LATE TRIASSIC VERTEBRATE TAPHONOMY AT PETRIFIED FOREST NATIONAL PARK

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ABSTRACT

Three vertebrate taphofacies can be recognized within the Petrified Forest Formation (Upper Triassic) at Petrified Forest National Park (PEFO), Arizona. Channel-hosted assemblages are characterized by fragmentary, abraded specimens, floodplain-hosted assemblages by abundant fossils, complete phytosaur skulls and skeletons of large tetrapods and paleosol-hosted assemblages by common terrestrial tetrapods and skeletons of small tetrapods. Paleosol-hosted assemblages are restricted to the Norian at PEFO.

INTRODUCTION

Petrified Forest National Park (PEFO) in northeastern Arizona preserves an abundant and diverse vertebrate fauna which has been widely studied (e.g., Murry and Long, 1989). However, there has been surprisingly little written about the taphonomy of the vertebrate occurrences (e.g., Murry and Long, 1989; Parrish, 1989). The objects of this paper are threefold: (1) to briefly review previous taphonomic work; (2) to describe the major vertebrate taphofacies that are present at PEFO; and (3) to refer major localities to these taphofacies. The paleontological collections of Petrified Forest National Park are assigned the acronym PEFO and UCMP to the University of California Museum of Paleontology, Berkeley, collections.

GEOLOGIC CONTEXT

Two formations of the Upper Triassic Chinle Group (sensu Lucas, 1993) are present at PEFO. These are the lower Petrified Forest Formation, which is divided in ascending order into the Blue Mesa, Sonsela and Painted Desert Members and the upper Owl Rock Formation. Vertebrate fossils at PEFO are restricted to the Petrified Forest Formation. Most fossils occur in the upper portion of the Blue Mesa and the lower portion of the Painted Desert Members (Lucas, 1993).

These faunas are respectively, Adamanian (late Carnian: late Tuvalian) and early Revueltian (early Norian), in age (Lucas and Hunt, 1993).

PREVIOUS TAPHONOMIC WORK

Murry and Long (1989) and Parrish (1989) have provided most of the previous observations on vertebrate taphonomy at PEFO. Murry and Long (1989) described the Dying Grounds and Crocodile Hill localities in the Blue Mesa as being within mudrock units associated with organic-rich mudstones and minor conglomerates. This package of facies obviously represent floodplain deposition. They noted that Dinosaur Hill and the Lungfish locality in the Painted Desert Member are associated with mottled mudrocks, reduction haloes and calcrete nodules indicative of paleosols. Parrish (1989) noted similar features at Dinosaur Hill (his Bolt quarry). Parrish (1989) also made general comments on the taphonomy of the "Blue Forest area" by which he meant the area which includes most of the Blue Mesa Member localities (Dying Grounds etc.). He concluded, like Camp (1930), that these localities were formed in ponds and marshes. We consider that these localities formed in a proximal floodplain environment.

THREE TAPHOFACIES AT PETRIFIED FOREST NATIONAL PARK

Hunt and Newell (Newell, 1992; Hunt, 1994; Newell and Hunt, in prep.) recognize three taphofacies in the Norian Bull Canyon Formation of east-central New Mexico. These are: (1) channel-sandbody-hosted assemblages; (2) floodplain mudrock assemblages; and (3) paleosol-hosted assemblages. Vertebrate specimens in channelform sandstones are dominantly the isolated and abraded fragments of phytosaurs, aetosaurs and metoposaurs, which represent channel lags. Floodplain assemblages represent the majority of fossil vertebrate specimens in the Bull Canyon Formation and include articulated specimens of larger (dorsal centra > 3 cm in length) tetrapods. These specimens occur in mudrocks formed on proximal floodplains. Paleosol assemblages are depauperate in aquatic/semiaquatic taxa and include articulated specimens of small tetrapods (dorsal centra < 6 cm in length). These assemblages occur in mottled mudrocks that contain carbonate (calcrete) nodules. During the past 5 years we have examined all major vertebrate localities at PEFO and can recognize these three taphofacies at the park.

Assemblages derived from channelform sandstones at PEFO have received little study because most specimens are poorly preserved. Specimens derived from channels principally represent phytosaurs, metoposaurs and aetosaurs in the Blue Mesa Member and phytosaurs and aetosaurs in the Painted Desert Member. No significant vertebrate fossils derive from this taphofacies.

