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Amphiuma (Caudata: Amphiumidae) from the Pleistocene Clark Quarry Local Fauna of Coastal Georgia

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AMPHIUMA (CAUDATA: AMPHIUMIDAE) FROM THE PLEISTOCENE CLARK QUARRY LOCAL FAUNA OF COASTAL GEORGIA

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ABSTRACT

Fossil vertebrae of an amphiumid salamander (*Amphiuma* sp.) are reported from a late Pleistocene (Rancholabrean NALMA) site of coastal Georgia. A suite of vertebral characters that identify the fossils to *Amphiuma* is given, as well as illustrations of important vertebral characters that distinguish the genus from sirenid salamanders. The presence of *Amphiuma* in the paleofauna indicates an aquatic habitat was present during the time of deposition.

Keywords: *Amphiuma*, Pleistocene, coastal Georgia.

INTRODUCTION

The Clark Quarry local fauna of Glynn County, coastal Georgia, has yielded a diverse Pleistocene (Rancholabrean North American Land Mammal Age [hereafter NALMA]) vertebrate fauna (e.g., 1, 2, 3, 4, 5). Recent radiocarbon (^{14}C) dating of bison (*Bison latifrons*) bone collected at the fossil site yielded an age of 12,350 ± 70 YBP for the fauna (6). Although the locality is best known for its megafauna, important microfossils have recently been discovered by screen washing *in situ* sediments from the site. These efforts have yielded fossils of small vertebrates including amphibians, reptiles, and rodents. Here we describe two relatively well-preserved *Amphiuma* vertebrae from the site, and illustrate and discuss vertebral characters and structures that clearly separate this taxon from those of the other North American aquatic eel-like salamanders of the family Sirenidae. We also discuss problems with the identification of isolated *Amphiuma* vertebrae to the species level. In these discussions we follow the vertebral terminology of Gardner (7). Institutional abbreviations include GCVP, Georgia College and State University Vertebrate Paleontology Collections; GC-H, Georgia College and State University Recent Herpetological Skeletal Collections.

SYSTEMATIC PALEONTOLOGY

Class Amphibia Linnaeus, 1758
Order Caudata Scopoli, 1777
Family Amphiumidae Gray, 1825
Genus *Amphiuma* Garden, 1821
Amphiuma sp. indet.

Fossil History of *Amphiuma* – Although the fossil record of the paedomorphic salamander genus *Amphiuma* is limited, it dates back to the late Paleocene (8), approximately 54 Ma B.P. Estes (8) described the extinct taxon *A. jepseni* on the basis of three partial skeletons from the late Paleocene (probably Tiffanian NALMA) Polecat Formation of Wyoming. Although certainly present, amphiumids are not known from the Eocene. Two records of amphiumid salamanders are reported from the Miocene, but these may be in error. Holman (9) erected the species *A. antica* on the basis of a single, poorly preserved (and poorly illustrated) trunk vertebra from the middle Miocene (Barstovian NALMA) of Texas. The taxon has since been shown to be invalid (nomen dubium) as the holotype and only known vertebra does not differ in any significant way from vertebrae of extant *Amphiuma* (see discussion in Gardner, 7). Gardner (7) further suggested that the fossil may not represent an amphiumid salamander, but we believe the specimen retains some characters consistent with the genus *Amphiuma* (e.g., similar neural crest and no aliform process). Albright (10) tentatively assigned a poorly preserved salamander vertebra from the early Miocene (Arikareean NALMA) of Texas to an amphiumid-like salamander. Unfortunately, the fossil is not figured and based on the description of the specimen, it is too fragmentary to determine a family allocation. We know of no Pliocene records of amphiumids, but Pleistocene (Rancholabrean NALMA) occurrences are well documented from Florida and Texas (e.g., 11) and from Georgia (12).

Material – Two trunk vertebrae, GCVP 8310 (Fig. 1A), and 8311.

