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# Late Pleistocene (Rancholabrean) Mammalian Assemblage from Paw Paw Cove, Tilghman Island, Maryland

*Ralph E. Eshelman, Darrin Lowery, Frederick Grady,  
Dan Wagner, and H. Gregory McDonald*

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Late Pleistocene  
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## ABSTRACT

Eshelman, Ralph E., Darrin Lowery, Frederick Grady, Dan Wagner, and H. Gregory McDonald. Late Pleistocene (Rancholabrean) Mammalian Assemblage from Paw Paw Cove, Tilghman Island, Maryland. *Smithsonian Contributions to Paleobiology*, number 102, vi + 15 pages, 4 figures, 1 table, 2018.—A small but significant assemblage of Late Pleistocene mammals was recovered from an eroding shoreline at Paw Paw Cove, located on the Chesapeake Bay side of Tilghman Island, Talbot County, Maryland. Additionally, Clovis-age (11,050–10,800 radiocarbon [<sup>14</sup>C] years before present) artifacts were found in a lag deposit beneath a loess deposit at the site. An accelerator mass spectrometry date obtained from an organic stratum below the loess at the same location suggests that this small fossil assemblage is approximately 21,000 years old. Identifiable taxa include four extinct species, *Castoroides* sp. (giant beaver), *Equus* sp. (horse), *Tapirus veroensis* (Vero tapir), and *Mammuth americanum* (American mastodon), along with *Canis* cf. *C. latrans* (coyote), and *Cervus elaphus* (wapiti). Significantly, the tapir and giant beaver are the first records for Maryland, and the tapir is the first record from the Coastal Plain of the Chesapeake region of Delaware, Maryland, and Virginia. The provisional identification of *Canis* cf. *C. latrans* may represent the first Late Pleistocene record from the Coastal Plain of the Chesapeake region of Delaware, Maryland, and Virginia.

Cover images, from left to right: tooth of coyote *Canis* cf. *C. latrans* (detail from Figure 4); Dan Wagner documenting soil profile at Paw Paw Cove site (detail from Figure 2); tooth of wapiti *Cervus elaphus* (detail from Figure 4).

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# Late Pleistocene (Rancholabrean) Mammalian Assemblage from Paw Paw Cove, Tilghman Island, Maryland

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## INTRODUCTION

Tilghman Island, like many islands along the eastern flank of the Chesapeake Bay in Maryland, has suffered from severe land loss over the past century and a half as a by-product of wave-related shoreline erosion. Various geologic strata and archaeological sites and features have been exposed and subsequently destroyed throughout this period of time. The tangible remnants of these former geoarchaeological deposits are essentially “flotsam and jetsam” accumulations within the nearshore swash and berm zone. Between 1977 and 2003 the eroding northern aspect scarp at the shoreline area (site 18TA212C) adjacent to Paw Paw Cove on the southwestern end of Tilghman Island, Talbot County (Figures 1, 2), was intermittently examined; description of the site was completed by Dan Wagner on 14 December 2007 and is presented herein. In addition to Paleoindian-age stone artifacts (11,050–10,800 <sup>14</sup>C years BP; Waters and Stafford, 2007), a small assemblage of Late Pleistocene mammal teeth also was discovered. Here we describe this small mammalian fossil assemblage and discuss the chronological and regional context of the assemblage.

Fossil pollen studies from freshwater peats dating between 30,000 and 13,000 years BP, within the Parsonsburg Sand (Sirkin et al., 1977) from the central Delmarva Peninsula of Delaware and Maryland, suggest a colder and perhaps drier environment during the Late Pleistocene, with an increase in moisture and a decrease and eventual disappearance of spruce by 9,000 years BP. The identified pollen includes pine, spruce, birch, alder, willow, oak, grass, sedge, and heaths. Spruce, pine, birch, and alder persisted until about 9,000 years BP, as it did in the Dismal Swamp of Virginia (Whitehead, 1972). The nearest unequivocal evidence of late Wisconsinan tundra vegetation is from Buckle’s Bog, Allegheny Plateau, western Maryland, located at 814 m elevation above sea level (Maxwell and Davis, 1972; Jackson and Whitehead, 1993).

## AGE AND STRATIGRAPHIC SETTING

An accelerator mass spectrometry (AMS) date on an organic stratum above the faunal assemblage at Paw Paw Cove suggests that the assemblage is approximately 21,000 years old; however, the presence of wapiti may indicate at least part of the fauna may be several thousand years younger (see discussion under *Cervus elaphus*). The area associated with

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**FIGURE 1.** Aerial photograph showing the southern end of Tilghman Island, Maryland, with Paw Paw Cove in the foreground. The location of the fossil outcrop encompasses an eroded bank scarp at the south end of Paw Paw Cove.

Paw Paw Cove and other localities within several miles of the site have been the focus of detailed multiyear geoarchaeological investigations. The research has provided a high-resolution understanding of the regional Late Pleistocene upland aeolian sequence stratigraphy, which is important relative to the preservation of Late Pleistocene fossils reported here and to understanding their original context.

The aeolian sequence chronology for the Delmarva Peninsula is somewhat complicated. These complications are commonly the by-product of the localized geology, sources of parent material, and wind velocity. For example, Markewich et al. (2015: fig. 1) provided a broad range of ages affiliated with loess deposits (86,000–55,000 calbp [calibrated year before present], 40,000–30,000 calbp, and 13,000–11,000 calbp) and dune field formations (35,000–16,000 calbp) at sites on the Delmarva Peninsula. The most fully understood regional loess formation was first recognized at Paw Paw Cove and can be confined to a very narrow time frame (see Wah et al., 2014). At Paw Paw Cove, Clovis-age (~13,000 calbp) artifacts are found as a lag deposit beneath the loess (Lowery et al., 2010). Early Holocene (~11,000 calbp) diagnostic projectile points at Paw Paw Cove

were found within the top of the youngest loess deposit. As such, the most recent regional loess sequence can be confined to the middle and late Younger Dryas climatic event (~12,600–11,600 calbp). This is the region's youngest loess deposit and is the type location for the “Paw Paw loess” (see Lowery et al., 2010). As indicated by the Clovis artifact lag deposit at Paw Paw Cove, the onset of the Younger Dryas (~12,800–12,600 calbp) was a period of marked upland erosion and deflation, resulting in an increase in dust in the northern hemisphere (see Mayewski et al., 1993: fig. 1). Evidence for this erosion event was observed in a few dated cores extracted from beneath the modern Chesapeake Bay (see Cronin, 2000).