The vast majority of vertebrate fossils from PEFO come from the floodplain taphofacies. Characteristic modes of preservation include the occurrence of isolated phytosaur skulls and of articulated/disarticulated, but associated, skeletons of large (dorsal centra > 6 cm in length) tetrapods (e.g., Camp, 1930; Hunt and Lucas, 1990; Figs. 1-2). Notable specimens include all the phytosaur skulls and skeletons described by Camp (1930) from the area that is now PEFO (e. g.,

UCMP 26699, holotype of *Machaeroprosopus adamanensis*: Fig. 1) and the partial aetosaur skeleton (Fig. 2) described by Hunt and Lucas (1992).

Paleosol assemblages are characterized by the presence of specimens of small terrestrial reptiles and articulated skeletons/partial skeletons of small (dorsal centra < 6 cm in length) tetrapods. Significant specimens from this taphofacies include the partial skeletons of a new small ceratosaur (cf. *Coelophysis* sp. of Padian, 1986), a small sphenosuchian skeleton (cf. *Sphenosuchus* sp. of Parrish, 1991) and the "holotype" of the nomen nudum *Chindesaurus bryansmalli* (Murry and Long, 1989). Incomplete specimens of terrestrial tetrapods from this taphofacies include isolated teeth of the ornithischian dinosaur *Revueltosaurus callenderi* (Padian, 1990).

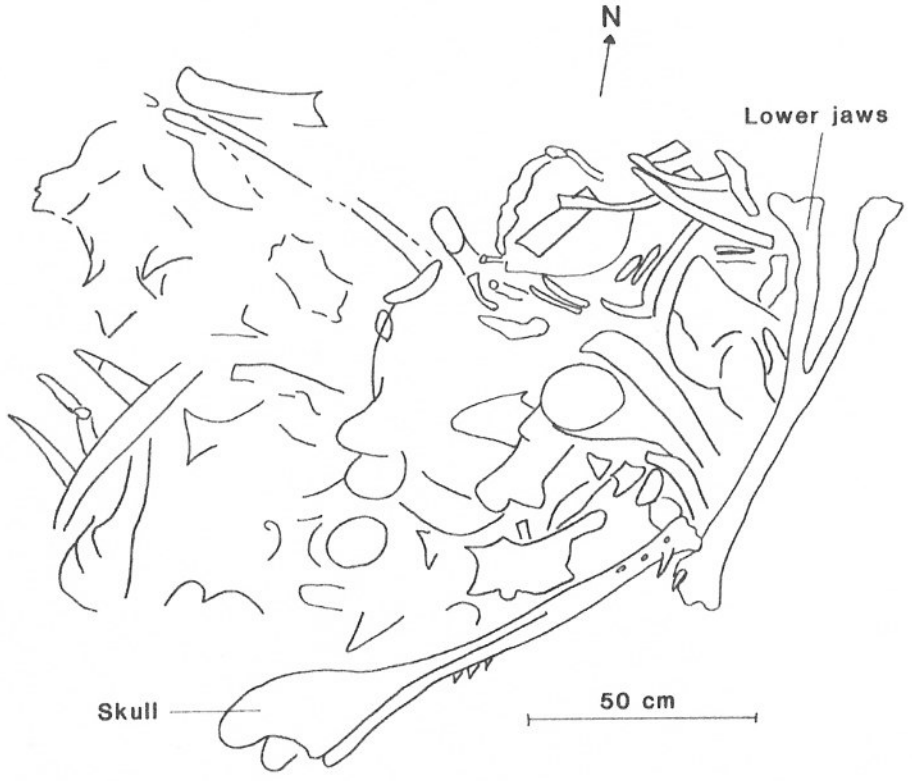


Figure 1. Quarry map of excavation of UCMP 26699, holotype of Machaeroprosopus adamanensis *(= Rutiodon crosbiensis of Hunt, 1993) from UCMP locality 7038 (scale is approximate). Adapted from two partial quarry maps (dated June 18th and 19th 1921) in the unpublished field notes of Charles L. Camp, in the archives of Petrified Forest National Park (courtesy of UCMP).*

STRATIGRAPHIC DISTRIBUTION OF TAPHOFACIES

All major vertebrate localities at PEFO can be categorized as either floodplain- or paleosol-hosted (Table 1). It is clear that the stratigraphic distribution of the taphofacies is not random (Table 1). Vertebrate accumulations of the paleosol taphofacies are restricted to the Painted Desert Member. This, in part, explains taxonomic differences between the faunas of the two units Parrish, 1993; Hunt and Lucas, this volume). Both faunas are dominated by semiaquatic/aquatic taxa, but those of Blue Mesa contain very few terrestrial reptiles (e. g., dinosaurs, sphenosuchians) relative to those from the Painted Desert. Specimens of terrestrial reptiles are almost entirely restricted to the paleosol taphofacies which is most common in the Painted Desert Member. The paleosol taphofacies is prominent in all vertebrate faunas of the

American Southwest in the early Revueltian (early Norian) which explains the acme zone of terrestrial tetrapods at this time (Hunt and Lucas, 1993).

