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THE GROUND SLOTHS (PILOSA) OF SOUTH CAROLINA

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ABSTRACT

A summary of museum and literature records of ground sloths collected from South Carolina is presented. The ground sloth record in South Carolina consists of three genera, *Eremotheirum* with two species, *Megalonyx* with three species and *Paramylodon* with one species. Three of these species, *Eremotherium eomigrans* and *Megalonyx leptostomus* from the Blancan and *Megalonyx wheatleyi* from the Irvingtonian are new records for the state. An early Pliocene specimen of *M. leptostomus* is the earliest record of sloths from South Carolina. The fossil record of sloths in the state extends from the Pliocene (Blancan) through the Pleistocene (Late Rancholabrean) and is confined to sedimentary deposits on the Coastal Plain.

Introduction

The southeastern United States has long been recognized as a source of vertebrate fossils, most Pleistocene fossils from the region having been found in Florida. Early publications contain numerous records of Pleistocene material from South Carolina (Leidy, 1853; 1854; 1855; 1856; 1859; 1860; 1877; Hay, 1923; Allen, 1926). More recent works (Ray, 1965; Ray *et al.*, 1968; Roth & Laerm, 1980; Ray & Sanders, 1984; Bentley & Knight, 1994, 1998; Bentley *et. al.*, 1994; McDonald *et al.*, 1996; Sanders, 2002) have added many additional Pleistocene vertebrate taxa to the fossil record of South Carolina. This paper supplements published reports of pilosan taxa with numerous new records from the state. A map of South Carolina with fossil localities is provided in figure 1.

Fossil remains of ground sloths in the United States were first reported by Thomas Jefferson (1799), and Harlan's (1825) note of their occurrence at Skiddaway Island, Georgia, is the earliest published record from the southeastern United States. Sloth remains were first reported from South Carolina by Holmes (1848: 663), who briefly mentioned bones of "*Megatherium*" from the Charleston area. For many years giant ground sloth specimens from North America were referred to the genus *Megatherium*, a prominent form in the Pleistocene fauna of South America, but North American megatheres are referable to the genus *Eremotherium* Spillman, 1948, (Cartelle & DeIuliis, 1995). Taxonomic revisions within that genus were reviewed by Sanders (2002: 28). Leidy (1855) commented on two small tooth fragments from the "shores of the Ashley River," Charleston County, in his discussion of *Megatherium mirable* (= *Eremotherium laurillardi*) from Skiddaway Island, Georgia and also reported and figured a fragmentary molariform tooth of *Mylodon harlani* (= *Paramylodon harlani*) from the Ashley River (Leidy, 1855: 10, pl. 16, fig. 21). Subsequently, Leidy (1859: 111, pl. 20, figs. 7-7b, 8, 8a) noted and figured a partial molariform tooth of *Mylodon* (= *Paramylodon*) *harlani* and a fragment of a tooth of *Megatherium mirable* (= *Eremotherium laurillardi*) from the "Post-Pleiocene [= Pleistocene] beds of the Ashley River." Additional records of sloths from South Carolina were reported by Hay (1923), Allen (1926), Roth & Laerm (1980), and Sanders (2002). These reports indicate that ground sloths were relatively common components of the Blancan (early Pliocene-early Pleistocene), Irvingtonian (early-middle Pleistocene), and Rancholabrean (late Pleistocene) faunas of South Carolina.

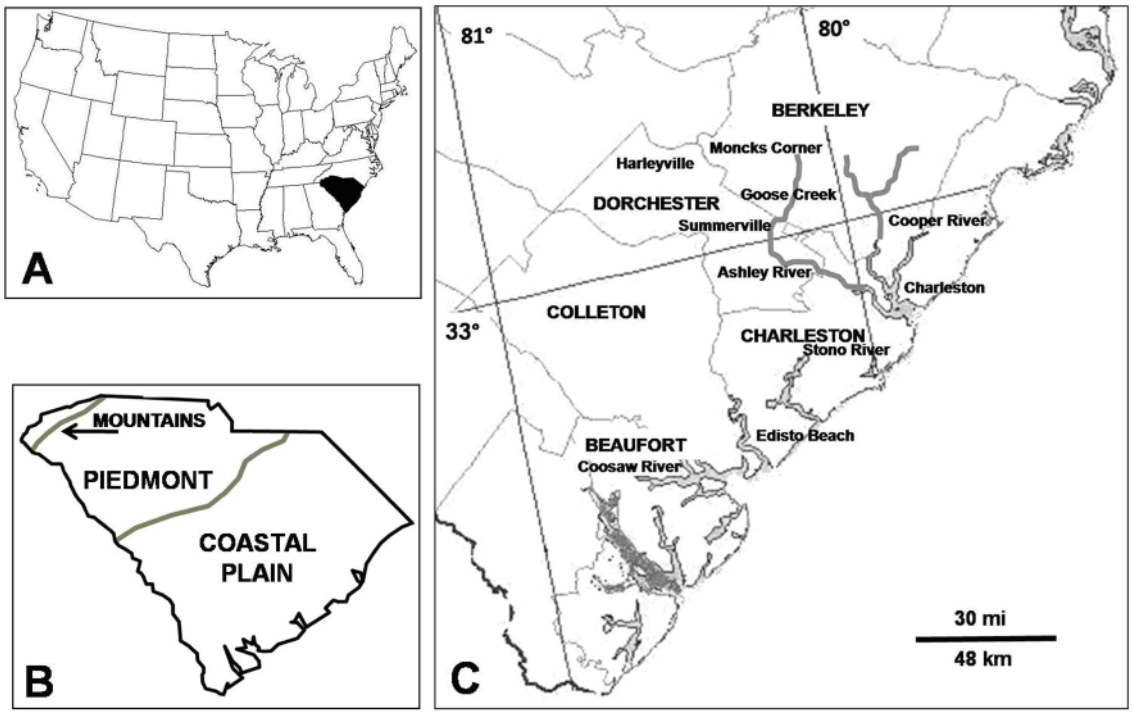

Figure 1. South Carolina and ground sloth fossil localities: A) Map of United States showing location of South Carolina; B) Map of South Carolina showing physiographic provinces; C) Localities on the Coastal Plain of South Carolina where ground sloth fossils have been collected. Map by S. Fields.

During the last few decades many fossils have been collected by divers on the bottom of various rivers on the Lower Coastal Plain of the state, most of the fossils having been washed from their original stratigraphic origin. Frequently consisting of reworked shark teeth, such specimens often are of comparatively little scientific value, but occasional specimens of extreme significance are found in the rivers. Examples include a complete skull of the Pleistocene tapir *Tapirus veroensis* (ChM PV4247), found at the bottom of the Cooper River by a hobby diver (Ray & Sanders, 1984) and a splendidly preserved skull of the giant Pleistocene beaver *Castoroides leiseyorum* (SCSM 75.33.1), also found at the bottom of the Cooper River (Parmalee & Graham, 2002).

