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EOCENE TERRESTRIAL MAMMALS FROM CENTRAL GEORGIA

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ABSTRACT

Descriptions of fossils of Eocene terrestrial mammals from the southeastern United States are rare, and particularly so in the Eocene sediments of Georgia. Here we describe a small collection of fossilized teeth and tooth fragments representing four mammalian taxa. The fossils were recovered by surface collecting overburden sediments and screen washing in situ Clinchfield Formation sediments exposed in an inactive kaolin mine, Hardie Mine, in Wilkinson County, Georgia. The Clinchfield Formation has been described as a Late Eocene coastal unit with abundant gastropods, bivalves, sharks, and rays. This is the first detailed description of terrestrial mammals from this unit. Although limited in diversity, this collection represents the most diverse Eocene-aged mammalian fauna described for the state.

Keywords: Eocene mammals, fossils, southeast

INTRODUCTION

Eocene land mammals from southeastern North America are poorly documented, especially compared with the well-documented mammalian faunas of the western interior (Rose 1999; Westgate 1990). In their summary of Tertiary mammal localities of North America, Janis et al. (1998) listed only seven Eocene-aged sites in the southeast. The most diverse Eocene land mammal assemblages from the Atlantic and Gulf coastal region include the Early Eocene Red Hot local fauna of Mississippi with at least 25 species (Beard and Dawson 2009; Beard and Tabrum 1991), the Early Eocene Fisher/Sullivan site of Virginia with at least seven species (Rose 1999), and the Middle Eocene Casa Blanca local fauna of Texas with at least 30 species (Westgate 1988, 1990). Other records of land mammals from the Eocene of southeastern North America are also known, but they are not diverse with only one or two taxa present. For example, Beard and Tabrum (1991) reported an Early Eocene primate from Mississippi. Gazin and Magruder (1942) described a titanothere and Schiebout (1979) described a miacid carnivore from the Middle Eocene of Mississippi and Alabama, respectively. Westgate and Emry (1985) described a pantolestid and an agriochoerid from the Late Eocene Crow Creek local fauna of Arkansas. In addition, Voorhies (1969) reported the occurrence of a sirenian tooth from Upper Eocene sediments in Twiggs County, Georgia. However, Domning et al. (1982) subsequently determined that it is most probably an entelodont tooth.

Here we describe fossil remains of four taxa of land mammals from Late Eocene sediments in central Georgia. The specimens were collected from fossiliferous Clinchfield Formation sediments exposed in an inactive kaolin mine previously designated as the Hardie Mine (Westgate 2001). The mine is located about 3.9 km NNW of Gordon in Wilkinson County (see the map in Parmley and Cicimurri 2003, Figure 1). The Clinchfield sediments were deposited during the Late Eocene circa 36.0–34.2 Ma (for more detailed discussions on the geological setting and age of the Hardie Mine fossils, see Parmley and Cicimurri 2003, Parmley and Cicimurri 2005, Parmley and DeVore 2005, Parmley and Holman 2003, and Westgate 2001). Today these sediments are present in the open-pit mine as an approximately 1-m thick stratum of in situ sediments exposed in the north wall of the mine and as nearby surface spoil pile sediments that are the result of past quarrying operations. Fortunately, the spoil pile sediments are clearly referable to the in situ Clinchfield sediments which, in the wall of the mine, are unconformably bounded below by kaolin deposits and above by nonfossiliferous Twiggs Clay sediments.

Huddlestun and Hetrick (1985) assigned this fossiliferous unit to the Riggins Mill Member Member of the Clinchfield Formation and characterized it as a fine to coarse sand unit containing macrofossils including nearshore gastropods and bivalves. In addition to the marine invertebrates, the Hardie Mine sediments have yielded a rich diversity of mainly near-shore sharks (Parmley and Cicimurri 2003; Westgate 2001), rays, and teleost fishes (unreported fossils in the Georgia College vertebrate paleontology [GCVP] collection). Also known from the Hardie Mine are a chimaeroid fish (Parmley and Cicimurri 2005), a colubrid snake (Parmley and Holman 2003), two genera of palaeopheid snakes (Parmley and DeVore 2005), five species of turtles (Parmley et al. 2006), indeterminate crocodilians (unreported GCVP fossils), an auk (Alcidae; Chandler and Parmley 2002), and at least one species of archaeocete whale (unreported GCVP fossils). The only terrestrial mammal from Hardie Mine was reported by Westgate (2001). He mentioned a titanothere tooth fragment that, at the time of publication, was held in a private collection.