In the Mid-Atlantic region, the Paw Paw loess formed as the result of several collective factors, including rapid climate change, sea level rise, isostasy, and possibly bioecological stress to the upland terrestrial floral communities. Because of the collapse of the Mid-Atlantic forebulge, coastal Delmarva was undergoing a period of marked isostatic depression approximately 13,000 years ago. Because of isostasy, relative sea level at the time was about 50–52 m (164–170 ft) below the present level. Some researchers (see Eisenman et al., 2009) suggested that a



FIGURE 2. Author Dan Wagner measuring and describing stratigraphic soil profile bank scarp at Paw Paw Cove locality.

period of marked atmospheric precipitation at about 13,000 years ago contributed to the Younger Dryas cooling in the North Atlantic region. If the marked precipitation noted by Eisenman et al. (2009) contributed to Delmarva's upland erosion, the formation of the Clovis artifact lag may have commenced during the terminus of the late Allerød oscillation and persisted into the earliest phase of the Younger Dryas. This combination of factors also may have initiated biological stresses on browsing and grazing mammals in the upland vegetation community at this time. These biological factors may have further destabilized regional land surfaces and exacerbated upland landscape erosion.

During the Younger Dryas, the lower reaches of the Susquehanna River (i.e., the Chesapeake Bay) accumulated a vast

quantity of eroded sediment within the adjacent floodplain (Cronin, 2000; Lowery, 2009). Because of the amassed sediment at or near base level, the lower Susquehanna River channel would have formed a braided river channel system. As the northern hemisphere climate cooled, the intense northwesterly winds reworked the accumulated sediment within the lower Susquehanna Valley, which subsequently provided the parent material for the approximate 12,600–11,600 calbp Paw Paw loess.

Recent research has shown that the chronological timing of the pre-24,000 calbp aeolian sequences recognized by Markewich et al. (2015) is further complicated by the accumulation of mixed old carbon within the regionally recognized paleosols situated beneath the overlying Paw Paw loess (Lowery et al., 2010). It would seem that cooler Late Pleistocene climatic conditions



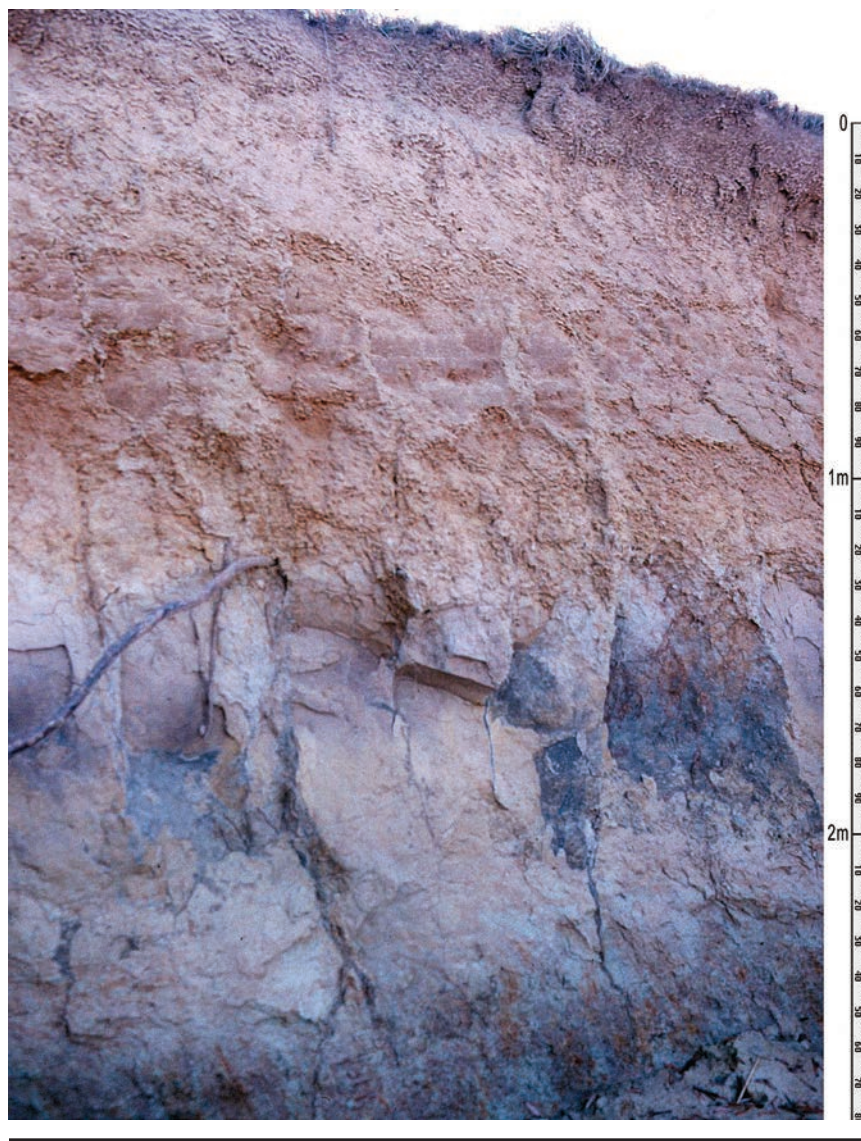


FIGURE 3. The eroded bank profile at Paw Paw Cove shows the buried 4ABb soil horizon at ~119 cm in depth. Note that the underlying soil strata are gleyed, which is indicative of wet conditions.

resulted in the long-term preservation of vitrified “old” charcoal. As such, aeolian localities with a single paleosol (see Table 1, Figure 3) can produce a gamut of averaged radiometric ages.

There are geologic exposures, like those recognized at Elliott’s Island in Dorchester County, Maryland, that contain peat buried beneath loess and aeolian sand strata (Lowery et al., 2012b). The buried peat exposure observed at Elliott’s Island represents a freshwater interdunal wetland or interdunal pond formation. Two thin organic lenses also have been observed beneath the main peat layer at Elliott’s Island, and these strata show no evidence of thermokarst cryoturbation indicative of permafrost gelisols. The main peat at Elliott’s Island is buried

beneath about 6 m of thick dune-loess deposit. The macrobotanical remains within the peat has been dated to circa 24,000 calbp at two widely separated locations (see Lowery et al., 2012b). These two age estimates encapsulate the coldest northern hemisphere episode recorded within the Greenland ice core data set (Alley, 2004). The macro- and microfloral data associated with the circa 24,000 calbp peat includes a sedge seed, several rush or bulrush seeds, seed fragments from bog white violet (*Viola lanceolata*), sphagnum moss stem and branch fragments, willow (*Salix* sp.?) twig fragments, an abundance of  $C_3$  grass and sedge phytoliths, red pine (*Pinus resinosa*) phytoliths, sedge pollen, willow (*Salix* sp.?) pollen, sphagnum moss pollen, heath pollen,

and some cedar (*Cupressaceae*) pollen. The relatively mild Last Glacial Maximum conditions indicated by the floral remains found at Elliott's Island also is indicated by the contemporaneously dated Columbian mammoth unearthed at Inglewood near Largo, Maryland (Karr, 2015; Haynes, n.d.).