Fifty years ago, the stratigraphic origins of many specimens recovered from rivers in the Lowcountry near Charleston would have been difficult to determine, but a vigorous geological survey of 16 quadrangles between Charleston and Moncks Corner and adjoining areas by R.E. Weems and E.M. Lemon Jr., of the U.S. Geological Survey has resulted in eight highly detailed geologic maps that define the various stratigraphic units within this region with a high degree of accuracy (Weems & Lemon, 1984). Consequently, it is now possible to place much more reliable dates on the fossils of the Charleston-Summerville-Moncks Corner region and adjoining areas (see figure 2). For example, it is now clear that the *Tapirus* skull from the Cooper River (and probably the *Castoroides* skull, as well) was eroded from the late Pleistocene Wando Formation, a marine unit that was deposited widely over the area around Charleston during Sangamonian time. A number of ChM sloth specimens from the late 19th century and early part of the 20th century have little or no locality data, but the fourth author's knowledge of the history of the ChM collections and the stratigraphy of the Charleston-Summerville-Moncks Corner region, based on the work of Weems & Lemon (1984; 1988) permits reasonably accurate judgments as to the particular stratigraphic unit from which those specimens likely came. Those specimens are included in this paper, along with numerous other previously unreported specimens from South Carolina.

One potentially confusing situation requires clarification. The reader will note that for some specimens included in this paper Edisto Beach is noted as being in Charleston County, but other Edisto specimens are recorded from Colleton County. That situation exists for two reasons. Historically, Edisto Island has been entirely in Charleston County, but in 1975 citizens of the Town of Edisto Beach, which incorporates a small portion of the southernmost end of the island, voted for annexation of the town into the adjoining Colleton County. That area includes the beach in front of Edisto Island State Park, a prime place for collecting fossils. The Charleston Museum contains many specimens from the beachfront along Folly Island, some dating to a period before the founding of the town and the State Park. Fossils can be found on the beach in front of the State Park and for at least 3.75 miles north of the park to Edingsville Beach, but museum records often give only "Edisto Beach" as the locality. Consequently, it has been impossible to determine which specimens may have been collected within the present-day Colleton County boundary. For that reason, and because Edisto specimens accessioned before the annexation were in fact collected in Charleston County, that county name has been retained in the Charleston Museum records for many of its specimens from the Edisto Island beachfront.

The Pilosa of South Carolina comprises three families with three genera and six species. Florida, with its long history of paleontological research, records seven taxa of late Pliocene-Pleistocene ground sloths (Hulbert, 2001). South Carolina, then, ranks second in the southeastern United States with regard to ground sloth diversity (table 1).

The purpose of this paper is five-fold: 1) To provide evidence for the presence three taxa new to the sloth paleofauna of South Carolina; 2) To update the taxonomic list of ground sloths recorded from South Carolina; 3) To compare the sloth faunal lists of various states in the southeastern United States; 4) To inventory sloth elements from South Carolina that are cataloged in various museum collections; 5) To demonstrate relative numbers of taxa and sites of collection.

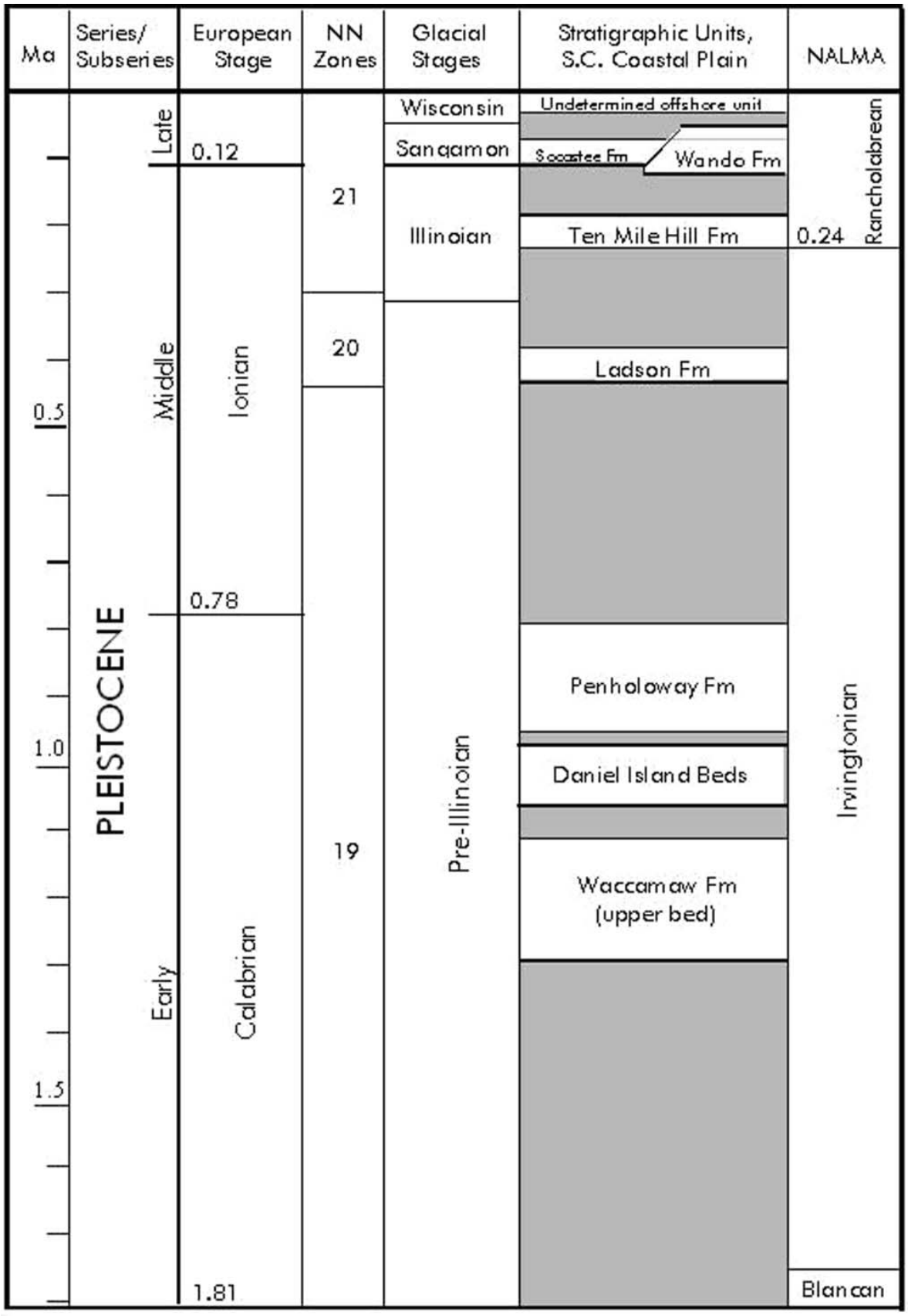

Figure 2A. Chronostratigraphic sequence of Pleistocene units on the Coastal Plain of South Carolina (after Bybell, 1990; Sanders *et al.,* 2009, with modifications). Time divisions and calcareous nannoplankton (NN) zones follow Lourens *et al.* (2004). Boundary of Blancan/Irvingtonian Land Mammal Age follows Bell *et al.* (2004). Boundary of Irvingtonian/ Rancholabrean follows Sanders (2002) and Sanders, *et al.* (2009) based upon *Bison* astragalus from Ten Mile Hill Formation.