MATERIALS & METHODS

Vertebrate fossils were surface collected from in situ sediments and overburden spoil piles between 1998 and 2005 (see Parmley and DeVore 2005 and Parmley and Holman 2003). A portion of the in situ material was screen washed and sorted with the use of light microscopes. Fossil identifications were accomplished using published descriptions and comparative Late Eocene fossil material from the White River deposits of Badlands National Park (BADL), South Dakota, housed in the GCVP collection.

SYSTEMATIC PALEONTOLOGY

Order Carnivora Bowditch, 1821
Family Amphicyonidae Haeckel, 1886
Genus *Daphoenus* Leidy, 1853
Daphoenus sp. indet.
(Figure 1D)

Material.—GCVP 19703, left C1.

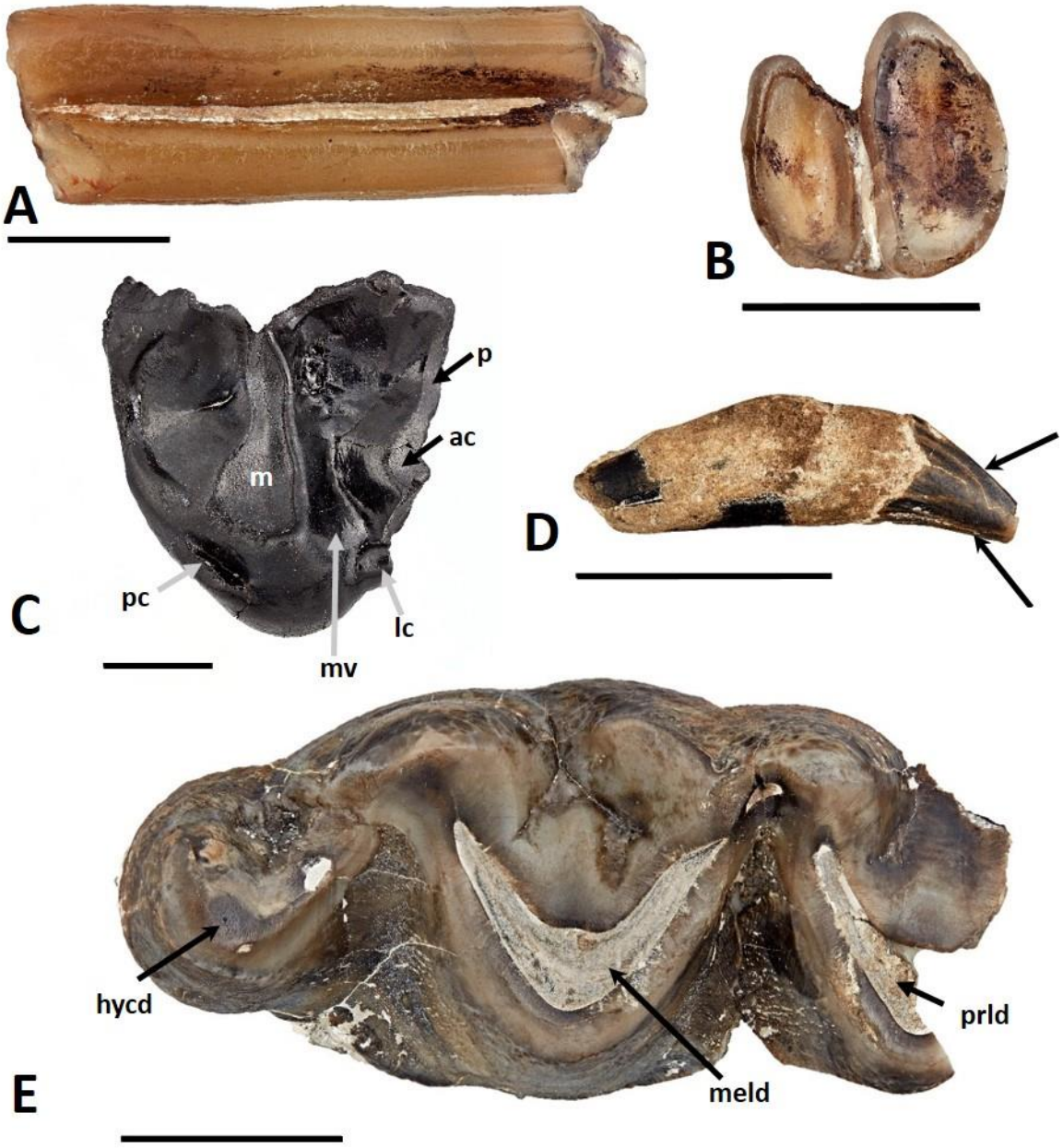

Figure 1. Mammal fossils from Hardie Mine, Wilkinson County, Georgia. A) buccal and B) occlusal views of a lagomorph left m1 (GCVP 19696), scale = 2 mm; C) occlusal view of a hyracodontid right M2 (GCVP 19697), m = metaloph, pc = posterior cingulum, mv = median valley, lc = lingual cingulum, ac = antecrochet, p = protoloph, scale = 5 mm; D) lingual view of a carnivoran left C1 (GCVP 19703), arrows indicate the position of longitudinal enamel ridges and corresponding sulci, scale = 2 cm; E) occlusal view of a brontothere right m3 (GCVP 19699), hycd = hypoconulid, meld = metalophid, prld = protolophid, scale = 2 cm. Anterior is to the right in all images.

Description.—This carnivoran canine compares favorably to the Eocene-Oligocene *Daphoenus* specimens from BADL housed in the GCVP collection (Table I). The specimen displays slight natural wear on the crown. The root appears to be complete. The Hardie Mine specimen has approximately the same tooth dimensions and displays longitudinal enamel ridges and corresponding sulci (Figure 1D arrows), as seen in GCVP 5125 and GCVP 2253. The Hardie Mine tooth is approximately 1.6 times longer (crown to root tip) than the canines of the creodont *Hyaenodon mustelinus* that could possibly occur in similar aged sediments (Gunnell 1998).