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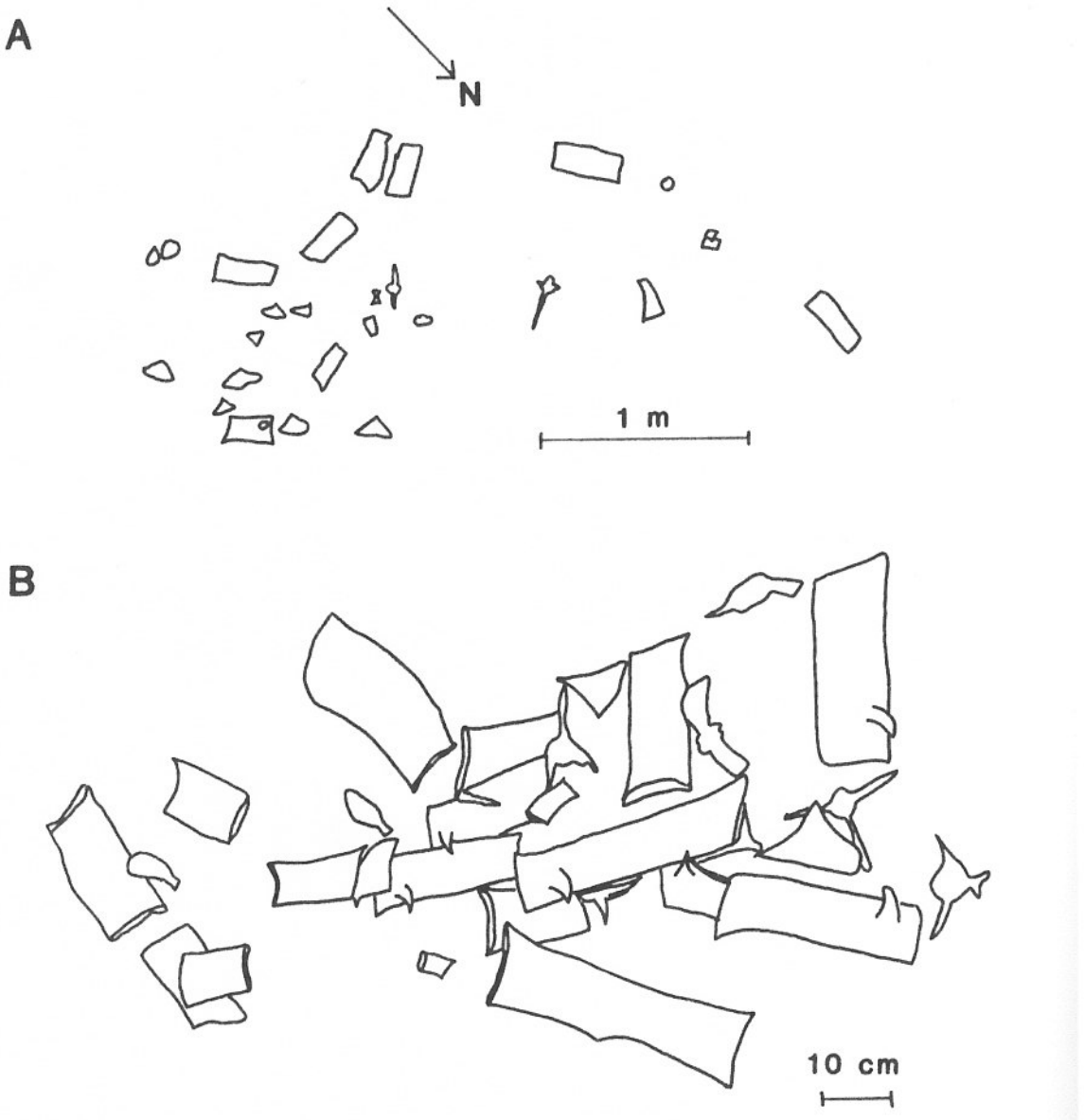


Figure 2. Quarry plans of partial skeleton of Paratypothorax andressi *(PEFO 3004) from archives at Petrified Forest National Park. Most elements are dorsal osteoderms or vertebrae. (A) Overview of whole quarry (scale is approximate). (B) Map of underside of principal jacketed block.*

Table 1. Some of the principal vertebrate localities at Petrified Forest National Park characterized by taphofacies. Note that none occur in the channel-sandbody-hosted assemblage. Locality names are those used historically, in the paleontological files at PEFO and in recent publications (e.g., Murry and Long, 1989; Hunt and Lucas, 1993).