At Paw Paw Cove, the upland backslope landscape position has 2% slope and an elevation of approximately 2.25 m; is moderately well drained; and has a parent material mix of loess, eolian sand, and possible pond sediments (119–142 cm). Deposits above 119 cm are Younger Dryas age; charcoal fragments up to 0.5 cm in the 4ABb horizon previously have been dated

at  $17,820 \pm 170$  radiocarbon years BP ( $21,358 \pm 415$  calibrated years BP). The Late Pleistocene (Rancholabrean) mammalian assemblage was reported from the 4ABb sediment horizon.

In summation, the eroded bank scarp (see Figures 2, 3), the sediment depositional history, and the soil development sequence at the Paw Paw Cove fossil locality (Table 1) provide a framework that permits an understanding of the circumstances for fossil preservation. As indicated by gleyed conditions and the preservation of organic carbon, the approximate 23-cm thick 4ABb soil horizon represents a buried wetland landscape. With a pH of 4.9, this marginally anaerobic soil horizon would not be

TABLE 1. Soil profile description (bank scarp) for Paw Paw Cove fossil locality.

Horizon <sup>a</sup>	Depth (cm)	Properties <sup>b,c</sup>
Ap	0–24	Dark brown (10YR 3/3) silt loam; moderate, medium granular structure; friable consistence; abrupt, smooth boundary
E	24–30	Yellowish brown (10YR 5/4) silt loam; weak, fine subangular blocky structure; friable consistence; clear, smooth boundary
BE	30–44	Yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) silt loam; weak, medium subangular blocky structure; friable consistence; clear, smooth boundary
Bt	44–53	Dark yellowish brown (10YR 4/4) loam; skeletan depletions of yellowish brown (10YR 5/4); weak, medium subangular blocky structure; patchy clay films; friable consistence; clear, smooth boundary
2Bt	53–83	Brown (7.5YR 4/4) and dark brown (7.5YR 3/4) fine sandy loam; skeletan depletions of light olive brown (2.5Y 5/3); weak, medium prismatic breaking to weak, coarse angular blocky structure; patchy clay films and bridging of particles; common manganese stains; cemented in places; firm consistence; clear, smooth boundary
2BC	83–93	Brown (7.5YR 4/4) light fine sandy loam; skeletan depletions of light olive brown (2.5Y 5/3); weak, coarse prismatic breaking to weak, very coarse angular blocky structure; common manganese stains; friable consistence; clear, smooth boundary
3BC	93–119	Dark yellowish brown (10YR 4/6) silt loam; many, medium distinct depletions of light brownish gray (2.5Y 6/1); weak, coarse prismatic breaking to weak, medium subangular blocky and weak, medium platy structure; patchy clay films; weakly fragic with vesicular pores and some brittleness; friable consistence; clear, wavy boundary
4ABb	119–142	Dark grayish brown (10YR 4/2) silt loam; few, fine distinct iron concentrations of dark yellowish brown (10YR 4/6), and prominent depletions of gray (5Y 5/1) along prism faces; moderate, very coarse prismatic structure; structureless, massive within prisms; firm consistence; clear, wavy to irregular boundary
4Bwb	142–177	Light olive brown (2.5Y 5/4) silt loam; common, medium prominent iron concentrations of strong brown (7.5YR 4/6), common, medium distinct depletions of light yellowish brown (2.5Y 6/3); also prominent depletions of gray (5Y 5/1) along prism faces; moderate, very coarse prismatic breaking to weak, very coarse subangular blocky structure; friable to firm consistence; clear, smooth boundary
5Btb	177–198	Dark yellowish brown (10YR 4/4) silty clay loam; common, coarse prominent depletions of olive (5Y 5/3); also prominent depletions of gray (5Y 5/1) along prism faces; moderate, very coarse prismatic breaking to moderate, medium subangular blocky structure; nearly continuous clay films; friable to firm consistence; clear, smooth boundary
5BCb	198–220+	Yellowish brown (10YR 5/4) silt loam; many, coarse prominent depletions of olive (5Y 5/3), and common, medium distinct iron concentrations of dark yellowish brown (10YR 4/6); also prominent depletions of gray (5Y 5/1) along prism faces; weak, very coarse prismatic breaking to weak, medium platy structure; patch clay films; friable consistence

<sup>a</sup> Sediment horizon abbreviations: ABb: buried horizon A and B; Ap: disturbed horizon A; BC: horizon B and C; BCb: disturbed horizon B and C; BE: horizon B and loess horizon; Bt: horizon B of silicate clay; Btb: horizon B of weakly developed silicate clay; Bwb: B horizon buried and weakly developed; E: loess horizon. For more information, see <https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/survey/class/>.

<sup>b</sup> Abbreviations YR and Y and the numerical x/x notation in parentheses under Properties refer to the Munsell System of Color Notation with hue (letters) and value/chroma (numbers); YR = yellow red; Y = yellow.

<sup>c</sup> Skeletan depletions = degrading argillic (clay) horizon.

conductive for the long-term preservation of bone. In contrast, denser tooth enamel, as preserved in specimens reported here, can survive under these conditions (see Kibblewhite et al., 2015). Given the degree of weathering noted within the other soil horizons at Paw Paw Cove (see Table 1), we hypothesize that fossil specimens had to originate from the 4ABb horizon. Charcoal from this wetland soil horizon, which was collected by C. Vance Haynes (emeritus professor, Department of Anthropology, University of Arizona), produced an AMS age estimate of  $17,820 \pm 170$  radiocarbon years before present (rcybp) (AA-3870) or  $21,358 \pm 415$  calbp. The Younger Dryas-age Paw Paw loess is confined to the upper 53 cm of the bank profile described in Table 1. Like Elliott's Island, two additional aeolian strata occur above the wetland 4ABb paleosol, and these are indicated by the 2Bt, 2BC, and 3BC soil horizons described in Table 1.