Table I. Upper canine measurements for *Daphoenus* sp. and *Hyaenodon mustelinus* from Badlands National Park and the Hardie Mine specimen from central Georgia. The letter in parenthesis for GCVP 5125 indicates multiple canines with the same catalog number. Length = tip of the crown to the tip of the root; depth = maximum anterior to posterior thickness; width = maximum lateral thickness.

Taxon	Specimen	Length (mm)	Depth (mm)	Width (mm)	D/W Ratio
Daphoenus sp.	GCVP 5125 (a)	39.29	10.26	7.73	1.33
Daphoenus sp.	GCVP 5125 (b)	37.42	10.00	6.26	1.60
Daphoenus sp.	GCVP 5125 (c)	40.09	10.33	7.60	1.36
Daphoenus sp.	GCVP 2253	33.77	11.38	6.94	1.64
Daphoenus sp.	GCVP 4572	35.92	9.01	7.59	1.19
Hyaenodon mustelinus	GCVP 2729	25.78	11.33	8.55	1.33
Hyaenodon mustelinus	GCVP 1761	17.52	10.52	8.03	1.31
Hardie Mine specimen	GCVP 19703	33.90	9.80	7.27	1.35

Remarks.—Hunt (1998) described *Daphoenus* as a common Eocene-Oligocene (40–27 Ma) taxon found across the central United States. He noted that species are distinguished from each other on the basis of skull length. Additionally, *Daphoenus* displayed a high degree of sexual dimorphism. Therefore, specific identification cannot be accomplished with a single tooth. The Hardie Mine specimen represents the first known occurrence of *Daphoenus* in the southeastern United States.

Order Lagomorpha Brandt, 1855
Family Leporidae Gray, 1821
Genus *Palaeolagus* Leidy, 1856
Palaeolagus temnodon Douglass, 1902
(Figure 1A,B)

Material.—GCVP 19696, left cheek tooth (p4, m1, or m2).

Description.—The larger anterior oval cusp and deep buccal groove of this cheek tooth clearly identifies this specimen as a lagomorph (Figure 1B). Size comparisons of GCVP 19696 with numerous *Palaeolagus* specimens from BADL indicate that this cheek tooth falls within the range of a p4, m1, or m2 for this taxon (Table II). In comparative material with cheek teeth remaining in the lower jaw, it is evident that p4, m1, and m2 exhibit similar morphologies.

Table II. Comparative measurements of p4, m1, and m2 for *Palaeolagus* sp. from Badlands National Park and the Hardie Mine specimen from central Georgia. APL = anterior-posterior crown length; ACW = anterior cusp crown width; PCW = posterior cusp crown width; ACL = anterior cusp crown length; PCL = posterior cusp crown length.

