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AMS RADIOCARBON DATES FOR PLEISTOCENE FAUNA FROM THE AMERICAN NORTHEAST

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ABSTRACT. Northeastern North America has produced an incredible number of late Pleistocene faunal remains; however, many of these were discovered and excavated prior to the development of radiocarbon dating. Moreover, many of the ^{14}C dates that do exist for such specimens were assayed prior to the development of purified collagen extraction methods, were performed on botanical remains of unspecified association with the faunal remains, or were accepted without concerns of young-carbon contamination from museum preservatives. Here, we present a set of high-precision accelerator mass spectrometry (AMS) dates obtained on Pleistocene faunal specimens from Connecticut, New Jersey, and Pennsylvania. Our data contains both newly discovered specimens, and specimens that have resided in museum collections for over a century.

METHODS

Bone and antler specimens were cleaned and washed using ultrasonic baths. Specimens containing sufficient preserved collagen are treated in 1N HCl at 4°C for 24 hr. The remaining residue is filtered, treated with 0.1N NaOH on filter to remove humic acid contamination, rinsed in deionized water, and heated at 80°C for 12 hr in a slightly acid environment to dissolve collagen and leave humic substances in precipitate. The collagen solution is purified, and the dried pure collagen is combusted at 575°C in an evacuated and sealed Pyrex® ampoule. Specimens lacking preserved collagen were pretreated for analysis of the bioapatite fraction and prepared following methods discussed by Cherkinsky (2009). After cleaning, the dried specimens were crushed to small fragments, and the fragments were treated with dilute 1N acetic acid to remove surface absorbed and secondary carbonates. Carbon dioxide from the secondary carbonates was collected and purified for analysis. The chemically cleaned sample was then reacted under vacuum with 1N HCl to dissolve the bone/antler mineral and release carbon dioxide from bioapatite. The resulting carbon dioxide was cryogenically purified from the other reaction products and catalytically converted to graphite using the method of Vogel et al. (1984). Graphite $^{14}C/^{13}C$ ratios were measured using the CAIS 0.5MeV accelerator mass spectrometer. The sample ratios were compared to the ratio measured from the oxalic acid I (NBS SRM 4990). The sample $^{13}C/^{12}C$ ratios were measured separately using a stable isotope ratio mass spectrometer and expressed as $\delta^{13}C$ with respect to PDB, with an error of less than 0.1‰. Uncalibrated dates are given in radiocarbon years before 1950 (yr BP), using the ^{14}C half-life of 5568 yr. The error is quoted as one standard deviation and reflects both statistical and experimental errors. All dates are corrected for isotopic fractionation.

RESULTS

Colts Neck Stag Moose (*Cervalces scotti*)

UGAMS-13936 **12,370 ± 25 ^{14}C BP**
Antler; bioapatite **$\delta^{13}C$ = –12.0‰**

Originally discovered in 1978 at the Big Brook fossil locality, east of Boundary Road in Colts Neck Township, Monmouth County, New Jersey (40°19′58″N, 74°13′37″W). Donated to the New Jersey State Museum (NJSM) by S Velasco of Colonia, New Jersey. NJSM catalog number NH12109. Identification as *C. scotti* based on size, palmation, and surface texture of antler fragment (Parris 1983).

Comments: Date compares favorably with previously reported *Cervalces* specimens from the region

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(e.g. Buckley and Willis 1970; Harington 1984; Robinson et al. 2005; Becker et al. 2010; Feranec and Kozlowski 2010).

Mount Hermon Stag Moose (*Cervalces scotti*)

UGAMS-17232 **9770 ± 35 ^{14}C BP**
Bone; collagen **δ^{13}C = –20.1‰**
UGAMS-17232A **10,370 ± 40 ^{14}C BP**
Bone; bioapatite **δ^{13}C = –9.2‰**

Fourth left rib of *Cervalces scotti* collected ~1884 from a shell and marl deposit at the base of a bog at Mount Hermon, Hope Township, Warren Co., New Jersey (40°55′26″N, 74°59′38″W). Formerly of the Princeton University museum, the specimen is now held by and on display at the NJSM. Catalog number PU 10648.

Comments: According to the New Jersey Historical Society (1894:10), the specimen was obtained in 1884 by A A Haines, who having been informed that the bones of an unknown animal had been encountered, "proceeded at once to the spot [and] secured all that could be obtained." Haines donated the skeleton to Princeton University that year. Scott (1885) formally described and identified the specimen as *C. scotti* (formerly *C. americanus*). After being donated to Princeton, the specimen was treated with alvar as a consolidant, mounted, and placed on display. The specimen was later transferred to the NJSM, where it has been on display for the past 30 yr. A fragment was removed from the midsection of the rib during routine maintenance in early 2014; PU 10648 is one of two nearly complete *Cervalces* specimens recovered from New Jersey, the other being the Columbia Stag Moose discussed by Harington (1984). Given the priority of discovery of PU 10648, its excellent condition and completeness, and continued public access, the skeleton remains the definitive specimen for the species.

Date returned on the collagen fraction is more than 1000 yr younger than the next-earliest *Cervalces* specimen in the region (Feranec and Kozlowski 2010) and therefore was viewed cautiously. Though organic solvents were used to remove the alvar preservative, it is possible that an unknown and undocumented preservative had been applied to the specimen at some point in the past 120 yr (e.g. casein glue). A second assay was performed on the bioapatite fraction of the bone. The resulting date is roughly 600 ^{14}C yr older than the collagen date, suggesting to us the likely presence of some undocumented preservative. The older date is preferred.

