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New record of an extinct fish, *Fisherichthys folmeri* Weems (Osteichthyes), from the lower Eocene of Berkeley County, South Carolina, USA

DAVID J. CICIMURRI[1] and JAMES L. KNIGHT[2]
[1]Campbell Geology Museum, 140 Discovery Lane, Clemson, SC 29634; dcheech@clemson.edu. [2]South Carolina State Museum, P.O. Box 100107, Columbia, SC 29202; jim.knight@scsm.org

Fisherichthys folmeri Weems 1999 (Sciaenidae?) is an extinct teleostean fish occurring in marine strata of the Gulf and Atlantic coastal plains, USA. We report isolated teeth collected from a lower Eocene (Ypresian) deposit in Berkeley County, South Carolina. Crowns of unworn teeth bear apical papillae surrounding a central depression, but these features are lost as teeth are worn through *in vivo* usage. The pulp cavity appears to become reduced in size as the tooth matures in the alveolus. *Fisherichthys folmeri* is thus far only known from Mississippi, South Carolina, and Virginia in strata ranging in age from 50.8 to 55 Ma.

INTRODUCTION

Fisherichthys folmeri Weems 1999 is an extinct fish occurring in lower Eocene (Ypresian) deposits of the Atlantic and Gulf coastal plains, USA (Fig. 1). The holotype (USNM 496271), a partial pharyngeal plate, was found in the Potapaco Member, Nanjemoy Formation of Stafford County, Virginia (Weems 1999). The only other documented record of the taxon is from Lauderdale County, Mississippi, where Case (1994a) erroneously identified specimens recovered from the Tuscahoma and Bashi formations as *Albula eppsi* White 1931 (also Weems 1999). *Fisherichthys* is tentatively assigned to Sciaenidae (drums), but similarities in tooth morphology may simply be a case of convergent evolution (Weems 1999). The arrangement of teeth within the dentition of *Fisherichthys* is quite unlike that seen in phyllodontids like *Phyllodus* Agassiz 1839, *Egertonia* Cocchi 1864, and *Paralbula* Blake 1940 (also Estes 1969, Weems 1999).

We recently collected *F. folmeri* (Figs. 2–15) in a Martin Marietta Aggregates limestone quarry in northern Berkeley County, South Carolina (see Fig. 1). Unfortunately, the fossiliferous deposit we sampled underlies a thick section of middle Eocene Santee Limestone and is not directly available to observation. Some sediment was brought to the surface from the actively mined portion of the quarry, which is filled with water, and we collected bulk matrix from several spoil piles adjacent to their excavation site. The spoil piles contain small blocks of Santee Limestone, and preserved bedding surfaces are irregular and contain vertebrate fossils like those we observed within the sediment proper. We believe that the fossiliferous deposit directly underlies the Santee Limestone and the contact between the two units is disconformable, with material from the older deposit having been reworked into the younger deposit.

The matrix we collected was screen-washed in the laboratory using USA Standard Testing Sieves down to 0.25 mm (#60 sieve). Through field collection and laboratory processing, we recovered a highly diverse vertebrate assemblage consisting of elasmobranch, osteichthyan, and reptilian species. The vertebrate and invertebrate fossils we obtained indicate an Ypresian age for the deposit.