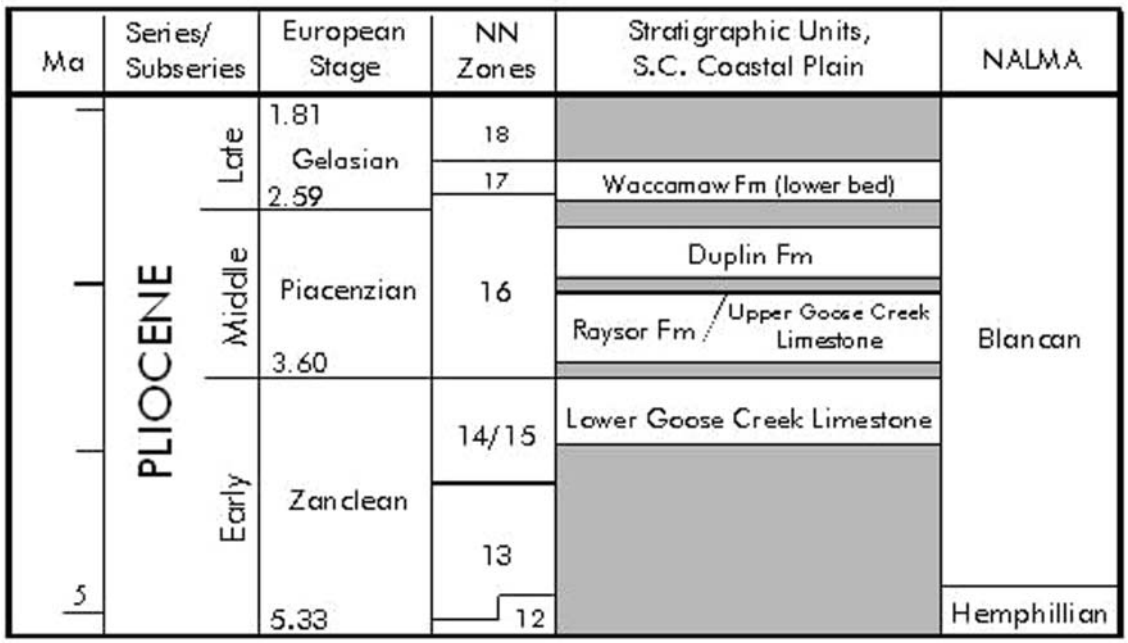

Figure 2B. Chronostratigraphic sequence of Pliocene units on the Coastal Plain of South Carolina (after Campbell & Campbell, 1995). Time divisions and calcareous nannoplankton (NN) zones follow Lourens *et al.* (2004). Boundary of Hemphillian/ Blancan Land Mammal Age follows Bell *et al.* (2004).

	Alabama	Florida	Georgia	Louisiana	Mississippi	North Carolina	South Carolina
Eremotherium laurillardi		4	5				9
Eremotherium eomigrans		1				1	1
Megalonyx jeffersonii	4	24	1	2	4	2	12
Megalonyx wheatleyi		5					1
Megalonyx leptostomus		5					1
Paramylodon harlani	1	8	1	2			5
Nothrotheriops texanum		2					

Table 1. Distribution of Pleistocene ground sloths in the southeastern United States. Compilation based on a review of the literature and unpublished sites and collections. The number indicates the number of localities for a given taxon from each state.

Abbreviations

Institutional
AMNH, American Museum of Natural History;
ANSP, Academy of Natural Sciences of Philadelphia;
ChM, The Charleston Museum;
FMNH, Florida Museum of Natural History;
MCZ, Museum of Comparative Zoology, Harvard University;
NCSM, North Carolina State Museum;
SCSM, South Carolina State Museum;
USNM, United States National Museum of Natural History.

Other
AP, anteroposterior;
ML, mediolateral;
Ma, millions of years;
ka, thousands of years;
YBP, years before present.

Material and Methods

In order to make this review as complete as possible we conducted a review of the literature in addition to examining specimens in collections. Examination of museum collections revealed numerous unpublished records of ground sloths from South Carolina. All measurements were taken with dial calipers, digital calipers,

or a measuring box (see von den Driesch, 1976: 10), and reported in millimeters to one decimal place unless otherwise specified. Nomenclature and taxonomy follow McKenna & Bell (1997) & Hulbert (2001). Images and measurements (in mm) of selected specimens are provided

Systematic Paleontology

Class Mammalia
Order Xenarthra
Suborder Pilosa
Family Megatheriidae
Eremotherium

Eremotherium laurillardi

Locality – Charleston Co. or Dorchester Co.: Ashley River.

Material – (1) Partial ungual (AMNH 32595) (as "*Megatherium mirabile*"); (2) Molariform fragments (AMNH 95772) (as "*Megatherium mirabile*").

Formation – Wando.

Horizon – Late Pleistocene (Weems & Lemon, 1984; Szabo, 1985); late middle Rancholabrean.

Locality – Berkeley Co.; 68 m northwest of U.S. Route 52, 3.86 km southwest of old Route 52 in Moncks Corner (33°10.1'N, 80°1'44" W); A.*E.* Sanders and party, May 1975.

Material – Partial postcranial skeleton (ChM PV4803) including right clavicle, right humerus, right and left radii, right ulna, right second phalanx of manus, right third ungual of manus, partial right femur, right and left fibulae, right and left astragali, right tarsal, right fourth metatarsal, right third ungual of pes, 13 vertebrae, portions of several ribs.

Formation – Ladson.

Horizon – Middle Pleistocene, Irvingtonian.

Comments – Sanders (2002) reported this animal as a large specimen, the right radius having a length of 790 mm. DeIuliis (1996) reported a range of 600 to 820 mm (mean = 700 mm, n =12) for the length of the radius in *E. laurillardi*, so this individual is only slightly larger than the mean of the size range for the species.

Locality – Charleston Co.: Ditch beside Casey Recreation Center, Old Moncks Corner Road, 0.4 mi NE U.S. Route 178 in Goose Creek, A.E. Sanders, B. Palmer *et al.*, April 2007.

Material – Posterior portion of left dentary; two partial teeth and several tooth. Fragments; left humerus; carpal; thoracic vertebra; elements of two ribs (ChM PV7678).

Formation – Ladson.

Horizon – Middle Pleistocene, Irvingtonian.

Locality – Dorchester Co.: Ditch opposite O.K. Tire Store, Trolley Road (County Road 199), 0.2 km east of Dorchester Road (S.C. Route 642) (32° 52'N, 80° 2'11" W); Vance McCollum, 6 November 1981.

Material – Partial molariform (ChM PV5842).

Formation – Ten Mile Hill.

Horizon: Late middle Pleistocene, early Rancholabrean.

Locality – Berkeley Co.: Bottom of west branch of Cooper River, ca. 1.8 km SSE Strawberry Chapel; L.B. Albright III, summer 1976.

Material – Ungual (ChM PV9005) AP 150.0, ML 37.0.

Formation – Wando.

Horizon – Early late Pleistocene, late middle Rancholabrean.

Locality – Cooper River.

Material – Molariform (SCSM 88.175.1), AP 48.5, ML 57.0.

Formation – Wando.

Horizon – Early late Pleistocene, late middle Rancholabrean.

Locality – Charleston Co.: East bank of lake, 183 m southeast of Ree Street, Trailwood Trailer Park, east side of SC Route 642 (Dorchester Road), ca. 12 km north of Charleston. A.E. Sanders, P.S. Coleman *et al.*, November 1982.

Material – Partial skull, mandibles, teeth, parts of post-cranial skeleton (ChM PV 4748).

Formation – Penholoway.

Horizon – Late early Pleistocene, middle Irvingtonian.

Reference – Sanders (2002).

Comments – This is the earliest known record of *Eremotherium laurillardi* from South Carolina. Sanders (2002) hesitated to refer this individual to *E. laurillardi* thinking that it might be referable to the late Blancan-Irvingtonian *Eremotherium eomigrans*. *E. eomigrans* is currently the only North American megathere known from the Blancan (De Iuliis & Cartelle, 1999).