Taxon	Specimen	APL (mm)	ACW (mm)	PCW (mm)	ACL (mm)	PCL (mm)
			p4			
Palaeologus sp.	GCVP 4828	2.49	2.26	2.12	1.15	0.86
Palaeologus sp.	GCVP 4521	2.24	2.26	2.19	1.11	0.97
Palaeologus sp.	GCVP 3071	2.08	1.90	1.57	1.08	0.84
Palaeologus sp.	GCVP 7880	2.08	1.89	1.67	1.14	0.91
Palaeologus sp.	GCVP 2764	2.18	2.06	1.80	1.16	0.88
Hardie Mine specimen	GCVP 19696	2.25	2.16	1.83	1.07	0.88
			m1			
Palaeologus sp.	GCVP 4828	2.60	2.37	2.26	1.08	0.84
Palaeologus sp.	GCVP 4521	2.60	2.48	2.28	1.44	1.23
Palaeologus sp.	GCVP 3071	2.23	2.14	2.03	1.28	0.83
Palaeologus sp.	GCVP 7880	2.41	1.92	1.75	0.97	1.07
Palaeologus sp.	GCVP 2764	2.43	2.13	1.91	1.32	0.96
Hardie Mine specimen	GCVP 19696	2.25	2.16	1.83	1.07	0.88
			m2			
Palaeologus sp.	GCVP 4828	2.59	2.35	2.12	1.11	0.97
Palaeologus sp.	GCVP 4521	2.52	2.32	1.95	1.11	0.98
Palaeologus sp.	GCVP 3071	2.24	1.94	1.63	1.05	0.91
Palaeologus sp.	GCVP 7880	2.48	1.86	1.62	0.91	0.90
Palaeologus sp.	GCVP 2764	2.50	1.09	1.87	1.25	1.09
Hardie Mine specimen	GCVP 19696	2.25	2.16	1.83	1.07	0.88

Remarks.—Korth and Hageman (1988) addressed the dental characteristics of Late Eocene and Early Oligocene species of *Palaeolagus*. They indicated that cheek tooth measurements of the Early Oligocene species (*P. hemirhizis*) overlap the Late Eocene (*P. temnodon*) and younger (*P. haydeni*) species by 50%. Emry et al. (1987) listed *P. temnodon* as a characteristic taxon of the Late Eocene. The Hardie Mine specimen represents the first known occurrence of *Palaeolagus* in the southeastern United States.

Order Perissodactyla Owen, 1848
Family Brontotheriidae Marsh, 1873
Genus *Megacerops* Leidy, 1870
Megacerops sp. indet.
(Figure 1E)

Material.—GCVP 19699, right m3; GCVP 19698, partial right dP4; GCVP 19702, partial left dP3; GCVP 19701, partial left dp3; GCVP 19700, upper molar occlusal fragment.

Description.—GCVP 19699 (m3) is the most complete brontothere tooth in the Hardie Mine collection (Figure 1E). The hypoconulid and metalophid are complete, however the anterior portion of the protolophid is broken. In comparison to upper Eocene brontothere material from BADL, this tooth (length estimated) falls at the low end of the range of the length and width measurements (Table III). GCVP 19698 consists of the lingual half of a dP4 with the anterior protocone and the posterior hypocone. GCVP 19702 is a fragment of an upper tooth, most likely a left dP3, consisting of the hypocone and medial cingulum. GCVP 19701 is a fragment of a lower brontothere tooth, most likely a left dp3, with portions of the anterio-lateral protolophid and posterio-lateral metalophid. GCVP 19700 is a fragment of an upper brontothere molar lacking defining characteristics.

Remarks.—All of the brontothere material from the Hardie Mine displays the thick enamel characteristic of this taxon. Mihlbachler et al. (2004) reviewed the systematics of Late Eocene brontotheres and concluded that *Megacerops* is the only valid taxon, and the two recognized species are distinguished from each other by horn morphology. In the absence of cranial material that includes horns, we are unable to assign these fossils to a species. Gazin and Magruder (1942) recorded a titanothere from the Middle Eocene of Mississippi. Westgate (2001) mentioned a tooth fragment from the Hardie Mine and indicated that it was relatively small for a Late Eocene titanothere. However, the nearly

Table III. Lower m3 measurements for brontotheres in the Georgia College vertebrate paleontology collection. All of the comparative specimens were collected in the upper Eocene strata of the White River Badlands of South Dakota. Following the systematic revisions suggested by Mihlbachler et al. (2004), all of these specimens should be considered *Megacerops*. For GCVP 19699 from the Hardie Mine locality, damaged and estimated length is given.