Remarks – The Clark Quarry vertebrae are assigned to the endemic North American salamander family Amphiumidae based on the presence of postzygapophyseal crests (Fig. 1A), an unequivocal vertebral autapomorphy for the family (7). Two genera of Amphiumidae are currently recognized, *Proamphiuma* Estes and the type genus *Amphiuma*. *Proamphiuma* is known from the late Maastrichtian or early Paleocene, while *Amphiuma* is known from the late Paleocene and Pleistocene to Recent (7, 11). The vertebrae of *Amphiuma* (and the fossils) differ from those of *Proamphiuma* in having relatively higher neural crests and postzygapophyseal crests, deeper subcentral keels, and relatively larger anterior basapophyses (7). Overall, the Clark Quarry vertebrae display a suite of features that characterize *Amphiuma* as follows (modified from Holman, 11, 13, and Gardner, 7): vertebrae elongate and amphicoelous; neural crests long and well developed; neural spines short and divergent from either side of the posterior extent of the neural crests; postzygapophyseal crests present (worn but evident in the fossils); alar processes present (damaged on the fossils); transverse processes broken but appear to be unicapitate suggesting a post-anteriormost trunk position; centra constricted medially with deep subcentral keels (evident but worn or damaged in both fossils); anterior basapophyses elongate (preserved in GCVP 8310 but damaged in GCVP 8311).

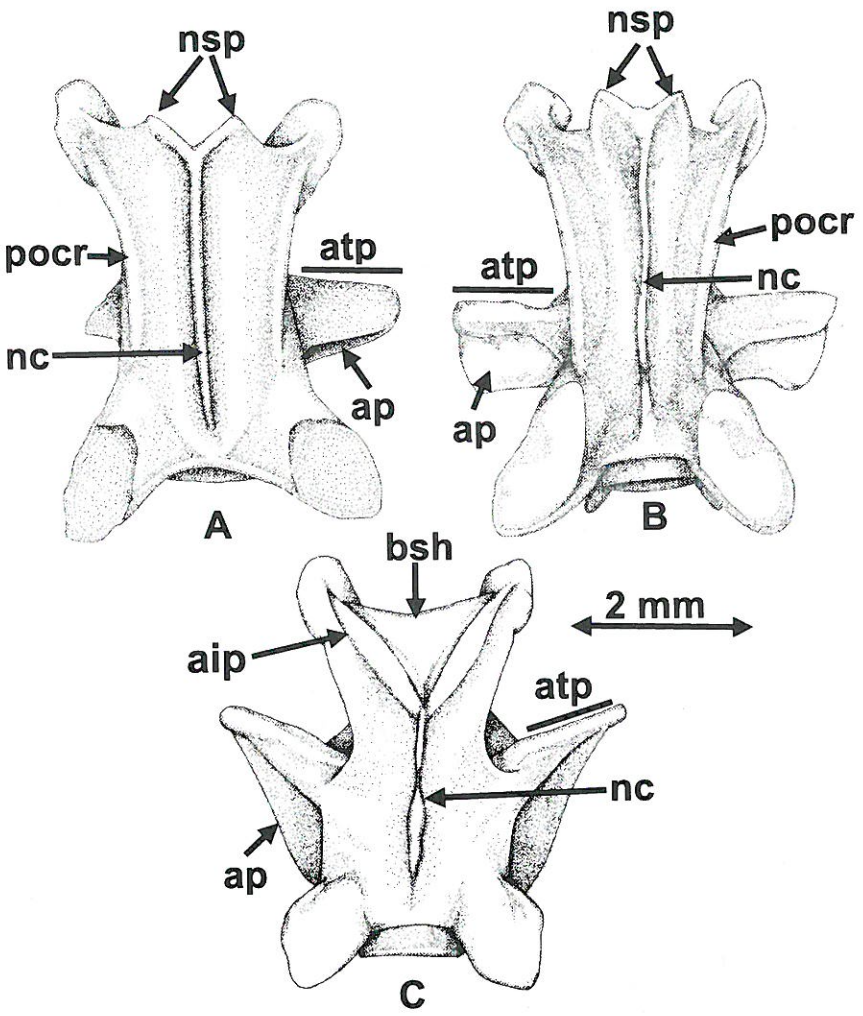

Figure 1. Comparison between trunk vertebrae of *Amphiuma* and *Siren*. All vertebrae are shown in dorsal view with the anterior end pointing to the bottom of the figure. A, Clark Quarry *Amphiuma* sp. fossil (GCVP 8310); B, Recent *Amphiuma means* (GC-H 4797), and C, Recent *Siren intermedia* (GC-H 4489). Osteological abbreviations: ap, anterior alar process; aip, aliform process; atp, angle of transverse process; bsh, bone sheet between aliform processes; nc, neural crest; nsp, neural spine; pocr, postzygapophyseal crest.