Harbour Mastodon (*Mammut americanum*)

UGAMS-16239 **11,680 ± 30 ^{14}C BP**
Bone; collagen **δ^{13}C = –21.4‰**

Cranial fragment of a juvenile American mastodon (*M. americanum)* discovered in 2013 in bedded Quaternary sediment at the Monmouth County Brooks locality, New Jersey (40°19′55″N, 74°10′26″W). Donated to the NJSM by G Harbour of Freehold Township. NJSM catalog number GP23439.

Comments: Date compares well with other *M. americanum* specimens from the American Northeast.

New Britain YWCA Mastodon (*Mammut americanum*)

UGAMS-17668 **11,160 ± 30 ^{14}C BP**
Bone; bioapatite **δ^{13}C = –12.7‰**

Long-bone fragment of an American mastodon (*M. americanum*) discovered in September 1852, "while excavating in a soft swampy soil for a pond on land belonging to Mr. William A. Churchill" (Schuchert and Lull 1914:322) near the Young Women's Christian Association (YWCA) at what

was once the intersection of School and College streets (41°39′50.4″N, 72°46′51″W). Yale Peabody Museum Vertebrate Paleontology catalog number VP 40002.

Comments: Skeletal elements found included femora, tibia, humeri, ribs, and several teeth; some of these bones are reported to have crumbled or disintegrated after removal from the ground. The mastodon bones were exhibited for ~30 yr at New Britain Normal School (now Central Connecticut State University), after which they were transferred to the Vertebrate Paleontology collection at the Yale Peabody Museum. This is one of several mastodons recovered in Connecticut, and the first to our knowledge that has been AMS dated.

Marshalls Creek Mastodon (*Mammut americanum*)

UGAMS-18087 **11,410 ± 30 ^{14}C BP**
Bone; collagen **$\delta^{13}C$ = –21.3‰**

Large cortical-bone fragment of an American mastodon (*M. americanum*) discovered in July 1968, by J Leap and P Strausser at the base of a peat bog north of Mountain Lake House Resort on PA State Route 209 (41°2′49″N, 75°6′39″W). State Museum of Pennsylvania (SMP) Vertebrate Paleontology catalog number 13.

Comments: A nearly complete mastodon skeleton was encountered at a depth of ~1.7 m. Excavations were performed by the State Museum of Pennsylvania (SMP) and led by D Hoff. The articulated and mounted skeleton has been on display at the State Museum since shortly after discovery. The bone specimen analyzed here is a fragment that was not included in the mounting process and that does not appear to have been treated with any consolidant or preservative.

Two ^{14}C dates were previously obtained on wood associated with the mastodon skeleton, and these are reported by Buckley and Willis (1970): I-3929 (12,160 ± 180 ^{14}C BP) and I-3930 (12,020 ± 180 ^{14}C BP). This result suggests that the Marshalls Creek specimen is ~600–700 ^{14}C yr younger than previous estimates.

Fairy Hole Giant Beaver (*Castoroides ohioensis*)

UGAMS-16240 **11,140 ± 30 ^{14}C BP**
Tooth; collagen **$\delta^{13}C$ = –21.25‰**

Molar (cf. lower first) from (*C. ohioensis*) collected in 1936 from the Fairy Hole Rockshelter (28-WA-25), Allamuchy Township, Warren Co., New Jersey (40°55′30″N, 74°53′35″W). NJSM catalog number AE585.20036.

Comments: Excavations at the rockshelter by Cross (1941) recovered a large number of faunal specimens including *Scalopus, Blarina, Eptesicus, Lynx, Mephitis, Canis, Procyon, Sus, Odocoileus, Tamias, Sciurus, Marmota, Erethizon, Ondatra, Microtus, Neotoma, Castor, Sylvilagus, Chelydra*, and *Clemmys*. Archaeological remains dating from the mid-Holocene to about AD 1500 were also recovered by Cross from the rockshelter. In 1951, J Zamos of Newton, New Jersey, collected a fluted (Paleoindian) biface from the rockshelter. Zamos notified the State Museum of his find in 1959. Association of faunal remains from the rockshelter—including this specimen—with recovered archaeological materials remains equivocal as discussed by Parris and Case (1980).

Three additional specimens of *Castoroides* are known from New Jersey. One specimen (NJSM 11883) was recovered from the Big Brook locality in 1977 (Parris 1983), and another specimen (NJSM 13478) is attributed to the general Monmouth Brooks locality. Neither of these have been ^{14}C dated. The third specimen, from Hop Brook locality, is discussed below. The date for the Fairy Hole specimen is in agreement with—and intermediate between—^{14}C dates reported for two specimens of *Castoroides* from New York State (Steadman et al. 1997; Feranec and Kozlowski 2010).

Hop Brook Giant Beaver (*Castoroides ohioensis*)

UGAMS-18142 **13,210 ± 30 ^{14}C BP**
Tooth; bioapatite **δ^{13}C = –13.12‰**

Molar (right upper second) from (*C. ohioensis*) collected in 1983 by G R Case from late Pleistocene sediments cut by a tributary to Hop Brook at the Big Brook locality, Holmdel Township, Monmouth Co., New Jersey (40°19′37″N, 74°13′34″W). NJSM catalog number NH12236.

Comments: Specimen was collected from the Hop Brook locality by an amateur paleontologist and donated to the NJSM shortly after discovery. The tooth was found in loose sediment adjacent to an outcrop of Pleistocene gravels. Sediment from the Pleistocene gravels was adhering to the tooth. Case reported that he had found a fluted (Paleoindian) projectile point at the same locality, in a similar matrix, on the same day; however, there is no direct association with this specimen.

The tooth had been treated with an unknown preservative; therefore, the assay was performed on the bioapatite fraction. The resultant date suggests that this specimen is significantly older than previously assayed *Castoroides* specimens in the region (see above) and extends the presence of the species in the Northeast back by more than 2000 ^{14}C yr.

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