In addition to the fossil specimens, one pig tooth, five cow teeth, and one sheep or goat tooth also were recovered from the shoreline. Knowing that it is often difficult to identify Recent from Late Pleistocene material, and that such differentiation is not flawless, the preservation of the Late Pleistocene material at this locality is distinguished from the Recent material by their black color, greater hardness, and heavier weight. The recovered pig, sheep/goat, and cow teeth are distinct from the Late Pleistocene remains by their light natural coloration, relative softness, and lighter weight. Collectively, preservation and size exclude the possibility that the cow teeth are *Bison*. The horse tooth is black and comparatively heavy, as are the teeth of the extinct tapir, mammoth, and giant beaver. Collectively, the cow, pig, and sheep/goat teeth represent Recent (Colonial to present) mixing along the shoreline, and they may have originated from an archaeological feature situated at the base of the Ap-soil horizon. Prehistoric artifacts and Colonial ceramics also are found along this shoreline, demonstrating that this site has had multiple periods of cultural occupation.

## SYSTEMATIC PALEONTOLOGY

Six taxa were recovered from the Paw Paw Cove fossil site. Four of these, the giant beaver, horse, tapir, and mastodon, are extinct species.

Class Mammalia		
Order Rodentia		
<i>Castoroides</i> sp.		Giant beaver
Order Carnivora		
<i>Canis</i> cf. <i>C. latrans</i>		Coyote
Order Perissodactyla		
<i>Equus</i> sp.		Horse
<i>Tapirus veroensis</i>		Tapir
Order Artiodactyla		
cf. <i>Cervus elaphus</i>		Wapiti [Elk]
Order Proboscidea		
<i>Mammut americanum</i>		Mastodon

## ORDER RODENTIA

### FAMILY CASTORIDAE

#### *Castoroides* sp.

##### Giant beaver

**MATERIAL.** USNM (U.S. National Museum) 521229, left lower fourth premolar. See Figure 4E.

**MEASUREMENTS.** Mesiodistal length, 20.5 mm; labiolingual width, 14.95 mm.

**REMARKS.** *Castoroides* was the largest rodent known in North America during the Pleistocene (Parmalee and Graham, 2002:65). Unlike living beavers, the giant beaver apparently did not build dams or fell trees but occupied a niche more like the modern muskrat (Kurtén and Anderson, 1980:236), occupying lakes, embayments, and associated bogs and wetlands. While reaching its greatest abundance in the Great Lakes region, giant beaver fossils have been recovered from Alaska south to Florida and from Texas to the East Coast (Kurtén and Anderson, 1980:236; FAUNMAP Working Group, 1994:508–509; Parmalee and Graham, 2002:70). Whereas five specimens are known from Virginia (McDonald and Freeman, 2009) and three from New Jersey (Big Brook, Monmouth County: Parris and Case, 1980; Parris, 1983; Fairy Hole Rock Shelter, Warren County: NJSM-ISS-20036 [New Jersey State Museum, Indian Site Survey], left lower first molar; Parris and Case, 1980; Parris, 1983; and Ramaness in Brook Farm, Holmdel Township, Monmouth County: NJSM 12236 molar; Dave Parris, personal communication), the Tilghman Island specimen is the first record for Maryland and only the fourth record from the Atlantic Coastal Plain of the Mid-Atlantic region of Delaware, Maryland, and Virginia. The other three Coastal Plain specimens are from Virginia: a right edentulous mandible (USNM 215021) from Metomkin Island, Accomack County; a lower fourth premolar (USNM 187484) from Deep Creek Pit, Norfolk County; and a likely inferior molar (USNM 534006, cast) from Gwynn Island, Mathews County. This taxon also is known from the late Wisconsin age Natural Chimneys fauna and Saltville fauna of the Appalachian Mountain region of Virginia. There are at least three other known specimens of *Castoroides* from Cedar Island, Accomack County, Virginia (see Lowery 2016:338, fig. 3.316), but these have not yet been deposited in a research collection.

Based on skull characters, Morgan and White (1995:420) described a new species of *Castoroides*, *C. leiseyorum*, from the late early Irvingtonian of Florida. It is not known if this taxon represents a geographical or chronospecies difference. Martin (1969) described a subspecies of *C. ohioensis*, *C. o. dilophidus*, based on the presence of a divided anterior lophid on the upper third molar and lower fourth premolar of Rancholabrean specimens from Florida. Because the subspecies *C. o. dilophidus* is based on a lower premolar tooth character that is not found in all specimens at the type locality and because the species



