooth (PEFO 3897) in basal view; lower Petrified Forest Member (Chinle Formation); Dying Grounds locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm. D-E, Orthacanthus compressus tooth in lingual-occlusal (D) and basal (E) views (after Johnson, 1980a; plate 36, figs. 3-4); scale equals 1.0 mm. F-G, Xenacanthus moorei? denticles (PEFO 3824, 3847) in lateral view; lower Petrified Forest Member (Chinle Formation); Crocodile Hill locality, Petrified Forest National Park, Arizona; scales equal 1.0 mm. H, Lissodus humblei finspine (PEFO 3826) in lateral view; lower Petrified Forest Member.

edge of the apical button there is typically a centrally-placed foramen, flanked by several (approximately two to eight) foramina encircling the margin of the apical button or scattered along the lingual margin of the tooth corona. Another key feature of X. moorei is that the labio-lingual root dimension is greater than the anteromedial-posterolateral dimension (Johnson, 1980a, b). The overall shape of the root is triangular, with a prominent labially-placed basal tubercle and numerous nutritive foramina surrounding the lingual edge along the midline of the tooth base axis.

Cappetta (1987) placed Xenacanthus moorei within the genus Orthacanthus. The systematics of xenacanth sharks are much confused, and the fact that Xenacanthus is based on a fin spine, Pleuracanthus laevisissimus, does not help alleviate the confusion. Johnson (1984) lists a number of useful characters for differentiating "Xenacanthus" from "Orthacanthus" teeth. "Xenacanthus" teeth have an apical button that is closely associated with the cusps, and the major transverse axes of the bases of the principal cusps forms a distinct angle with the labial margin of the root (Fig. 1 A-C). In "Orthacanthus" (Fig. 1 D-E), the major transverse axes of the bases of the principal cusps are nearly parallel with the labial margin of the root between the cusp, the apical button is distinctly isolated from the cusps, and a central foramen is present which is situated between the apical button and intermediate cusp. The latter feature is typically absent in Xenacanthus. Based on Johnson's criteria, I retain X. moorei within the genus Xenacanthus.

Xenacanthus moorei has been described from the Kalgary, Rotten Hill and Sunday Canyon localities in the Dockum Group of Texas (Johnson, 1980b; Murry, 1982, 1986, 1987b) and from the Placerias and Downs quarries in the Petrified Forest Member of the Chinle Formation near St. Johns, Arizona (Jacobs and Murry, 1980).

Dermal and mucous membrane denticles from sharks are common components of Upper Triassic localities in the Southwest. However, as noted by Zangerl (1981), the variation in individual sharks is so great that determination of species is difficult. The presence of a limited number of shark taxa in the Chinle Formation provides an opportunity to ascribe denticles of taxa

FIGURE 1. (continued) (Chinle Formation), Dying Grounds locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm. I, Lissodus? denticle (PEFO 3898); lower Petrified Forest Member (Chinle Formation); Dying Grounds locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm. J, Lissodus? denticle (PEFO 3899); lower Petrified Forest Member (Chinle Formation); Dying Grounds locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm. K, Acrodus? finspine fragment (PEFO 3833); upper Petrified Forest Member (Chinle Formation); Lungfish locality, Petrified Forest National Park, Arizona; scale equals 1.0 mm.

with a relative amount of certainty. Some denticles from Crocodile Hill and the Dying Grounds localities consist of aggregates of lepidomorium-like structures. Fusion of two or three of the structures into a single denticle is typical with the denticles fusing to form an irregular-shaped bony base (Fig. 1 F-G). These denticles are somewhat similar to the "gill teeth" (mucous membrane denticles?) of Xenacanthus decheni illustrated by Fritsch (1895, plate 100, figs. 2-3) from the Permian Gaskohle of Germany. A similar denticle has been figured from the Calgary local fauna (Murry, 1986, fig. 9.2 F1).

Cohort Euselachii
 Superfamily Hybodontoidae
 Family Polyacrodontidae
Lissodus Brough, 1935
Lissodus humblei (Murry, 1981)

Referred specimens: PEFO 3825, 20 finspine fragments, Crocodile Hill locality; PEFO 3826, finspine fragment, PEFO 3827, 13 finspine fragments, Dying Grounds locality; ?PEFO 3828, 4 denticles, Crocodile Hill locality; ?PEFO 3898 denticle, ?PEFO 3899 denticle, ?PEFO 3829, denticles, Dying Grounds locality, lower Petrified Forest Member (Chinle Formation), Petrified Forest National Park, Arizona.

Discussion: Hybodont spines (Fig. 1 H) referable to Lissodus humblei were recovered from the Dying Grounds and Crocodile Hill localities. These tapering spines are oval in cross-section and are characterized by a series of anastomosing ridges on their lateral faces which increase in number (up to approximately 12) towards their base. A series of triangular, slightly-hooked denticles alternate on the posterior margins of the spines. Such spines are identical to those described from the Calgary area in Crosby County, Texas (Murry, 1981, 1986).

In the Crocodile Hill and Dying Grounds area, several shark denticle morphotypes are present which may be referable to Lissodus humblei. Thorn-like denticles (Fig. 1 I-J) with large cancellous or corrugate bone bases and with straight to hooked "cusps" are present at the localities. These dermal denticles were probably arranged on the outside of the body. Other denticles, possibly referable to Lissodus, consist of irregular-shaped structures upon which a number of smaller denticulate structures emanate.

Family Acrodontidae
 Acrodus Agassiz, 1837
Acrodus n. sp.

Referred specimens: PEFO 3830, Tooth with root, Lungfish locality; PEFO 3831, 4 fragmentary teeth, Lungfish locality; PEFO 3911, tooth, PEFO 3832, 7 fragmentary teeth, Crystal Forest locality; ?PEFO 3833, finspine fragment, ?PEFO 3900, finspine fragment, Lungfish locality; upper Petrified Forest Member, Chinle Formation, Petrified Forest National Park, Arizona; SMU 69687-69689, teeth with roots, Ward Terrace; 69690, teeth