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Osteichthyans from the Fairpoint Member of the Fox Hills Formation (Maastrichtian), Meade County, South Dakota, USA

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ABSTRACT

The Fairpoint Member of the Fox Hills Formation (upper Maastrichtian) in Meade County, South Dakota, USA, contains an osteichthyan assemblage indicative of transitional to marine shoreface deposits. The fauna consists of: *Lepisosteus* sp., *Paralbula casei*, *Cylindracanthus* cf. *C. ornatus*, *Enchodus gladiolus*, *Hadrodus* sp., and indeterminate osteichthyans with probable affinities to the Siluriformes and Beryciformes. The Fairpoint fauna is of limited species diversity and in this character mirrors many other Upper Cretaceous North American osteichthyan assemblages. Comparison to Upper Cretaceous chondrichthyan diversity and consideration of the structure of Cretaceous marine food webs suggest that osteichthyans are strongly under-represented in the Upper Cretaceous of North America. The small size and poor preservation potential of many Upper Cretaceous North American osteichthyans probably account for much of this observed paucity. Fairpoint osteichthyans are members of families that survive the Cretaceous–Paleocene boundary extinction event. Some of these genera and families are still extant and occur in a wide array of modern fresh, brackish, and shallow marine environments.

1. Introduction

The upper Maastrichtian Fox Hills Formation is a prominent, fossil-rich member of the Upper Cretaceous marine stratigraphic sequence in north central South Dakota and adjacent parts of North Dakota (Feldmann, 1966, 1972; Waage, 1968; Speden, 1970; Erickson, 1974, 1992; Klett and Erickson, 1977; Landman and Waage, 1993). In western South Dakota, the Fox Hills Formation is sandier than it is to the east (Waage, 1968; Stoffer et al., 1998, 2001), contains some continental deposits and lignite (Black, 1964; Pettyjohn, 1967), and is poorly fossiliferous. Vertebrate fossils in the western, sandy part of the Fox Hills outcrop belt in South Dakota are particularly rare. Pettyjohn (1967) noted without description, his discovery in this area of a few isolated reptile remains and chondrichthyan teeth.

Chamberlain et al. (2001) described rare osteichthyan scales and chondrichthyan skeletal fragments from the Fox Hills Formation in Badlands National Park. Currently, the only exception to this picture of vertebrate fossil paucity in the Fox Hills Formation in the western regions of the South Dakota, is the rich chondrichthyan assemblage described by Becker et al. (2004) from the middle of the Fairpoint Member of the Fox Hills Formation near Enning, South Dakota, and a younger chondrichthyan assemblage studied by Cicimurri (1998) from a site northeast of Enning.

In this paper, we describe an osteichthyan assemblage recovered from the Fairpoint Member of the Fox Hills Formation near Enning, South Dakota (Fig. 1). This report is a follow up study to our earlier work (Becker et al., 2004) on chondrichthyans from the same site. It is the first description of osteichthyan skeletal material from the Fairpoint Member. The Fairpoint osteichthyan assemblage is typical of other contemporaneous North American Upper Cretaceous localities which preserve abundant osteichthyan fossils but have very limited species diversity. The Fairpoint fauna consists of osteichthyan families and genera which survived well into the Tertiary, and some of which occur in modern fresh, brackish and shallow marine environments.

2. Materials and methods

2.1. Repository and comparative materials

Specimens described here have been reposited in the fossil fish collection of the American Museum of Natural History (AMNH),

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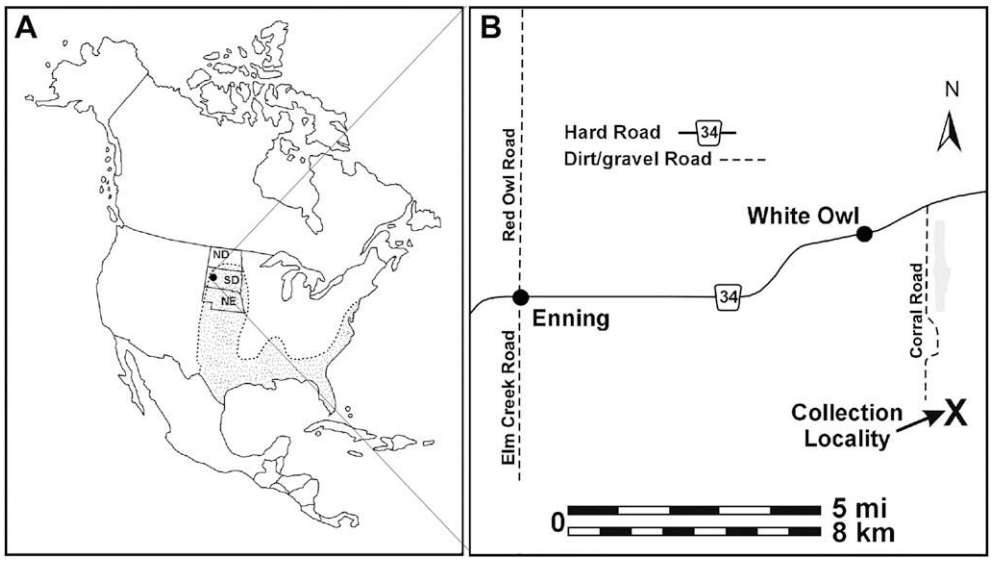