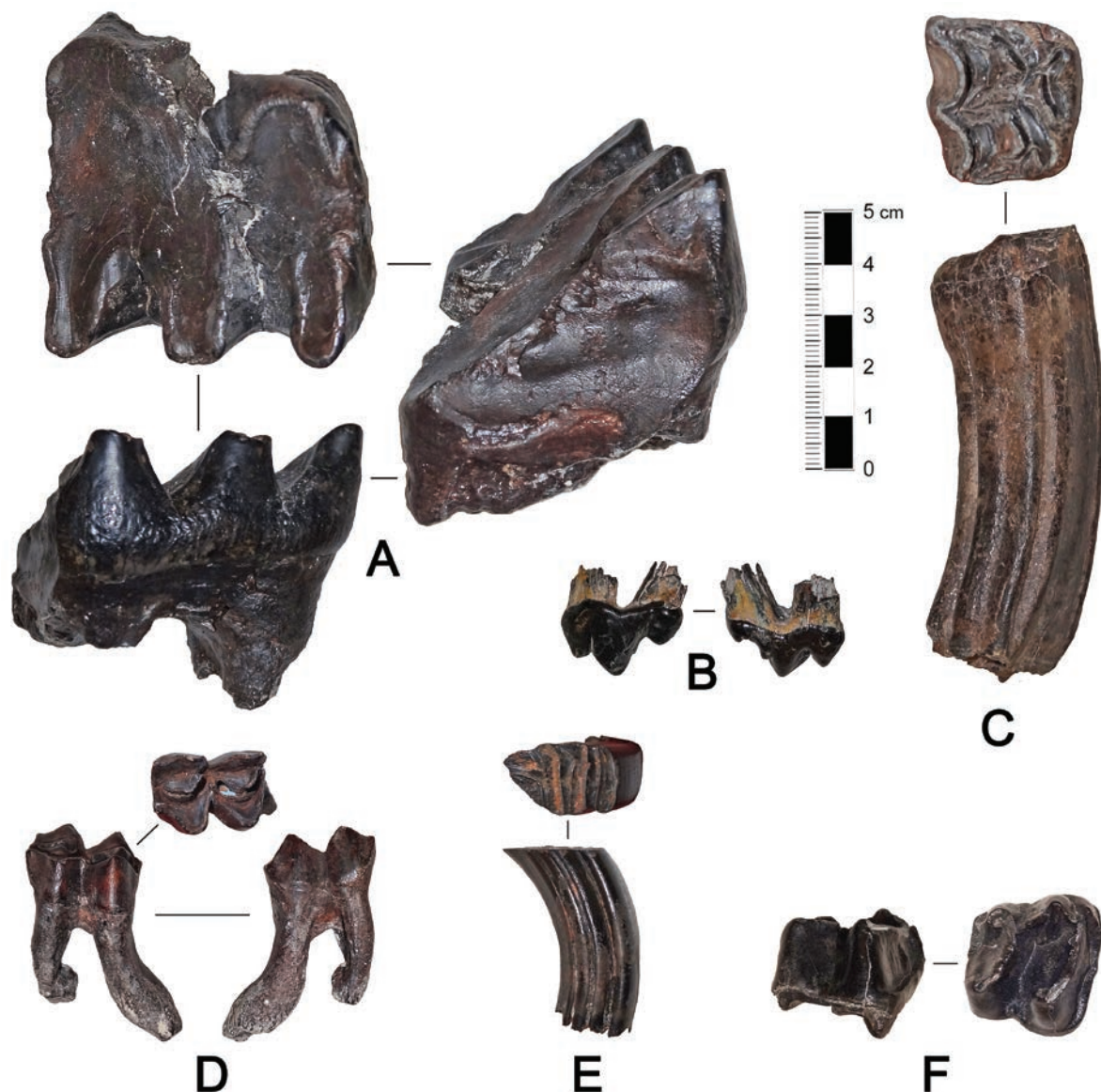


FIGURE 4. Paw Paw Cove specimens: (A) USNM 521234 *Mammuth americanum* (American mastodon), deciduous fourth premolar; (B) USNM 521230 *Canis* cf. *C. latrans* (coyote), right lower first molar; (C) USNM 521231 *Equus* sp. (horse), right upper molar or premolar; (D) USNM 521233 cf. *Cervus elaphus* (wapiti), lower first or second molar; (E) USNM 521229 *Castoroides* sp. (giant beaver), left lower fourth premolar; (F) USNM 521232 *Tapirus veroensis* (Vero tapir), right third upper molar.

*C. leiseyorum* is based on skull characters, a clear understanding of their taxonomic relationships, if any, cannot be determined with the material now in hand.

Hulbert et al. (2014) suggest there may be, in fact, two distinct species of giant beaver from the Late Pleistocene of the eastern United States: one in the southeast (*C. dilophidus*), which would also include *C. leiseyorum*, and one in the north (*C. ohioensis*). The species are diagnosed largely on skull characters and therefore not informative for the identification of the specimen

reported here. Because Maryland is located geographically between the range of these two proposed species and because we have no skulls, we have chosen not to make a species determination until the taxonomic and evolutionary relationships across a broader geographic range are more fully resolved.

Previous records of *Castoroides* in the region have been attributed to *C. ohioensis*, but these specimens were reported prior to the description of *C. o. dilophidus* or *C. leiseyorum* and should be reevaluated in view of these new taxa. Interestingly, three

lower fourth premolars—one each from North Carolina, Virginia, and Maryland—possess a double anterior lophid pattern: specimen USNM 239820 from the Island Creek Local Fauna, North Carolina (R. E. Eshelman and Clayton E. Ray [National Museum of Natural History, Smithsonian Institution], unpublished); specimen USNM 187484 from Deep Creek Pit, Virginia; and the Tilghman Island specimen. Another Maryland specimen (USNM 170885) from Prince George's County does not exhibit this character. Martin (1969) suggested this bilophid dental variation may be a trait characteristic of an Atlantic Coastal Plain subspecies ranging from Florida to at least Maryland. Hulbert et al. (2014) noted in their study of *Castoroides* that the dilophid pattern of the p4 was present in 36 specimens, or 64% of specimens from Florida; however, they did not conclude this character was of specific distinction but a population variable.

## ORDER CARNIVORA

### FAMILY CANIDAE

#### *Canis* cf. *C. latrans* Say

##### Coyote

**MATERIAL.** USNM 521230, right lower first molar. See Figure 4B.

**MEASUREMENTS.** Mesiodistal length, 24.55 mm; labiolingual width, 9.8 mm.

**REMARKS.** The m1 (USNM 521230) compares well in size, shape, and robustness with two Rancholabrean age specimens of *Canis latrans* of a p4 (USNM 639779) and M2 (USNM 639780) from New Trout Cave, West Virginia. The tooth also compares well with two *C. latrans* m1s from the Irvingtonian age Cumberland Cave, Maryland, but their lengths are smaller (18.0 and 19.5 mm). The m1 dimensions fall within the larger end of the size range of Recent *C. latrans* as reported by Nowak (1979: fig. 47). Skull and dental characters have been used to distinguish *C. latrans*, *C. lupus*, and *C. rufus* (Bekoff, 1977; Bekoff and Gese, 2003), but Jackson (1951) stresses dental measurements may not be reliable. We therefore provisionally assign this tooth to *C. latrans*.

The extant coyote is known from the Irvingtonian to the Recent and was common and widespread during the Late Pleistocene, ranging from Alaska, Wisconsin, and Pennsylvania south to Florida and Mexico (Nowak, 1979:73; Kurtén and Anderson, 1980:167). Gidley and Gazin (1933:23) reported *Canis* cf. *C. priscولاتrans* from the Irvingtonian Cumberland Cave fauna of western Maryland. Kurtén (1974) regarded all coyote-like specimens from the latest Blancan and Irvingtonian of North America as *C. priscولاتrans*, an intermediate chronospecies between the Blancan *C. lepophagus* and the later *C. latrans*. Nowak (1979:75) and Bever (2005) suggest that all similarly sized specimens of *Canis* dating from the Irvingtonian to the Recent are referable to *C. latrans*.

Coyotes were believed to have been restricted to the southwest and plains regions of the United States and Canada, and to northern and central Mexico, prior to European settlement (Moore and Parker, 1992), but the fossil record suggests they were much more widely spread during the Pleistocene. Nowak (2002) states *C. latrans* disappeared from the east during the end of the Rancholabrean and did not return until the small wolf *C. lupus rufus* was extirpated in the twentieth century. The first report of a living coyote in Maryland was in 1921, but today the coyote can be expected to be found throughout the state (Paradisio, 1969:131, 133).