E. eomigrans continued into the Irvingtonian and in Florida is present in the Haile 16A fauna (ca. 1.5 Ma), Leisey Shell Pit, Crystal River Power Plant, and the Payne Creek Mine, all considered to be between 1.3 and 1.0 Ma. Assignment of the Irvingtonian records of *Eremotherium* from South Carolina to *E. laurillardi* rather than *E. eomigrans* is reasonable since this record from the Penholoway Formation is considerably younger than the youngest records of *E. eomigrans* in Florida. An unequivocal identification to species is difficult given the general similarity in size and cranial and dental morphology of *E. eomigrans* to the later species *E. laurillardi*. While similar in size to *E. laurillardi*, the bones of the post-cranial skeleton of *E. eomigrans* are more gracile, the lesser tuberculum of the humerus is less prominent and it has a pentadactyl manus with ungual phalanges on digits I to IV.

Locality – No data. Vicinity of Charleston and Summerville; Charleston, Berkeley, Dorchester Counties. The following specimens have been in the Charleston Museum collections for many years but have no data regarding their respective localities, collectors, or dates of collection.

Formation – Probably Ten Mile Hill Formation (late middle Pleistocene, early Rancholabrean), as suggested by the light coloration and degree of permineralization of the specimens.

Material – Distal end of left tibia (ChM PV7689); right radius (ChM PV7690); proximal end of right tibia (ChM PV7694); proximal portion of left tibia (ChM PV7695); proximal portion of right radius (ChM PV7696); proximal end of right humerus (ChM PV7697); astragalus (ChM PV7698); distal end of right tibia (ChM PV7699); left tibia (ChM PV7700); four caudal vertebrae, one lumbar, associated (ChM PV7705); distal end of radius (ChM PV2706); undetermined bone fragment (ChM PV7607).

Locality – Charleston Co.: Bolton Phosphate Mine, Stono River; ca. 1880.

Material – Partial left dentary with 2nd and 3rd molariform teeth (ChM PV7702).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – Charleston Co.; Cooper River, ca. 1880.

Material – Vertebral neural arch with spinous process (ChM PV7691).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – Charleston Co.: Kiawah Phosphate Mine, Cooper River; Ed Robertson, ca. 1890.

Material – Fragment of right maxilla with 2nd and 3rd molariform teeth (ChM PV 7701).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – Charleston Co.: Cooper River, B. Albright, summer 1975.

Material – Thoracic vertebra (ChM GPV 1977).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – Charleston Co.: Hoopstick Island, Bohicket Creek, Johns Island Chamberlain, October 1937.

Material – Thoracic vertebra (ChM PV7692).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – "Phosphate workings near Charleston, SC" (AMNH).

Material – First phalanx (AMNH 13712) "*Megatherium* sp." (= *E. laurillardi*).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – "Ashley phosphate beds" (AMNH).

Material – (1) Partial molariform (AMNH 12532); "*Megatherium*" (= *E. laurillardi*); (2) Proximal humerus (ANSP 12550): "*Megatherium*" (= *E. laurillardi*).

Formation – Wando.

Horizon – Late Pleistocene, late-middle Rancholabrean.

Reference – Leidy (1859; 1860; 1877).

Locality – No data. Vicinity of Charleston.

Formation – Probably the Wando (late Pleistocene, late middle Rancholabrean), as suggest-

ed by the degree of permineralization of the specimens.

Material – Distal end of right tibia (ChM PV7688); partial carpal (ChM PV7693); caudal vertebral centrum (ChM PV7703); podial (ChM PV7704); undetermined bone fragment (ChM PV7707); caudal vertebra (ChM PV7709).

Locality – Colleton Co.: Edisto Beach.

Material – Three elements identified as "*Eremotherium* cf. *E. mirabile*" (Roth & Laerm, 1980) (= *Eremotherium laurillardi*), one (ChM PV2454) subsequently redetermined as *Cuvieronius* sp.; (1) Ungual (ChM PV2426); (2) Lumbar vertebral fragment (ChM PV2400).

Formation – Undetermined offshore unit (Sanders, 2002).

Horizon – Late Pleistocene, late Rancholabrean.

Locality – Charleston Co.: Edingsville Beach, Edisto Island; G.W. Seabrook, ca. 1920.

Material – Badly worn right tibia missing proximal end (ChM PV7687).

Formation – Undetermined offshore deposit.

Horizon – Late Pleistocene; late Rancholabrean.

Locality – Charleston Co.: Edisto Beach; E.B. Chamberlain, R.N.S. Whitelaw, 14 April 1930.

Material – Thoracic vertebra.

Formation – Undetermined offshore deposit.

Horizon – Late Pleistocene; late Rancholabrean.

Locality – Charleston Co.: Edisto Beach; Edmund R. Cuthbert, Jr.

Material – Partial ungual (ChM PV5696).

Formation – Undetermined offshore deposit.

Horizon – Late Pleistocene; late Rancholabrean.

Eremotherium eomigrans

Locality – Dorchester Co.: Greenhurst Subdivision, near Summerville: Walrus Ditch Local Fauna.

Material – Tooth and postcranials: some elements depicted in figure 3: (1) Calcaneum (SCSM 89.240.21) (see figure 3A). Length AP 417, ML proximal end 208; (2) Partial right ulna (SCSM 89.240.22); (3) Thoracic vertebral centrum (SCSM 89.240.23). Height 85.6, AP 99.7, ML 105.6; (4) Partial molariform (SCSM 89.240.24) (see figure 3B) AP 45.4, ML 58.7; (5) Metacarpal (right MC IV) (SCSM 89.240.25); (6) Partial ungual (SCSM 89.240.26); (7) Patella (SCSM 89.240.27). Height 154.6, AP 69.8, ML 110.9; (8) Middle tarsal (SCSM 89.240.28); (9) Partial sacral or sternal rib (SCSM 89.240.29; (10) Thoracic vertebra (SCSM 89.240.30). Height 93.4, AP 106.2, ML 114.3; (11) Distal portion of radius (SCSM 89.240.31) AP 95.3, ML 90.3; (12) Unciform (SCSM 89.240.32); (13) Scapular fragment (SCSM 2006.1.40); (14) Partial thoracic vertebra (SCSM 2006.1.41). Centrum height 79.6, AP 85.7, ML 104.4; (15) Cuneiform (SCSM 2006.1.42); (16) Scapular fragment (SCSM 2006.1.43); (17) Metacarpal (left MC IV) (SCSM 2006.1.44); (18) Ungual (SCSM 2006.1.45) (see figure 3C) AP 225.0, ML 67.8; (19) Ungual (SCSM 2006.1.46) AP 195.3, ML 56.8; (20) Thoracic vertebral centrum (SCSM 2006.1.47). Height 88.2, AP 111.2, ML 108.7; (21) partial rib (SCSM 2006.1.48).

Comments – Assignment of the *Eremotherium* material from this locality to *E. eomigrans* is based on the age of the fauna, which is a typical Blancan assemblage and includes the following Blancan indicator taxa (Morgan & Hulbert, 1995): *Smilodon gracilis*, *Nannippus peninsulatus*, *Canis lepophagus*, and the ground sloth *Megalonyx leptostomus*. This is the first report of *E. eomigrans* from South Carolina.

Formation – Assignment to this unit is based upon constraints imposed by the occurrence of *Nannippus* and *Erethizon* at this locality, the youngest date for *Nannippus* being 2.2 Ma (Morgan *et al.*, 2008) and the oldest date for *Erethizon* being 2.6 Ma (Albright, 1999: 93-94). Campbell & Campbell (1995: 66) placed the age of the lower bed of the Waccamaw at 2.4-2.53 Ma, which coincides with the dates for *Nannippus* and *Erethizon*.