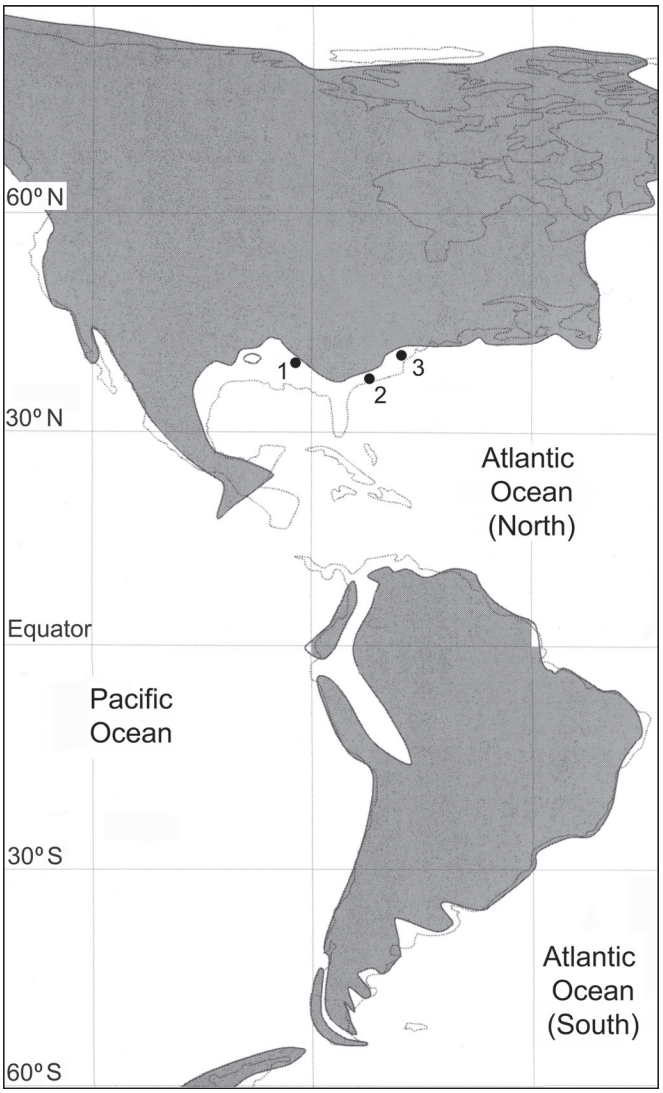


Figure 1. Paleogeographic map of North and South America showing continental distributions and locations of shorelines during the lower Eocene (gray areas represent exposed landmass). Closed circles indicate occurrences of *Fisherichthys folmeri*; 1—Lauderdale Co., MS; 2—Berkeley Co., SC; 3—Stafford Co., VA. Base map modified from Weems and Grimsley (1999).

SYSTEMATIC PALEONTOLOGY

ORDER: PERCIFORMES Günther 1880

FAMILY: SCIAENIDAE(?) Cuvier 1829

GENUS: *FISHERICHTHYS* Weems 1999

Type Species—*Fisherichthys folmeri* Weems (1999:63)

Type Locality—Fisher/Sullivan site near Fredericksburg, Virginia, USA.

Referred Material—The specimens discussed in this report are housed at the Bob Campbell Geology Museum (BCGM). These include: BCGM 9029, one tooth (Figs. 2–5); BCGM 9030, one tooth (Figs. 6–9); BCGM 9031, one tooth (Figs. 14–15); BCGM 9032, one tooth (Figs. 10–13); BCGM 9033, 14 isolated teeth.