Taxon	Specimen	Maximum length (mm)	Maximum width (mm)
Titanothere	GCVP 2042	92.09	39.33
Brontops sp.	GCVP 3278	89.79	37.36
Titanothere	GCVP 3448	n/a	43.61
Titanothere	GCVP 3546	119.70	45.26
Titanothere	GCVP 3922	98.91	38.24
Titanothere	GCVP 4580	109.43	46.11
Titanothere	GCVP 9368	97.56	39.89
Brontops sp.	GCVP 11238	99.92	43.53
Titanothere	GCVP 19695	97.07	37.21
Hardie Mine specimen	GCVP 19699	79.66; est. 90.56	37.59

complete m3 described here falls within the range of Late Eocene m3's examined from BADL. Janis et al. (1998) reported no brontothere specimens from the southeastern United States in Late Eocene-aged sediments. Therefore, the Hardie Mine specimen represents the first known occurrence of *Megacerops* in the Late Eocene sediments of the southeastern United States.

Family Rhinocerotidae Gray, 1821
Genus *Hyracodon* Leidy, 1856
Hyracodon sp. indet.
(Figure 1C)

Material.—GCVP 19697, partial right M2.

Description.—Although fragmentary, this tooth exhibits distinctive characteristics of *Hyracodon* including a posterio-medial metaloph (Figure 1C m) and a portion of the anterio-medial protoloph (Figure 1C p). An abbreviated lingual cingulum (Figure 1C lc) is present at the opening of the median valley (Figure 1C mv) between the protoloph and metaloph. An antecrochet (Figure 1C ac) protrudes from the protoloph posteriorly into the median valley. In comparison to GCVP 14950, a *Hyracodon* M2 from BADL, GCVP 19697 is the same size and exhibits the same characteristics as the corresponding portionof that tooth. Additionally, the vertical distance from the lingual cingulum to the enamel dentine junction and the vertical distance from the posterior cingulum (Figure 1C pc) to the enamel dentine junction are comparable.

Remarks.—Janis et al. (1998) reported no *Hyracodon* material from the Gulf Coast or southeast US. However, *Hyracodon* is known from the Late Eocene of the Central and Northern Great Plains. Prothero (1998) described *Hyracodon* as a cursorial rhinoceros common between 40 and 30 Ma. The Hardie Mine specimen represents the first known occurrence of *Hyracodon* in the southeastern United States.

DISCUSSION

Unfortunately, most of the Hardie Mine fossil mammal material is fragmentary but, given the paucity of information on land mammals from this region of North America during the Eocene, the records are noteworthy. The taxa described here are relatively common in the western interior and found together in Late Eocene deposits of the Central Great Plains. Although limited in diversity, these fossils from the Clinchfield Formation represent the most diverse collection of Late Eocene land mammals thus far reported from Georgia.

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REFERENCES

Beard, K.C. and A. Tabrum. 1991. The first early Eocene mammal from eastern North America: an omomyid primate from the Bashi Formation, Lauderdale County, Mississippi. Mississippi Geology, 11, 2, 1–6.

Beard, K.C. and M.R. Dawson. 2009. Early Wasatchian mammals of the Red Hot local fauna, uppermost Tuscahoma Formation, Lauderdale County, Mississippi. Annals of Carnegie Museum, 78, 3, 193–243.

Chandler, R. and D. Parmley. 2002. The earliest North American record of an auk (Aves: Alcidae) from the Late Eocene of central Georgia. Oriole, 68, 7–9.

Domning, D.P., G.S. Morgan, and C.E. Ray. 1982. North American Eocene sea cows (Mammalia: Sirenia). Smithsonian Contributions to Paleobiology, 52, 1–64.

Emry, R.J., P.R. Bjork, and L.S. Russel. 1987. Chadronian, Orellan, and Whitneyan Land Mammal Ages. *In* Cenozoic Mammals of North America, M.O. Woodburne. eds. 118–152. University of California Press.

Gazin, C.L. and S.J. Magruder. 1942. A new titanothere from the Eocene of Mississippi, with notes on the correlation between the marine Eocene of the Gulf Coastal Plain and continental Eocene of the Rocky Mountain region. Smithsonian Institution, 101, 13, 1–17.

Gunnell, G.F. 1998. Creodonta. *In* Evolution of Tertiary Mammals of North America, C.M. Janis, K.M. Scott, L.L. Jacobs, and G.F. Gunnell. eds. 91–109. Cambridge University Press.

Huddlestun, P.F. and J.H. Hetrick. 1985. Upper Eocene Stratigraphy of Central and Eastern Georgia. Georgia Department of Natural Resources.