Horizon – Late Pliocene, middle to late Blancan.

Comments – While there is an extensive record of *Eremotherium* in Florida, many of the records are from sinkhole deposits and age assignment can be determined only from the associated fauna. The numerous specimens of *Eremotherium* in South Carolina with a stratigraphic context provide some of the best information on the chronology of the species for North America. The recovery of the earliest species of *Eremotherium*, *E. eomigrans*, from

Figure 3. Elements of *Eremotherium eomigrans* from the late Blancan Walrus Ditch Local Fauna near Summerville, Dorchester County, SC: A) SCSM 89.240.21 calcaneum; B) SCSM 89.240.24 molariform; C) SCSM 2006.1.45 distal phalanx (ungual). This is the first report of this taxon from South Carolina. Photography by S. Fields.

the Walrus Ditch fauna, is the first record of this species outside of Florida, extending the geographic range of the species. Based on the South Carolina stratigraphic record of the genus it appears that *Eremotherium* was present in South Carolina until its extinction in the Rancholabrean. There are no Rancholabrean records of *Eremotherium* from South Carolina with radiocarbon dates and based on the current available records it appears that the genus had disappeared from the region prior to the late Pleistocene extinction event. Its disappearance from North America before the end of the Pleistocene has been noted by McDonald and Lundelius (2009). Four specimens from Edingsville Beach and adjacent Edisto Beach (ChM PV7687, ChM PV5696, PV2426, PV2400) document the presence of this genus on the emerged Coastal Plain in the Late Rancholabrean during the Wisconsin glacial stage. As summarized by Sanders (2002: 133-134), 28 genera of land mammals representing a paleoenvironment consisting of grassland (*Bison, Equus, Palaeolama*), forest (*Eremotherium, Mammuthus, Mammut*), and stream bank (*Castor, Castoroides, Tapirus*) habitats are recorded in the Charleston Museum collections. The prolific abundance of fragments of the shells of freshwater turtles found on Edisto Beach indicate the presence of streams with little or no salinity and "[t]he abundance of their remains suggests that freshwater streams were plentiful, at which time the shoreline would have been a considerable distance seaward of the present strand line at Edisto Beach." (Sanders, 2002: 133).

Given the paleontological implications of an inland paleoenvironment, Sanders (2002: 134) postulated that "the Pleistocene land mammals from this locality probably date from Mid-Wisconsinan through Late-Wisconsinan time, since

a substantial portion of the early Wisconsin must be allowed for the gradual development of topsoil to nourish [a succession of] plants that would form suitable habitats on the then-newly-exposed coastal margin as sea level was receding." If such were the case, the offshore fossil-bearing deposits nearest to the present shoreline would likely be of Mid-Wisconsinan age, those at the edge of the Continental Shelf clearly dating from the Wisconsinan glacial maximum. A mid-Wisconsinan age for the Edisto terrestrial fauna is supported by an amino-acid date of 40,000 years obtained from a fragment of shell of a freshwater turtle (*Pseudemys*) in connection with an experimental study by R.E. Weems (U.S. Geological Survey) and Sanders (2002). However, the age(s) of the various components of the Edisto Beach Faunal Assemblage are not precisely known. Evaluation of a number of other taxonomic groups suggests that several ages are assignable to the various components of the faunal assemblage (Knight and D. Cicimurri, in prep).

In concluding that *Eremotherium* did not survive into the latest Pleistocene in North America, McDonald & Lundelius (2009: 413) cited a date of 38,860 + 1300 RCYBP as the youngest record for the genus in the United States. Thus, the amino-acid date of 40,000 YBP inferred for the Edisto Island Rancholabrean fauna and its eremothere components are in accordance with their data.

Family Megalonychidae
Megalonyx
Megalonyx jeffersonii

Locality – Charleston Co.: Edisto Beach.

Material – (1) Molariform (ChM PV 2423): AP 36.4, ML 18.2; (2) Molariform (ChM PV2427): AP 15.2, ML 14.2; (3) Molariform (juvenile) (ChM PV2455): at base AP 12.2, ML 14.3; at tip: AP 10.8, ML 11.4; (4) Upper left caniniform (ChM PV5706); Length 36.7, width 17.8; (5) Molariform (ChM PV5707): AP 16.7, ML 21.1; (6) Upper right caniniform (ChM PV5708): AP 34.5, ML 17.4; (7) Left astragalus (USNM 424556); (8) Left molariform (USNM 375841): AP 15; ML 26.8; (9) Lower left caniniform (USNM 424554); (10) Upper left caniniform (USNM 424555): length 36.1, width 17.1.

Formation – Undetermined offshore unit.

Horizon – Late Pleistocene, late Rancholabrean.

References – Roth & Laerm (1980), Sanders (2002).

Locality – Beaufort Co.: Coosaw River; Earle Sloan, c. 1905.

Horizon – Possibly late Pleistocene.

Material – Lower caniniform (ChM PV5850): Length 34.6, width 18.6.

Reference – Sanders (2002).

Locality – Dorchester Co.: Ditch in Irongate subdivision west of Trolley Road (County Road 199), ca. 0.8 km north of Dorchester Road (S.C. Route 642); A.E. Sanders, summer 1981.

Material – Four articulated thoracic vertebrae with rib (ChM PV5853).

Formation – Wando.

Horizon – Late Pleistocene, Rancholabrean.

Reference – Sanders (2002, fig. 7).

Locality – Dorchester Co.: Harleyville, Giant Cement Company quarry, S.C. Route 453, 0.75 mi. NE I-26. Ardis Local Fauna.

Material – Upper third molariform (SCSM 93.105.194): AP 13.9; ML 20.5.

Horizon – Late Pleistocene, late Rancholabrean.

Reference – Bentley *et al.* (1994).

Locality – Berkeley Co.: Bottom of West Branch of Cooper River; ca. 1.1 mi SE Strawberry Landing; L.B. Albright III, summer 1976.

Material – Partial posterior thoracic vertebra (ChM PV7682): Width across transverse process approx. 180, length of neural spine: 131.7.

Formation – Probably Wando.

Horizon – Probably late Pleistocene, late middle Rancholabrean.

Locality – Berkeley Co.: Amoco Site, Cooper River.

Material – Mandibular symphysis with two caniniforms (SCSM 77.8.4): Left caniniform length 29.9, width 15; right caniniform length 30, width 15.

Formation – Probably Wando.

Horizon – Probably late Pleistocene, late middle Rancholabrean.

Locality – Berkeley Co.: Cooper River.