Amphiumid vertebrae resemble those of the sirenid genera *Siren* and the diminutive *Pseudobranchus* in having elongate centra with alar processes, well-developed neural crests, and well-developed subcentral keels along the ventral aspect of the centra. In spite of these similarities, *Amphiuma* vertebrae (and the fossils) differ from those of *Siren* and *Pseudobranchus* in having less extensive alar processes, lacking widely diverged aliform processes, having postzygapophyseal crests, and in having differently positioned transverse processes. In *Amphiuma*, the alar processes (especially the anterior ones) are shaped differently and are much less expansive in their lateral and anterior extent than those of the sirenids (see Fig. 1B, C). The alar processes of the fossils are badly damaged, but they retain enough of the structures to determine that they were amphiuma-like (Fig. 1A). The short, divergent neural spines of *Amphiuma* (Fig. 1A, B) are in strong contrast to what is seen in *Siren*: widely divergent aliform processes with a thin shelf of bone between them that projects off the posterior lateral margins of the neural arch (Fig. 1C). We do not know if this "paraaliform" shelf of bone is unique to Sirenidae, but it never occurs in *Amphiuma*. As previously mentioned, postzygapophyseal crests are a derived character state unique to *Amphiuma* (see Fig. 1A, B). Also, the transverse processes of *Amphiuma* are positioned perpendicular (or nearly so) to the long axis of the centra (Fig. 1A, B), whereas in sirenids they are oblique to the long axis, and are directed posteriorly (Fig. 1, C).

Although the fossils are confidently referred to genus, the specific identification of isolated *Amphiuma* vertebrae is problematic. Four species of *Amphiuma* are known: the late Paleocene species *A. jepseni* Estes and the Recent species *A. means*, *A. tridactylum* Cuvier and *A. pholeter* Neill. Fossils of *A. jepseni* were not available for comparison during this study, but considering the geographic and temporal separation between the two localities (late Paleocene of Wyoming vs. late Pleistocene of Georgia), it is highly unlikely that the Clark Quarry fossils pertain to this taxon. During the course of this study we did, however, critically examine isolated trunk vertebrae from nine individuals of *A. means*, five of *A. tridactylum*, and one of *A. pholeter* to determine if we could distinguish the species on the basis of vertebral differences. Other than the fact that the trunk vertebrae of large adult *A. means* and *A. tridactylum* were consistently larger than those of the smaller species *A. pholeter*, we could not differentiate isolated *Amphiuma* vertebrae to species. Compared to Recent specimens, GCVP 8310 and 8311 represent a small amphiumid(s) with a total length of approximately 340 mm. Although this is within the size range of adult *A. pholeter*, it also is within the size range of small individuals of *A. means* and *A. tridactylum*. Although the fossils cannot be assigned to *A. means* on the basis of vertebral morphology, this is the species that would be expected in the paleofauna on the basis of (1) the young age of the fauna (cf. 12, 000 yrs BP), and (2) it being the only living amphiumid species that occurs today in SE Georgia (14). Nonetheless, we hesitate to make a species determination on the basis of temporal and biogeographic considerations.

DISCUSSION

This is only the second report of a fossil amphiumid salamander in Georgia. Hulbert and Pratt (12) reported that fossil *Amphiuma means* (dentaries and vertebrae) were common in the coastal Rancholabrean Isle of Hope fossil site of Chatham County, Georgia. They did not provide osteological evidence for their allocation of the fossils to *A. means*; presumably their identification was based on the present day biogeographic distribution of the species. We recently examined the Isle of Hope material, and although the vertebrae are likely too large to be *A. pholeter*, they are within the size range of extant *A. means* and *A. tridactylum*. Here we provide evidence that the vertebral morphology of amphiumid salamanders is very distinctive at the generic level, but is too homogeneous at the Recent species level to differentiate isolated vertebrae at this taxonomic position.

Based on the known habitat requirements of Recent *Amphiuma* (e.g., 14, 15, 16, 17), its presence in the Clark Quarry local fauna suggest that an aquatic habitat such as (for example) a swamp, sluggish stream, or a pond was present in the Clark Quarry area during the time of deposition. This is supported by fossils of other vertebrates in the Clark Quarry fauna such as ranid frogs, alligators, aquatic pond turtles, and natricine snakes (including *Thamnophis* and *Nerodia* [see 18]).

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