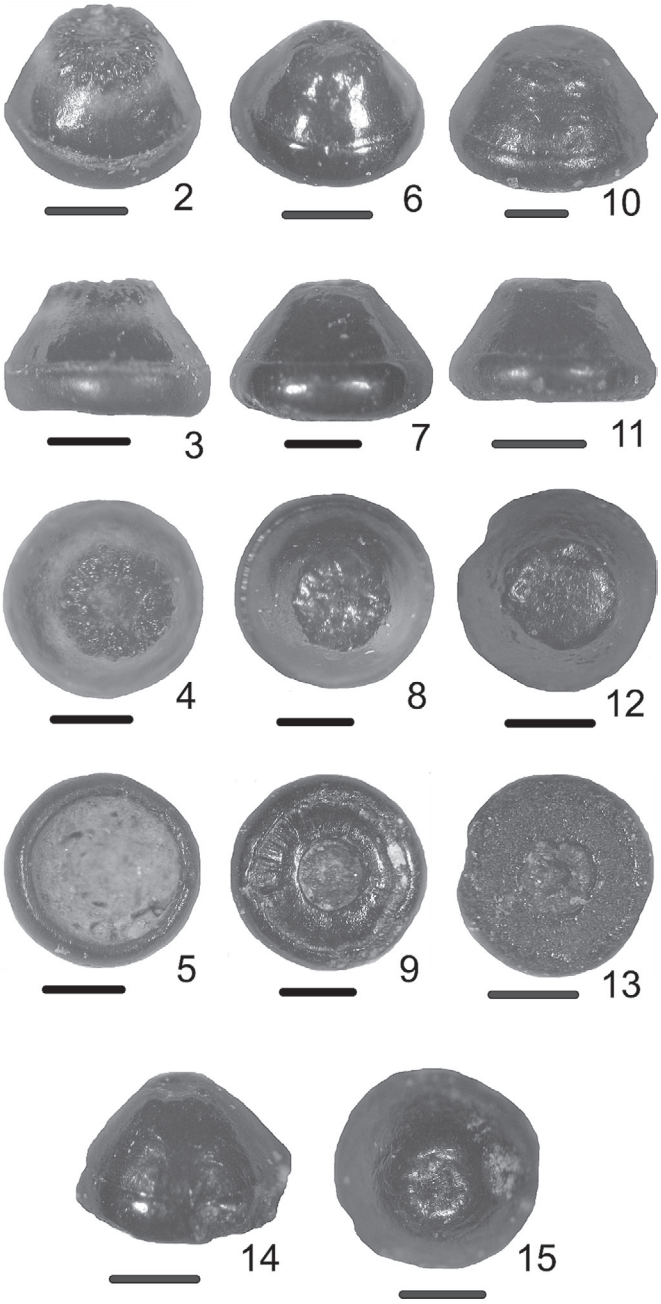
Description—The teeth are unique in that they are conical, bear an apical concavity surrounded by a ring of irregularly distributed papillae, and a grooved cingulum near the gum line (also Weems 1999). Our *F. folmeri* sample preserves previously unknown morphological details. Papillae are obvious on unworn teeth (Figs. 2–4), but these are abraded through *in vivo* usage and become less noticeable around the central concavity (Figs. 6–8, 14–15). Eventually even the concavity is lost as the occlusal surface becomes flat and smooth, and the crown appears truncated in profile (Figs. 10–12). Weems (1999) correctly predicted that teeth have an internal pulp cavity, which he based on the morphology of pharyngeal plate alveoli (p. 63; also pl. 4.8A and B). The pulp cavity has a circular outline and is largest in unworn, possibly newly erupted teeth, but it becomes much reduced as the tooth matures in the alveolus (Figs. 5, 9, 13).

DISCUSSION

Biostratigraphy

Fisherichthys folmeri was recovered from both the upper Tuscahoma Formation and the lower Bashi Formation in eastern Mississippi (Case 1994a). The Paleocene-Eocene boundary in the Gulf Coastal Plain in recent years has been placed at the Initial Eocene Thermal Maximum instead of the boundary between calcareous nannofossil zones NP 9 and NP 10 as it was in the past (Aubrey et al. 2003). This now puts the Paleocene-Eocene boundary within the upper part of the Tuscahoma Formation, and not at the Tuscahoma Formation-Bashi Formation contact (Harrington 2001, Harrington and Kemp 2001). Mammalian remains from the upper part of the Tuscahoma Formation are indicative of the Wasatchian North American Land Mammal Age (Beard and Dawson 2001), and this part of the formation is therefore of Ypresian age, not Thanetian. Deposits of the Bashi Formation have been assigned to the lower half of calcareous nannofossil zone NP 10 and accumulated between 54.8 to 54.2 Ma (Berggren et al. 1995, Harrington 2003, Danehy et al. 2007). In Virginia, *F. folmeri* occurs in the basal part of Bed B of the Potapaco Member, Nanjemoy Formation (Weems 1999, Weems and Grimsley 1999), which has been assigned to zone NP 11 (Gibson and Bybell 1991). This zone represents an interval of time of only 800,000 years, from 53.6 to 52.8 Ma (Berggren et al. 1995).