Material – Numerous isolated teeth and postcranial elements: (1) Femoral head (SCSM

75.41.116): Greatest diameter 92.3; (2) Proximal right ramus (SCSM 79.38.194); (3) Partial ramus with one molariform (juvenile) (SCSM 79.38.143): Molariform AP 9.1, ML 12.7; (4) Lower right caniniform (juvenile) (SCSM 79.38.142): Crown length 18.0, width 8.5, base length 25.8, width 12.1; (5) Second phalanx of manus (SCSM 79.38.140): AP 70.91, ML 30.2; (6) Co-ossified proximal and second phalanx of digit III of pes (SCSM 83.107.2): AP 81.2, ML 56.2; (7) Second phalanx of digit III of pes (SCSM 80.85.11): AP 59.7, ML 54.8; (8) Right astragalus (SCSM 75.31.52): AP 87.1, ML 78.02; (9) Upper left caniniform (SCSM 86.58.18): Length 33.6, width 16.1; (10) Upper right caniniform (SCSM 79.38.39): Length 40.5, width 19.5; (11) Lower right caniniform (SCSM 79.38.141): Length 33.4, width 15.9; (12) Upper left caniniform (SCSM 83.83.11): Length 30.5, width 15.9; (13) Ungual (SCSM 79.38.82): AP 147.8, ML 39.6; (14) Ungual (SCSM 76.15.3): AP 127.8, ML 34.7; (15) Ungual (SCSM 75.41.78): AP 102.8, ML 31.43; (16) Ungual (SCSM 96.12.15): AP 153+ (distal portion missing), ML 40.5; (17) Ungual (SCSM 75.31.177): AP 116.7, ML 37.9; (18) Ungual (SCSM 83.83.13): AP 120.6, ML 33.1; (19) Caudal vertebra (SCSM 79.38.242): Centrum AP 48.1, ML 67.1; (20) Caudal vertebra (SCSM 79.38.84): centrum AP 52.1, ML 63.3; (21) Second phalanx (SCSM 77.8.11): AP 71.8, ML 37.9; (22) Right metacarpal IV (SCSM 79.38.102): AP 102.9, ML 37.6; (23) Partial humerus (proximal and distal ends missing) (SCSM 79.38.238): greatest transverse diameter of diaphysis 77.4, AP diameter 54.7; (24) Partial humerus (proximal and distal ends missing) (SCSM 73.38.300): greatest transverse diameter of diaphysis 71.8, AP diameter 56.8; (25) Partial humerus (proximal and part of distal ends missing) (SCSM 77.8.8): Greatest transverse diameter of diaphysis 69.2, AP diameter 59.8; (26) Distal portion of left humerus, trochlea missing (SCSM 77.8.6): greatest transverse diameter of distal end 195.3; (27) Left proximal ulna (SCSM 79.38.237): Greatest length 470 (estimated), AP diameter distal end 110.2; (28) Right ulna (SCSM 79.38.178): Greatest length 472, AP diameter distal end 111.8; (29) Sacrum (SCSM 79.38.240): Length along fused neural spines 323, greatest width approx. 275; (30) Left calcaneum (SCSM 79.38.235): AP 215.0, ML (width of tuber calcis) 204.0; (31) Right tibia (SCSM 79.38.236): Length 325.0, width of midshaft 86.0; (32) Left tibia (SCSM 96.43): Length 332.0, width of midshaft 76.0; (33) Four proximal ribs (SCSM 79.38.251, 252, 254 and 420).

Formation – Probably Wando.

Horizon – probably late Pleistocene, late middle Rancholabrean.

Locality – Dorchester Co.: East bank of Chandler Bridge Creek, ca. 0.1 mi. north of County Road 230. Rodent Ditch Local Fauna.

Material – (1) Proximal ungual (SCSM 99.43): Carina AP 43.7, ML 33.4; (2) Molariform (SCSM 99.43): AP 15.9, ML 23.4.

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Locality – Dorchester Co.: Between Summerville and Goose Creek: Crowfield Lake: Crowfield Local Fauna.

Material – Three upper molariforms, one tooth fragment, proximal phalanx of third digit of manus (SCSM all uncataloged).

Formation – Wando.

Horizon – Late Pleistocene, late middle Rancholabrean.

Reference – F. Grady, USNM, pers. comm.

Locality – Charleston Co.: Edisto Beach; E.R. Cuthbert, Jr., c. 1960.

Material – Proximal portion of left calcaneum.

Formation – Undetermined offshore deposit.

Horizon – Late Pleistocene; late Rancholabrean.

Megalonyx wheatleyi

Locality – Dorchester Co.: Giant Cement Company quarry, Camelot Local Fauna ca. four km north of Harleyville.

Material – SCSM 2003.75 and 2004.1: A large series of postcranial elements (ca. 300 specimens) representing a minimum of five individuals of various age groups.

Comments – A description of these elements was the basis of the senior author's Ph.D. dissertation and is beyond the scope of this paper. Fields (2010) provides a complete treatment of the Camelot *Megalonyx* series. In this paper we present only caniniforms from the site. McDonald (1977) and McDonald *et al.* (2000) demonstrated that length and width of the upper and

lower caniniforms were useful in delimiting the various taxa within the Family Megalonychidae; (1) Upper left caniniform (SCSM 2003.75.328): Length 36.1, width 18.8 (figure 4); (2) Upper left caniniform (SCSM 2003.75.409): Length 31.2, width 16.6; (3) Upper left caniniform (SCSM 2004.1.77): Length 38.9, width 18.6; (4) Upper left caniniform (SCSM 2004.1.30): Length 34.9, width 17.9; (5) Lower left caniniform (SCSM 2004.1.76): Length 34.4, width 16.6; (6) Lower left caniniform (SCSM 2004.1.3.1): Length 31.5, width 13.7; (7) Lower right caniniform (SCSM 2004.1.26.1): Length 32.5, width 14.7; (8) Proximal phalanx, digit III of pes (SCSM 2004.1.131): AP 52.8, ML 48.5 (figure 5); (9) Second phalanx, digit III of pes (SCSM 2004.1.130): AP 60.9, ML 53.0 (figure 5).

Horizon – Late-middle Pleistocene, late Irvingtonian.

Comments – Only the sample from the Camelot fauna includes diagnostic specimens that permit assignment to the species *M. wheatleyi* are included here, these include the caniniforms (figure 4) and unfused proximal and second phalanges of the third digit of the pes (figure 5). The specimens from Goose Creek should be considered *Megalonyx* cf. *wheatleyi* until taxonomically useful parts of the skeleton are recovered and the tentative assignment to *M. wheatleyi* is based primarily on their age, as this is currently the only species known for the middle and early Irvingtonian. However, the senior author is currently investigating quantitative and qualitative characters of *Megalonyx* from the Irvingtonian and will propose taxonomic revision for the genus. Until completion of the analysis, we follow the existing standard that recognizes *M. wheatleyi* from the Irvingtonian.

Measurements indicate that *Megalonyx* caniniforms from the Camelot fauna are intermediate in size between large individuals assigned to *M. jeffersonii* from the Rancholabrean and the smaller Blancan species, *M. leptostomus*, and fall into the range of other specimens assigned to *M. wheatleyi* (figure 6). In addition to their intermediate size, the morphology of the caniniforms conforms to the criteria of McDonald (1977) for *M. wheatleyi* in that the lingual column is better developed than in *M. leptostomus* but is not prominent as in *M. jeffersonii*. The lingual column is better defined by the more prominent grooves which are lacking in *M. leptostomus*.

Figure 4. Lingual view of upper left caniniform of *Megalonyx wheatleyi* from Camelot L.F: SCSM 2003.75.328. Photography by S. Fields.

Figure 5. Unfused phalanges of digit III of the pes in *Megalonyx wheatleyi* from Camelot L.F.: Left) SCSM 2004.1.131 proximal phalanx; Right) SCSM 2004.1.130 second phalanx. Photography by S. Fields.

Locality – Berkeley Co.: Goose Creek; drainage ditch on south side of County Road 996, 1.3 km southwest of U.S. Route 176; Jonathan Geisler, Bricky Way, 21 November 1992.

Material – Upper right molariform (ChM PV4930) AP 20.2, ML 29.1.

Formation – Ladson.

Horizon – Middle Pleistocene, late Irvingtonian.

Reference – Sanders (2002) as *M. jeffersonii*.

Locality – Berkeley Co.: Goose Creek: West side of U.S. Route 176, 0.8 km north of U.S. Route 52; Bill Palmer, 20 July 1997.