Floodplain taphofacies	Paleosol taphofacies	Stratgraphic unit (Member)
Dying Grounds		Blue Mesa
Crocodile Hill		Blue Mesa
Jasper Forest		Blue Mesa
Crystal Forest		Blue Mesa
Devil's Playground		Blue Mesa
Phytosaur Basin		Blue Mesa
Flattops		Painted Desert
Black Forest		Painted Desert
Billings Gap		Painted Desert
Lungfish Locality	Painted Desert	
Dinosaur Hill	Painted Desert	
Dinosaur Hollow	Painted Desert	

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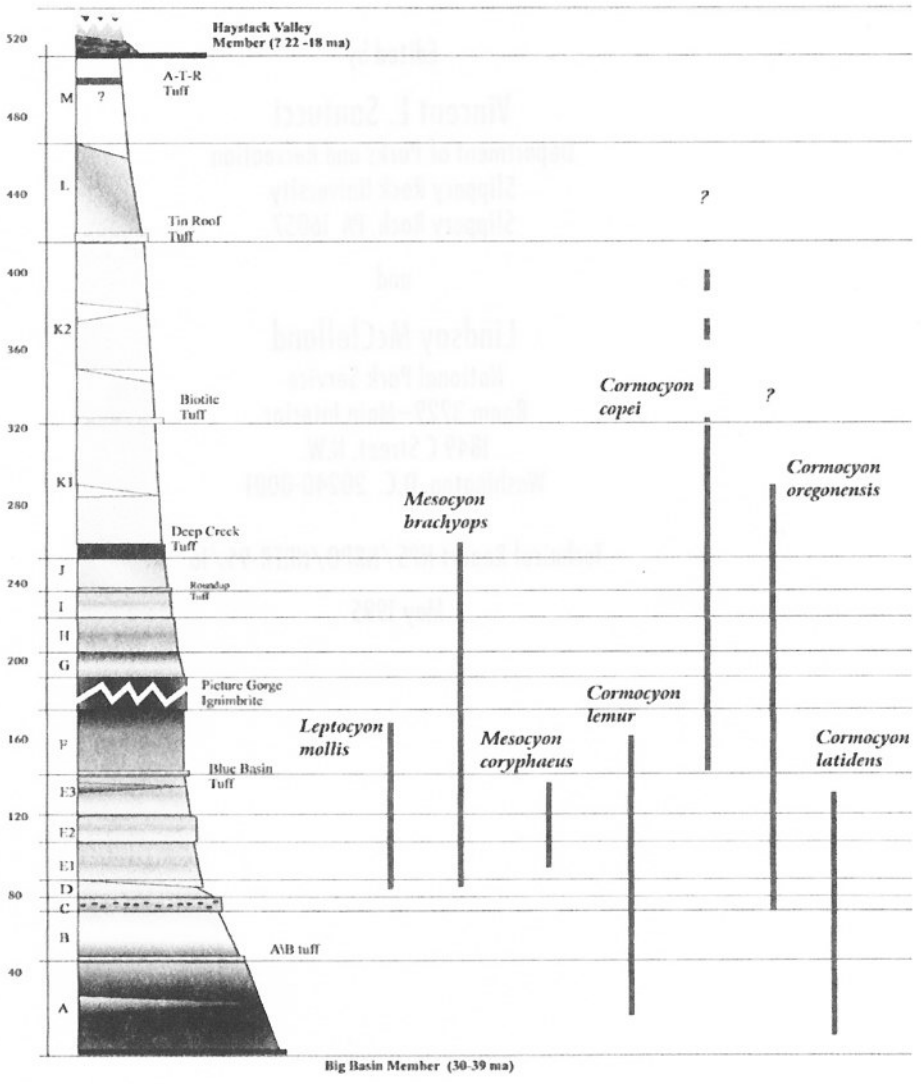
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