Hunt, R.M. 1998. Amphicyonidae. *In* Evolution of Tertiary Mammals of North America, C.M. Janis, K.M. Scott, L.L. Jacobs, and G.F. Gunnell. eds. 196–221. Cambridge University Press.

Janis, C.M., K.M. Scott, L.L. Jacobs, and G.F. Gunnell. 1998. Evolution of Tertiary Mammals of North America. Cambridge University Press.

Korth, W.W. and J. Hageman. 1988. Lagomorphs (Mammalia) from the Oligocene (Orellan and Whitneyan) Brule Formation, Nebraska. Transactions of the Nebraska Academy of Sciences and Affiliated Societies. XVI, 141–152. https://digitalcommons.unl.edu/tnas/182/.

Mihlbachler, M.C., S.G. Lucas, and R.J. Emry. 2004. The holotype specimen of *Menodus giganteus*, and the "insoluble" problem of Chadronian brontothere taxonomy. New Mexico Museum of Natural History and Science Bulletin, 26, 129–135.

Parmley, D. and D.J. Cicimurri. 2003. Late Eocene sharks of the Hardie Mine local fauna of Wilkinson County, Georgia. Georgia Journal of Science, 61, 3, 153–179. https://search.proquest.com/docview/230536691/fulltextPDF/9E3AB4954A734537PQ/1?accountid=11078.

Parmley, D. and D.J. Cicimurri. 2005. First record of a chimaeroid fish from the Eocene of the southeastern United States. Journal of Paleontology, 79, 6, 1219–1221.

Parmley, D. and M. DeVore. 2005. Palaeopheid snakes from the Late Eocene Hardie Mine local fauna of central Georgia. Southeastern Naturalist, 4(4), 703–722. https://www.jstor.org/stable/3878233.

Parmley, D. and J.A. Holman. 2003. *Nebraskophis* Holman from the Late Eocene of Georgia (USA), the oldest known North American colubrid snake. Acta Zoologica Cracoviensia, 46, 1, 1–8.

Parmley, D., J.H. Hutchison, and J.F. Parham. 2006. Diverse turtle fauna from the late Eocene of Georgia including the oldest records of aquatic testudinoids in southeastern North America. Journal of Herpetology, 40, 3, 343–350. https://www.jstor.org/stable/3878233.

Prothero, D.R. 1998. Hyracodontidae. *In* Evolution of Tertiary Mammals of North America, C.M. Janis, K.M. Scott, and L.L. Jacobs. eds. 589–594. Cambridge University Press.

Rose, K.D. 1999. Fossil mammals from the early Eocene Fisher/Sullivan site. *In* Early Eocene vertebrates and plants from the Fisher/Sullivan site (Nanjemoy Formation) Stafford County, Virginia. R.E. Weems and G.J. Grimsley. eds. 133–138. Virginia Division of Mineral Resources, publication 152, Charlottesville.

Schiebout, J.A. 1979. An overview of the terrestrial early Tertiary of southern North America-fossil sites and paleopedology. Tulane Studies in Geology and Paleontology, 15, 3, 75–94.

Voorhies, M.R. 1969. An Eocene sea cow tooth from Twiggs County, Georgia. Bulletin of the Georgia Academy of Science, 27, 93–94. https://gcsu.idm.oclc.org/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=geh&AN=1969-030673&site=eds-live&scope=site.

Westgate, J.W. 1988. Biostratigraphic implications of the first Eocene land-mammal fauna from the North American coastal plain. Geology, 16, 11, 995–998. https://doi.org/10.1130/0091-7613(1988)016%3C0995:BIOTFE%3E2.3.CO;2

Westgate, J.W. 1990. Uintan land mammals (excluding rodents) from an estuarine facies of the Laredo Formation (middle Eocene, Claiborne Group) of Webb County, Texas. Journal of Paleontology, 64, 3, 454–468. https://www.jstor.org/stable/1305596?seq=1#metadata_info_tab_contents.

Westgate, J.W. 2001. Paleoecology and biostratigraphy of marginal marine Gulf Coast Eocene vertebrate localities. *In* Eocene Biodiversity, G.F. Gunnel. ed. 263–297. Kluwer Academic/Plenum Publishers.

Westgate, J.W. and R.J. Emry. 1985. Land mammals of the Crow Creek local fauna, late Eocene, Jackson Group, St. Francis County, Arkansas. Journal of Paleontology, 59(1), 242–248. https://www.jstor.org/stable/1304839.