Material – Lower left molariform (ChM PV5847) AP 17.1; 24.8.

Formation – Ladson.

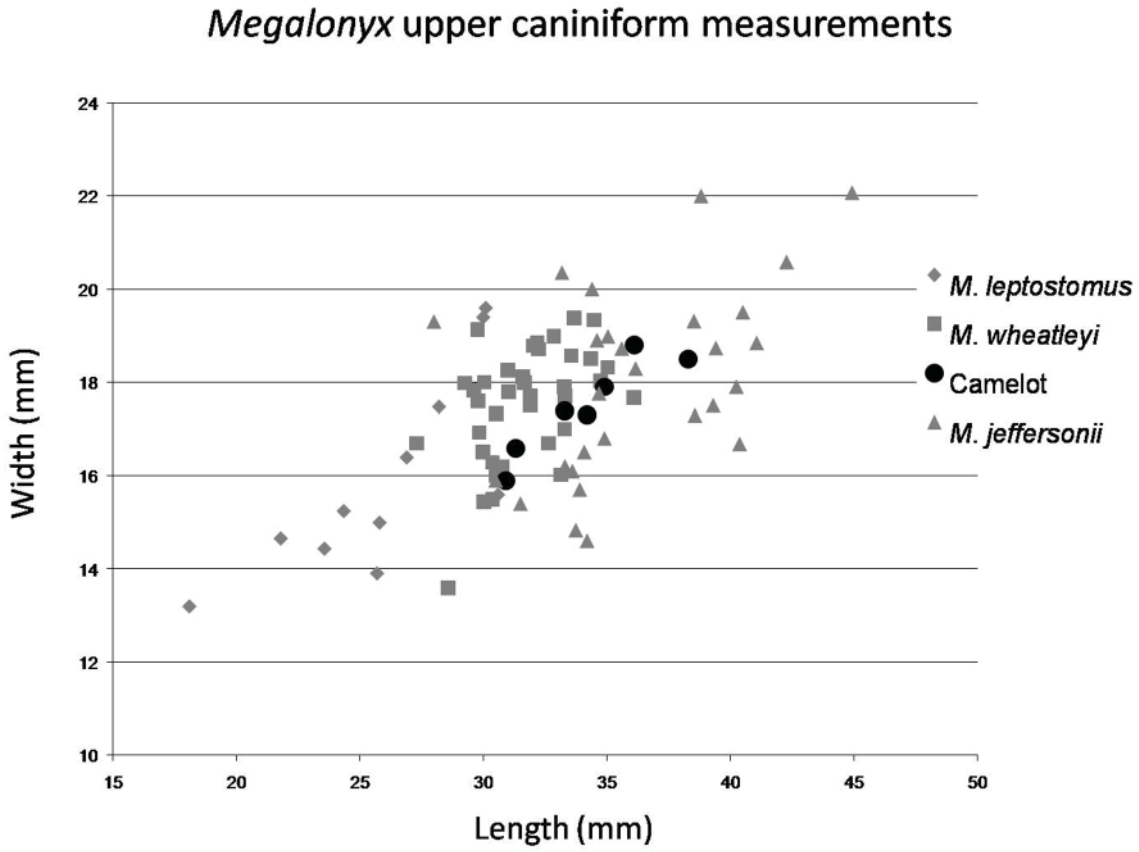

Figure 6. Scatter diagram of caniniform measurements of *Megalonyx* from various sites in North America. Specimens from the Camelot L.F. fall within the range of *M. wheatleyi*.

Horizon – Middle Pleistocene, late Irvingtonian.

Reference – Sanders (2002) as *M. jeffersonii*.

Megalonyx leptostomus

Locality – Dorchester Co.: Summerville: Walrus Ditch Local Fauna.

Material – (1) Molariform (SCSM 2006.1.101): AP 10.0; ML 15.5 (figure 7); (2) Partial molariform (SCSM 2006.1.102): AP 10+; ML 14.4 (figure 7); (3) Partial caniniform (SCSM 2006.1.103): AP 26.3+; ML 15.8; (4) Partial caniniform (SCSM 2006.1.104): AP 30.0; ML 15.9 Formation: Waccamaw (lower bed).

Horizon – Late Pliocene, late Blancan.

Comments – These specimens and the one below are the first known records of *M. leptostomus* in South Carolina. While the three specimens above can be easily assigned to the genus, none are diagnostic to species and assignment to *M. leptostomus* is based on the age of the fauna because only a single Blancan species is currently recognized.

Locality – Berkeley Co.: Bottom of West Branch of Cooper River, ca. 1.1 miles SE Strawberry Landing; L.B. Albright III, summer 1976.

Material – Left proximal humerus (ChM PV7681): Greatest transverse diameter: 115.2, greatest diameter of head: 69.4.

Formation – Goose Creek Limestone.

Horizon – Early Pliocene, early Blancan.

Comments – This specimen is the earliest record of sloths in South Carolina.

Family *Mylodon*tidae
Paramylodon
Paramylodon harlani

Locality – Berkeley Co.: Goose Creek.

Material – Dentary fragment, three rib fragments, three complete and two partial molariform teeth (AMNH 32596).

Formation – Uncertain. If the specimens came from a spot in the town of Goose Creek it is likely that they are from the middle Pleistocene Ladson Formation, but if they are from a point along the

Figure 7. Molariforms of *Megalonyx leptostomus* from the late Blancan Walrus Ditch Local Fauna near Summerville, Dorchester County, SC: SCSM 2006.1.101; SCSM 2006.1.102. This is the first report of this taxon from South Carolina. Photography by S. Fields.

stream by that name their stratigraphic origin could be the early late Pleistocene Wando Formation or, at higher elevations along the creek, the late middle Pleistocene Ten Mile Hill Formation.

Horizon – Middle Pleistocene, late Irvingtonian; early-middle late Pleistocene; early-middle Rancholabrean (Weems & Lemon, 1984; Szabo, 1985; Weems & Lemon, 1988; Sanders, *et al.* 2009).

Locality – Berkeley Co.: Bottom of Cooper River.

Material – (1) Right upper caniniform tooth with oblique wear (SCSM 78.23.59). AP 17.2; ML 14.0; (2) Right astragalus (SCSM 79.38.105). Greatest length: 152; greatest width 123; (3) Lower left third molariform (SCSM 79.38.40). AP 18.8; ML 31.1; (4) Right third metacarpal (SCSM 79.38.103). AP 107.2; ML 78.6; (5) Partial right zygoma (SCSM 79.38.265); (6) Partial left zygoma (SCSM 79.38.257); (7) Left mandible (SCSM 83.145.1). Total length: 316; alveolar length of cheek tooth row: 140.5; depth of ramus below third molariform: 90; (8) Right tibia (SCSM 79.38.106). Length: 263.6; AP proximal end: ca. 112; ML distal end: 149.7; AP distal end: 112.7.

Formation – Wando.

Horizon – Early late Pleistocene (Weems & Lemon 1984, Szabo 1985), late middle Rancholabrean.

Locality – Berkeley Co.: Bottom of Cooper River at "Amoco site" adjacent to Daniel Island.

Material: (1) Right upper caniniform (SCSM 77.8.9). AP 19.4, ML 14.6; oblique wear; (2) Cervical vertebra (SCSM 77.8.2). Total height 136.9; centrum AP 42.7, ML 67.7; (3) Left ulna (SCSM 77.8.7). Total length: 379.0; (4) Cervical vertebra (SCSM 77.8.1). Total height: 143.5; centrum AP 40.4. ML 68.7; (5) Left tibia (SCSM 77.8.5). Length: 262.3; AP proximal end 137.2; ML distal end: 146.6; AP distal end: 116.2.