This is the first provisional record for coyote in the Late Pleistocene of Maryland and is the first provisional record for the Atlantic Coastal Plain of the Mid-Atlantic portion of Delaware, Maryland, and Virginia (Nowak, 1979: fig. 46; FAUNMAP Working Group, 1994:358–359; McDonald et al., 1998: fig. A6-38). The nearest known geographical fossil record of *C. latrans* from the Mid-Atlantic region is a Late Pleistocene specimen from south-central Pennsylvania (FAUNMAP Working Group, 1994:358).

## ORDER PERISSODACTYLA

### FAMILY EQUIDAE

#### *Equus* sp.

##### Horse

**MATERIAL.** USNM 521231, right upper molar or premolar. See Figure 4C.

**MEASUREMENTS.** Mesiodistal length, 25.2 mm; labiolingual width, 24.1 mm.

**REMARKS.** The taxonomy of North American *Equus* has been in a state of flux for well over a century (Barrón-Ortiz et al., 2017). Of the 60 or more named species applied to North American *Equus*, most are either invalid or junior synonyms (Hulbert, 1995a). This tooth represents a medium-sized horse belonging to the *E. complicatus*, *E. fraternus*, *E. leidy*, *E. littoralis* group, which is characteristic of the southeastern United States during the Late Pleistocene. These species are based on isolated teeth without stratigraphic or temporal control and are among those *Equus* species most often judged to be taxonomically invalid (Savage, 1951; Winans, 1985). These horses have very similar enamel patterns and only slight differences in size. Hay (1913) and Savage (1951) suggested that *E. complicatus* and *E. fraternus* are synonymous, but this is refuted by Lundelius (1972). Sellards (1940) and Lundelius (1972) suggested that *E. fraternus* and *E. leidy* are likely the same taxon. Mikko (2003) placed *E. complicatus*, *E. fraternus*, and *E. leidy* as *incertae sedis* in his proposed phylogeny of Equidae and did not even include *E. littoralis*. These named species in reality may represent only geographical, ontogenetic, or chronological variations of one species. Therefore, the Tilghman Island specimen



cannot be reliably assigned to a species based solely on an isolated tooth.

As discussed above, the preservation of the horse tooth, including the black color, hardness, and weight of the tooth, compares favorably with the teeth of extinct Late Pleistocene taxa from the deposit. The enamel pattern of the tooth compares favorably with that seen in other Late Pleistocene horses. There are at least 15 isolated teeth as well as a few isolated bones identified as *Equus* from presumably Late Pleistocene Maryland deposits in the USNM collections.

## FAMILY TAPIRIDAE

### *Tapirus veroensis* (Sellards)

#### Vero tapir

**MATERIAL.** USNM 521232, right third upper molar. See Figure 4F.

**MEASUREMENTS.** Mesiodistal length, 28.5 mm; labiolingual anterior width, 29.5 mm; posterior labiolingual width, 24.4 mm. Upper third molars of this species identified from Melbourne, Florida, in the USNM collections (USNM 239810, 239811) were measured during preparation of a publication on the Late Pleistocene Island Creek Local Fauna, New Hanover County, eastern North Carolina. The range of measurements for three M3s are mesiodistal length, 24.8–25.9 mm; labiolingual anterior width, 28.7–30.7 mm; and labiolingual posterior width, 24.5–25.7 mm. The Paw Paw Cove molar is longer; the anterior width measurement falls within and the posterior width falls just below the range of variation. The measurements for the Paw Paw Cove specimen fall within the range of *T. veroensis* provided by Graham (2003: figs. 5.15, 5.16) for length versus anterior and posterior width.

**REMARKS.** The Tilghman Island specimen is clearly too small to be considered one of the larger tapir species: *T. copei*, *T. haysii*, or *T. merriami* (see Graham, 2003: figs. 5.15, 5.16). *Tapirus haysii* is larger than *T. veroensis* (Hulbert 1995b). *Tapirus haysii* is reported from the Middle Irvingtonian Cumberland Cave local fauna of western Maryland (Gidley, 1913; Gidley and Gazin, 1933; van der Meulen, 1978). Gazin (1950:403) reported an association of *T. cf. T. haysii* and *T. veroensis* from Melbourne, Florida, which was noted by Ray (1964:65) as the best test for sympatry of fossil tapir species (the three living species of *Tapirus* are sympatric in northern Colombia; Hershkovitz, 1954).

Gazin (1950:403) reported one complete series of upper cheek teeth representing one individual compared well in measurements to *T. haysii*, but we were unable to find any such teeth in the collection. Unfortunately, Gazin did not catalog the Melbourne collection when he studied it, and we could not identify the specimen(s) he tentatively assigned to *T. cf. haysii* (Gazin, personal communication to Eshelman, 9 January 1976). Either all the specimens he reported are *T. veroensis* or the questionable

specimen(s) is missing. One lower mandible found with a note in Gazin's handwriting identified it as *T. cf. T. haysii*, but it is assignable to *T. veroensis*. Until such time that a specimen of *T. haysii* can be recovered from the Melbourne fauna, this fauna does not support the conclusion of two contemporaneous tapir species from the Melbourne Formation. Graham (2003:99) also suggested the possibility of these two species living contemporaneously in Missouri during the Late Pleistocene.

Simpson (1945:60) stated, "neither qualitatively nor quantitatively have I found any way of distinguishing some variants of *T. veroensis* from some variants of *T. terrestris* [a living tapir] . . . on the basis of teeth alone. This complete intergradation in tooth characters of species that are, nevertheless, surely distinct emphasizes the stereotyped nature of *Tapirus* and also how unreliable may be the usual paleontological identification from single teeth or dentition." There is no known sexual dimorphism or geographical size variation in living tapirs (Simpson, 1945:42, 50; Hooijer, 1947:297), but Hooijer (1947:290) suggested a chronocline of decreasing size from the fossil *T. indicus intermedius* to the living *T. indicus indicus*. Additional studies of fossil species and their living descendants may show that size is not always a justifiable character for fossil species differentiation. Ray (1964), Ray and Sanders (1984), and Graham (2003) discuss geographic, temporal, and taxonomic problems in fossil species of *Tapirus*.