Although a precise age for the South Carolina material is unknown, the overall composition of the vertebrate assemblage (currently under study) indicates a lower Eocene age, and this is supported by associated invertebrates like ostra-



Figures 2–15. Isolated *Fisherichthys folmeri* teeth from South Carolina, scale bars = 0.5 mm. **2-5.** BCGM 9029. **2.** Oblique. **3.** Profile. **4.** Occlusal. **5.** Basal view. **6-9.** BCGM 9030. **6.** Oblique. **7.** Profile. **8.** Occlusal. **9.** Basal view. **10-13.** BCGM 9032. **10.** Oblique. **11.** Profile. **12.** Occlusal. **13.** Basal view. **14-15.** BCGM 9031. **14.** Oblique. **15.** Occlusal view.

codes (Swain *personal communication*). The teleost otolith assemblage suggests that the South Carolina deposit perhaps formed as late as zone NP 12 (50.8 to 52.8 Ma) (Stringer *unpublished data*). The lithology of the Jamestown deposit and the vertebrate fossils it contains are similar to what has been reported from strata identified as the Chicora Member of the Williamsburg Formation in northwestern Berkeley County, South Carolina (i.e., Weems 1998, Hutchinson and Weems 1998). Strata within the Chicora Member have all been assigned an upper Paleocene (Thanetian) age (dated to NP 9 or older), but the recent adjustment of the Paleocene-Eocene boundary leads us to consider the possibility that beds occurring within NP 9 are of Ypresian age. The Jamestown fossiliferous deposit could represent an unnamed Ypresian deposit occurring in northern Berkeley County that was reported by Harris and Zullo (1991). This unnamed deposit disconformably overlies the Chicora Member, whereas the Chicora Member is disconformably overlain by the Fishburne Formation further to the south in Dorchester County (Harris and Zullo 1991, Edwards et al. 2000). The Fishburne Formation is currently the only named Ypresian lithostratigraphic unit in South Carolina (Gohn et al. 1983), and strata were assigned to NP 11 by Edwards et al. (2000). However, the Fishburne Formation differs from the Jamestown deposit in being a nodular glauconitic limestone, and no vertebrate fossils have thus far been reported (Gohn et al. 1983, Edwards et al. 2000). At this time we cannot directly correlate the Jamestown deposit with the Chicora Member, the unnamed deposit of Harris and Zullo (1991), or the Fishburne Formation, which is thus far only known to occur in Dorchester County (Edwards et al. 2000). It is possible that the Jamestown deposit is chronostratigraphically equivalent to the Fishburne Formation, but this must be tested by drilling additional core samples in Dorchester and Berkeley counties, as well as identifying calcareous nannofossils or pollen in order to obtain a tighter age constraint for the Jamestown deposit.

Paleobiology

Although the middle Tuscahoma Formation (Paleocene) preserves an open marine fauna, the upper Tuscahoma Formation represents a brackish-water environment with emergent swamps (Case 1994b, Harrington et al. 2004). The Bashi (Mississippi) and Nanjemoy (Virgnia) formations, as well as the South Carolina deposit, contain nearly identical vertebrate assemblages, and the depositional settings of the units producing these assemblages were similar, with the vertebrate taxa inhabiting tropical to subtropical neritic marine environments (Dockery 1986, Ingram 1991, Kent 1999a, 1999b, Weems 1999, Weems and Grimsley 1999).

Weems (1999) suggested that teeth of *F. folmeri* were effective at grasping and manipulating externally slippery (or soft) but internally hard prey like smooth-shelled mollusks, squid, and holothurians (Weems 1999:63). The degree of wear we observed on isolated teeth indicates that they were retained in the dentition for an extended period of time or, contrary to Weems' (1999:63) suggestion, the animals' feeding habits resulted in rapid tooth wear. The presence of *F. folmeri* in lower Eocene deposits of Mississippi, Virginia, and South Carolina indicates that similar prey species must also have inhabited these areas.

CONCLUSIONS

Fisherichthys folmeri is thus far known only from Ypresian strata of Virginia, South Carolina, and Mississippi, all within the Gulf and Atlantic coastal plains of the USA (Fig. 1). Despite the fact that vertebrate assemblages are generally similar around the North Atlantic, no comparable material has been reported from contemporaneous deposits of Europe or Africa (i.e., White 1926, 1931, Arambourg 1952, Darteville and Casier 1943, 1949, 1959, Casier 1946, 1966, 1967). This could be because *F. folmeri*: (1) is endemic to eastern North America; (2) has not been collected elsewhere because of the small size of the teeth; or (3) has not been recognized as a distinct taxon (i.e., may erroneously have been identified as an albulid or phyllodontid).

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