Formation – Probably Wando.

Horizon – Probably early late Pleistocene, late middle Rancholabrean.

Locality – Colleton Co.: Edisto Beach.

Material – Roth & Laerm (1980); (1) Molariform (ChM PV2422); (2) Molariform fragment (ChM PV2427); (3) Distal fragment of humerus (ChM PV2741); (4) Metapodial (ChM GPV2004); (5) Ungual (USNM 22842).

Formation – Undetermined offshore unit (Sanders, 2002).

Horizon – Late Pleistocene, late Rancholabrean.

Locality – "Phosphate workings near Charleston" (AMNH records).

Material – Tooth and phalanx (AMNH 13715).

Formation – Wando.

Horizon – Early late Pleistocene (Weems & Lemon, 1984; Szabo, 1985), late middle Rancholabrean.

Comments – Harlan (1831) described a sloth mandible from Big Bone Lick, Kentucky, which he referred to *Megalonyx laqueatus* that was subsequently recognized by Richard Owen as a *Mylodon*t and named *Mylodon harlani* (Owen, 1843), now known as *Paramylodon harlani*. The first reports of *Mylodont* sloths in the southeastern United States were by Leidy (1855: 10, pl. 16, fig. 21) who reported and figured a fragmentary molariform tooth of *Mylodon harlani* from Skiddaway Island, Georgia and later (Leidy, 1859:111, pl 20, figs. 7-7b, 8, 8a) noted and figured a partial molariform tooth of *Mylodon* from the "Post-Pleiocene [= Pleistocene] beds of the Ashley River."

During the second stage of the Great American Biotic Interchange (GABI) in the Blancan, the *Mylodont* sloth, *Glossotherium chapamalense* dispersed into North America (Robertson,

1976). By the Irvingtonian, *G. chapadmalense* had evolved into *Paramylodon harlani* (McDonald, 1995). There are currently no Irvingtonian records of *P. harlani* in the state but this species is well represented in the Rancholabrean.

Discussion

As can be ascertained from the preceding accounts, ground sloths of various taxa were relatively common and formed a conspicuous component of the late Pliocene-Pleistocene fossil mammal fauna of South Carolina. Six species in three genera representing three families have been identified to date: *Eremotherium laurillardi*, *E. eomigrans*, *Megalonyx jeffersonii*, *M. wheatleyi*, *M. leptostomus* and *Paramylodon harlani*. Based on the fossil record of Florida, it seems possible that the number of recorded taxa might go even higher. *Nothrotheriops texanum* known from the Irvingtonian of Florida is one taxon that might have been present in the Irvingtonian faunas of South Carolina (McDonald, 1985; 1995).

There are three principal physiographic provinces in South Carolina, the Blue Ridge, the Piedmont, and the Coastal Plain (see figure 1B). All of the fossil sloth remains recovered in the state have come from the sedimentary rocks of the Coastal Plain. Fossil vertebrate remains and are not found above the Fall Line because the crystalline rocks of the Piedmont and Blue Ridge provinces are not overlain by sedimentary deposits necessary for the quick burial and permineralization of skeletal elements.

The distribution of *Megalonyx* and *Paramylodon* extends across the North American continent and includes a diverse array of physiographic provinces. *Megalonyx* is known from numerous caves through the Appalachians (McDonald, 2003) and would be expected to have occurred in the Blue Ridge Mountains and Piedmont provinces of the state. *Paramylodon harlani* has been interpreted as a grazer (Stock, 1925; Naples, 1989; Ruez, 2005) and thus would probably have inhabited open savanna. Remains are rarely recovered from cave sites (McDonald, 2003) but would be expected to be found on the Piedmont as well as the Coastal Plain.

Two major types of river systems traverse the physiographic provinces of South Carolina. Alluvial rivers originating in the mountains and piedmont include the Great Pee Dee, Savannah, Broad, Saluda, Congaree, Wateree, Catawba and Santee. Blackwater rivers originate in the coastal plain and include the Cooper, Ashley, Edisto, Salkahatchie, Combahee, Ashepoo, New, Four Holes, Little PeeDee, Waccamaw, Black and Lumber. Fossil sloth remains have been recovered from the Ashley, Cooper, Coosaw, and Stono rivers, as well as from paleo river channels (figure 1C).

In the late 1970's and early 1980's Mr. Rudy Mancke, then Curator of Natural History at the South Carolina State Museum, had a scuba-diving team collecting for that museum in the major rivers of the Charleston area. The Cooper River, in particular, provided fruitful diving sites. Mancke arranged for funding from the Amoco Oil Company to support the divers as they dived in the Cooper River at the Amoco Site, the source of much of the material reported in this paper. The Amoco site is just northwest of Daniel Island in Berkeley County. This mixed assemblage is primarily Rancholabrean in age.

Edisto Beach and the beachfront northward along Edisto Island is the source of the Edisto Beach Faunal Assemblage (Roth & Laerm, 1980; Sanders, 2002). As noted by Sanders (2002), the vertebrate material representing two distinct groups of faunal remains (terrestrial and marine) is continuously deposited and mixed together on the beach by wave action. The terrestrial vertebrate remains are of Wisconsinan (late Rancholabrean) age and the marine vertebrates seem almost certainly to date from the post-glacial rise in sea level that brought the Atlantic to its present stand along the South Carolina coast approximately 7,000 years ago. *Paramylodon harlani*, *Eremotherium laurillardi*, and *Megalonyx jeffersonii* were the pilosan members of the Edisto Rancholabrean age fauna.

The Charleston-Summerville-Goose Creek area, and around Monks Corner, are particularly productive, and many of the fossils reported here were collected in those areas. Some of the sites deserve further exploration.

The Walrus Ditch faunal assemblage, discovered by V. McCollum and M. Swilp, was collected from the bank of a drainage ditch in a housing area near Summerville, Dorchester Co. Several mammal taxa from the faunal assemblage (*Nannipus peninsulatus, Smilodon gracilis, Canis lepophagus*, *Holmesina floridana*) suggest a late Blancan age for the assemblage.

The Camelot local fauna was collected from a channel-fill in unnamed sands and clays that overlie the late middle Eocene Tupelo Bay Formation in the northeastern corner of the Giant Cement Plant quarry about 4 km north of Harleyville, Dorchester County (see Geisler *et al.*, 2005 for their revision of the nomenclature of the basalmost Eocene stratigraphic unit in the quarry). Among the many mammal fossils collected there were more than 300 elements of *Megalonyx wheatleyi*.

While discoveries have been made since the early 1800's, our knowledge of the Pleistocene fauna of the southeastern United States has been limited except for Florida (Webb, 1974; Morgan & Hulbert, 1995). This is also true for the sloths (see table 1), as Florida has the greatest diversity and number of localities for each taxon. The smaller number of taxa and individual records in the rest of the Southeast is probably not a true reflection of actual conditions but merely an artifact of relatively limited field work and insufficient published records. As demonstrated by this report, if the effort is made to document this or any group, the records can be substantially improved. Because of the spotty record, it is difficult to accurately assess the biogeography of these taxa and how it relates to their paleoecology. We cannot determine at present if absence of a taxon truly reflects its absence or merely a lack of data. This pattern is clearly reflected in South Carolina where all records are from the more intensely collected coastal plain, while less effort has been spent in the upland part of the state.

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