Fig. 1. Location maps for the Enning, South Dakota osteichthyan site. A, Upper Plains States. Square–Enning collection locality. Dotted line and hatchured area–late Maastrichtian (*Jeletzkytes nebrascensis* Zone) paleogeographic reconstruction for the Western Interior Seaway and the Gulf and Atlantic coastal plains. Map redrawn from Becker et al., 2004, fig. 1C; paleogeography redrawn from Becker et al., 2006b, fig. 1.1, and Kennedy et al., 1998, fig. 5. B, detailed locator map of the collection site. Redrawn from Becker et al., 2004, fig. 1C.

New York, New York and are identified by the acronym AMNH FF. We also examined specimens housed in the modern fish collections of the (AMNH) and the Academy of Natural Sciences (ANSP), Philadelphia, Pennsylvania for comparative purposes.

2.2. Geologic setting

In the Meade County area of South Dakota, Pettyjohn (1967) divided the Fox Hills Formation into two members: the Fairpoint Member, and the White Owl Member. The Fairpoint Member is the lower of the two members and lies on top of the Pierre Shale (see Becker et al., 2004, fig. 3, for a stratigraphic column of the locality). The lower and middle parts of the Fairpoint Member consist of about 50 m of poorly cemented, light colored, marine sands, with occasional channel cuts, large-scale cross-bedding, and lenses of dark, hematitic concretions. Our collection site lies in this facies, about 40 m above the contact with the Pierre Shale (Becker et al., 2004). Above these marine sands, the Fairpoint Member becomes continental in character (Pettyjohn's (1967) Stoneville Facies), and contains prominent lignitic horizons. The overlying White Owl Member consists of massive, cross-bedded marine sands with prominent concretion horizons. At the top of the White Owl Member is a series of multicolored sands and clays Pettyjohn (1967) called the Enning Facies. These beds probably represent a northern continuation of the Interior Zone of weathering that colors the top of the Fox Hills Formation and younger beds in the Badlands area to the south (Stoffer et al., 1998). A more complete description of the geology of our collection site is given in Becker et al. (2004).

The material discussed in this paper was collected near the town of Enning in southeastern Meade County, South Dakota (Fig. 1). The outcrop and associated harvester ant debris cones where our osteichthyan fossils were recovered occur along a hilltop where there is a dense array of indurated, dark brown hematite-cemented concretions up to 3 m in diameter. Fossil plant fragments and *Ophiomorpha* burrows occur within some of these concretions. The concretions, which tend to coalesce and form distinct layers, are perched on sandstone that is white to tan in color and well-sorted with hummocky and high-angle, tangentially cross-stratified beds occurring at some horizons. Pieces of fossil wood up to about 15 cm in length lie scattered around the base of the outcrop.

2.3. Methods

A few fossils were collected from the outcrop, whereas many more were found by surfacing collecting the loose sand eroded from the exposure and covering the ground surface to considerable depth. However, more than half of the total we collected was taken from harvester ant debris cones associated with the exposure. We removed the outer 2–4 cm of selected debris cones during the hotter part of the day while the nest's inhabitants were below ground, and then sorted through this material (see Hatcher, 1896, for an early discussion of harvester ant nest collection techniques). Whereas some of the specimens recovered from debris cones appear to be exceptionally well preserved, others show evidence of bleaching and chemical deterioration probably related to exposure to formic acid produced by the ants. Sediment and microfossils were carefully separated using hand sieving in the field and with progressively finer meshes in the laboratory. In the laboratory, microfossils were collected and identified through the use of a magnifying glass, low-power binocular microscope, and a JEOL JSM-6301 digital scanning electron microscope operating at an accelerator voltage of 4.0 kilovolts.

3. Systematic paleontology

Class: Osteichthyes Huxley, 1880
Order: Lepisosteiformes Hay, 1926
Family: Lepisosteidae Cuvier, 1825
Genus *Lepisosteus* Lacepéde, 1803

Lepisosteus sp.

Referred Material. AMNH FF20274, ganoid scale (Fig. 2A, B).

Description. The ganoid scale is 2.5 mm thick and has an enameled outer surface, dense bony basal layer, and peg and socket joints for articulation to adjacent scales. The enameled surface measures 19 mm from opposite corners in longest dimension and exhibits growth annuli and minute pores.