In the New World there are three living species of tapirs, all restricted to southern Mexico, Central America, and South America. During the Pleistocene, tapirs ranged into the mid-latitudes of the United States. Tapirs are selective browsers that frequent aquatic habitats (Graham, 2003:88, 101). The Paw Paw Cove specimen is the first record of tapir from the Late Pleistocene of Maryland and the first record from the Atlantic Coastal Plain of Mid-Atlantic Delaware, Maryland, and Virginia (FAUNMAP Working Group, 1994:431; McDonald et al., 1998: fig. A6-48; Graham, 2003: fig. 5.19). Fossil tapir specimens are known from noncoastal plain deposits of Virginia and West Virginia and from Early Pleistocene noncoastal plain sites of Maryland, such as at Cumberland Cave.

## ORDER ARTIODACTYLA

### FAMILY CERVIDAE

#### *cf. Cervus elaphus* Linnaeus

#### Wapiti

**MATERIAL.** USNM 521233, lower first or second molar. See Figure 4D.

**MEASUREMENTS.** Mesiodistal length, 22.6 mm; greatest labiolingual width, 15.4 mm.

**REMARKS.** Fossil cervid taxa are largely identified by antlers, often represented in faunas as those that were naturally cast. We are unaware of any comprehensive tooth analysis

to distinguish between wapiti (*Cervus elaphus*), moose (*Alces alces*), and elk-moose (*Cervalces scotti*) with the exception of Churcher (1991: tbl. 1), which unfortunately is based on a small collection of only 16 lower fourth premolars.

Churcher's measurements (mean and range) are as follows:

*Cervalces scotti* ( $n = 6$ ): Buccal face mesiodistal length, 26.3 mm (28.0–25.3 mm); lingual face mesiodistal length, 27.4 mm (28.6–25.2 mm); buccolingual width over protoconid–paraconid, 20.1 mm (21.0–19.6 mm); buccolingual width over hypoconid–metaconid, 19.2 mm (20.6–17.9 mm).

*Alces alces* ( $n = 10$ ): Buccal face mesiodistal length, 27.5 mm (29.9–25.0 mm); lingual face mesiodistal length, 28.2 mm (30.3–25.0 mm); buccolingual width over protoconid–paraconid, 18.9 mm (20.4–16.9 mm); buccolingual width over hypoconid–metaconid, 18.1 mm (19.8–16.3 mm).

While the lower teeth are not from the same position in the jaw, the Paw Paw Cove lower molar (USNM 521233) is smaller than any of the elk-moose or moose fourth premolars in Churcher's study. Identifying a fossil cervid taxon based on a single tooth is questionable, so we provisionally assign this specimen as cf. *Cervus elaphus*.

Late Pleistocene remains of wapiti are common in North America, ranging from the Yukon to Ontario and south to Arkansas and South Carolina (Kurtén and Anderson, 1980:318; O'Gara and Dundas, 2002). Grady (1984) reported *Cervus elaphus* from Wormhole Cave, West Virginia. An AMS  $^{14}\text{C}$  date on a *Neotoma* mandible from the cave dated at  $51,650 \pm 4,110$  years BP (Semken et al., 2010). *Cervus* sp. (USNM 12473, immature pair of fused metatarsals; USNM SC 641954, partial upper molar) also is reported from the Middle Irvingtonian age Cumberland Cave of western Maryland.

Recent study by Meiri et al. (2013) suggests wapiti is a late arrival in North America, crossing the Bering Land Bridge into North America about 15,000 years ago and then rapidly spreading southward. If the identification and date of *Cervus* sp. is correct from the Wormhole Cave and from the Middle Irvingtonian age Cumberland Cave (estimated to date between 1.6 and 1.3 million years ago (MYA) [Martin, 2012] and 0.840 MYA [Repenning, 1992]) those dates dispute the hypothesis of Meiri et al. (2013). Historically, wapiti were once found throughout Maryland, including the tidewater of the Chesapeake Bay (Mansueti, 1950:11–12; Paradiso, 1969:183). Wapiti feed on twigs, bark, herbs, and grasses and are found in woodlands and forests (Kurtén and Anderson, 1980:318).

The Tilghman Island specimen is the second fossil record for *Cervus* from the Atlantic Coastal Plain of the Mid-Atlantic region of Delaware, Maryland, and Virginia (FAUNMAP Working Group, 1994:442–443; McDonald, et al., 1998: fig. A6-51). The extinct elk-moose, *Cervalces scotti*, is widely distributed in the eastern United States (Churcher and Pinsof, 1987) and is well-known from south of the Great Lakes, including several Ohio localities (Glantzhober and McDonald, 2015); it also is known from a nearly complete skeleton from New Jersey (Scott,

1885), along with a cervical vertebra probably belonging to *C. scotti* recovered off the central New Jersey coast (Becker et al., 2010). An antler beam and maxilla section of elk-moose was recovered from Cedar Island, Accomack County, Virginia (see Lowery 2016:338, fig. 3.316). The specimen is uncatalogued, and thus far these specimens have not been deposited in a research collection. The Tilghman Island tooth compares favorably in size with *Cervus* and is referred to that taxon. The first record of *Cervus* sp. is a left radius fragment (USNM 632326) found on the shore of Chesapeake Bay, believed to be eroded from Late Pleistocene sediments, at Flag Pond, Calvert County. This location is approximately 24 km (15 mi) south-southwest of Paw Paw Cove.

## ORDER PROBOSCIDEA

### FAMILY MASTODONTIDAE

#### *Mammut americanum* (Kerr)

##### American mastodon

**MATERIAL.** USNM 521234, deciduous fourth premolar. See Figure 4A. In addition, there are an uncatalogued molar and a tusk fragment. It is unclear if these are part of one or more individuals.

**MEASUREMENTS.** Mesiodistal length, 66.3 mm; labiolingual width, 59.9 mm.

**REMARKS.** The American mastodon is among the most well-known Pleistocene mammals. Fossil remains have been recovered from Alaska to Mexico (Kurtén and Anderson, 1980:344; Polaco et al., 2001; Zazula et al., 2014). American mastodon fossils appear to be concentrated in the Great Lakes, along the Atlantic Coast (Dreimanis, 1968), in the Mississippi River valley, and in Florida (FAUNMAP Working Group, 1994:424–425).

Mastodon teeth often are recovered by scallop-dredging fishing boats on the Atlantic Continental Shelf, some as far as 300 km from the present shore, including the coast of Maryland and Virginia (Whitmore, 1967; Kurtén and Anderson, 1980:344). American mastodon is known from several localities in Maryland. Clark et al. (1906) reported six specimens represented by “imperfect teeth” in the Maryland Geological Survey collections. Two of these teeth are from St. Mary's County and a third from the Ridgeley estate of Hampton, Baltimore County. No other location data were provided. Hay (1923) listed five specimens. The first three included an upper third molar (USNM 200) found near St. Mary's City and a lower third molar (USNM 201) found near St. Clements, both from St. Mary's County, and a tooth from Hampton, Baltimore County, all apparently the same as mentioned by Clark et al. (1906). The last two specimens listed by Hay included a tooth, probably from Lane's Creek near Mercersburg, Pennsylvania, just inside the Maryland

border, and a second tooth near Clear Spring, Maryland, both in Washington County. Oler (1937) summarized the records of proboscideans from Maryland, including all the specimens recorded by Hay except for the Clear Springs tooth, but Oler also added a specimen from Plum Point, Calvert County. At least some, if not all, of the Maryland Geological Survey–The Johns Hopkins University specimens are now in the National Museum of Natural History collections (USNM 200, 201, 352). In the years since Oler's work, two additional mastodon teeth have been added to the collection: a cast of a third molar (USNM 452989) from Hensen Creek, Temple Hills, and a third molar (USNM 21086) from near Oxen Hill, both Prince George's County. A complete update of the Quaternary vertebrates, including proboscideans, in Maryland is under study by Eshelman and Grady.

Remains of American mastodon are strongly linked to Late Pleistocene boreal forests (Whitehead et al., 1982; Petersen et al., 1983; Jackson and Whitehead, 1986; Bearss and Kapp, 1987; Kapp et al., 1990). Given the ecology of mastodons, they are often found in association with other browsing mammals (Graham, 2001), which is the case with the Tilghman Island site. The presence of wapiti also is indicative of a forested habitat.

Like modern elephants, mastodons have a pattern of sequential tooth replacement, with six teeth in each quadrant of the skull. Based on the timing of tooth loss and replacement in the skull and jaw of modern elephants, Laws (1966) established a means to estimate the chronological age of an individual based on the stage of wear of the mesial tooth and relative stage of eruption of the succeeding tooth. This approach was adopted by Saunders (1977) for mastodons. Assuming the lifespan of a mastodon was comparable to that of the African elephant, the presence of the deciduous premolar and its degree of wear suggest an age of approximately 13 years for this Paw Paw Cove individual when it died.

## PALEOECOLOGY

The fossil assemblage described is small but suggests the presence of a diversity of habitats, including wetlands, forest, and grasslands, that formed shortly after the full glacial boreal forests were replaced by the mesic broad-leafed forests. The presence of giant beaver and the tapir suggest a lake or associated bogs and wetlands were nearby the Paw Paw Cove site. However, while extant tapirs are often associated with wet environments they also are known to frequent dry forests. The horse suggests open habitat was present, perhaps in the form of a parkland or meadow within the forest. At nearby Parson's Island, Maryland, recent research on a buried 20,000 calbp-dated surface (Puseman et al., 2014) suggests a diverse terrestrial floral community encompassing a mixture of  $C_3$  grasslands, wetlands, upland herbaceous plants, and forests, which included both Douglas fir (*Pseudotsuga menziesii*) and speckled alder (*Alnus incana*).

The maximum depth of the Chesapeake Bay is about 63 m (208 ft). At 21,000 years ago, sea level was about 120 m (393 ft) lower, so at that time the Paw Paw Cove locality would have been above a river floodplain, not along an estuary.

## SUMMARY AND CONCLUSIONS

During the terminal Pleistocene circa 12,600 to 11,600 calbp a thin veneer (<150 cm) of loess enveloped the western side of the Delmarva Peninsula (see Lowery et al., 2010; Lothrop et al., 2016; Wah et al., in press). Loess distribution, deposit characteristics, and particle size distribution within the loess suggest multiple sources for the parent silts. At the time of the loess deposition, relative sea level within the modern confines of the Chesapeake Bay was approximately 50 m (164 ft) lower than present (see Lowery et al., 2012a). Certainly, the low-sea-stand floodplain adjacent to the Susquehanna River west of Paw Paw Cove acted as the chief source of aeolian loess sediments. With winds from the north and west, silts were deposited across the uplands of the western Delmarva Peninsula. However, before the onset of loess deposition, much of the uplands seem to have been eroded or truncated during the climatic shift from warm late Allerød oscillation into the Younger Dryas cold event. Low moist interfluvial areas, like those at Paw Paw Cove, were spared. As a result, a marine isotope stage of MIS-2 (late glacial maximum) paleosol has been preserved along much of the eastern shore in areas that have survived Holocene marine transgression. The  $^{14}\text{C}$  dates from the surface horizon of the paleosol (i.e., Tilghman Paleosol) at Paw Paw Cove range between 21,046 and 22,018 calbp ( $17,820 \pm 170$   $^{14}\text{C}$  years BP). During the late glacial maximum, relative sea level was 100–120 m (328–396 ft) lower than present, and the Norfolk Canyon encapsulated an estuary somewhat analogous to the modern Chesapeake Bay. At the time, Paw Paw Cove would have been an upland interfluvial wetland positioned 6.5 km (~4 mi) east of the Susquehanna River and 280 km (~175 mi) inland from the primordial Chesapeake Bay–Norfolk Canyon estuary.

A small but significant Late Pleistocene mammalian fauna found associated with the approximate 21,000-calbp paleosol consists of six taxa, four of which are extinct. The fauna was recovered from Paw Paw Cove, Tilghman Island, Talbot County, Maryland. *Castoroides* sp. (giant beaver)<sup>1</sup> and *Tapirus veroensis* (Vero tapir) are the first records for Maryland; the tapir is also the first record from the Coastal Plain of the Chesapeake region of Delaware, Maryland, and Virginia. The provisional presence of the coyote, *Canis* cf. *C. latrans*, and wapiti, *Cervus elaphus*, appear to be the oldest records for these taxa in the eastern United States.

## NOTE

1. The late William P. Doeppkens, a farmer and self-taught archaeologist from Davidsonville, Maryland, documented what

were believed to be trace fossil remains of *Castoroides* tunnels in Crofton, Maryland, in 1973 after a bulldozer collapsed through the topsoil over the tunnels. Doepkens self-published his report in 1979, "Excavation of an Extinct Native Maryland Beaver Complex at Crofton, A.A. Co., Maryland." The Paw Paw Cove tooth is the first fossil tooth of this taxon known to be found in Maryland.

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