

## Prehistoric Sloth Extinctions in Cuba: Implications of a New “Last” Appearance Date

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**ABSTRACT.**—We report the youngest radiocarbon determination so far for an identified species of Antillean sloth, 4190 ± 40 yr BP, based on a molariform of *Megalocnus rodens* from the locality of Solapa de Silex, Lomas de Cacahual, prov. La Habana, Cuba. Together with other recently reported age estimates, the evidence is now secure that at least some Antillean sloth species survived until ca. 4200 yr BP, or approximately 1000 yr later than the first plausible evidence for the presence of humans in the Greater Antilles. The survival of relatively large terrestrial mammals for such a lengthy period after the arrival of *Homo sapiens* indicates that insular extinctions in the Late Quaternary did not always occur in a “blitzkrieg” manner.

**KEYWORDS.**—vertebrate paleontology, radiocarbon dating, Megalonychidae, Greater Antilles, extinction

### INTRODUCTION

New accelerator mass spectrometer (AMS) age estimates (“dates”) on remains of sloths (Megalonychidae, Phyllophaga) from Cuba and Hispaniola reported by Steadman et al. (2005) establish conclusively that at least some Antillean megalonychids survived into the mid-Holocene. Limb bones of *Neocnus comes* from Haiti yielded the youngest date, 4391 ± 42 yr BP (<sup>14</sup>C years before present, not  $\delta^{13}\text{C}$  corrected) or 4850-5260 cal BP. (Calibration in calendar years is based on the 2 $\sigma$  range rounded to the nearest decade, calculated using calibration program CALIB 5.0.1 of Stuiver et al. [2005].) For Cuban sloths, the youngest date in this series was 4960 ± 280 yr BP (4970-6300 cal BP), based on a proximal humerus of *Parocnus browni*. These dates are of great interest because they are thousands of years younger than any “last” appearance dates (LADs) considered reliable for sloth species living on the New

World mainland (MacPhee, in press). Except for the two living taxa, *Choloepus* and *Bradypus*, all mainland sloths appear to have died out before ~10,000 yr BP (Steadman et al. 2005; see also Martin and Steadman 1999).

Here we report an even younger AMS determination for a Cuban sloth, 4190 ± 40 yr BP (4580-4840 cal BP,  $\delta^{13}\text{C}$  corrected; Beta Analytic 206173), based on a molariform referable in size and distinctive features to *Megalocnus rodens*, the largest Antillean megalonychid (White and MacPhee 2001). This radiocarbon age is 15% younger than the previous youngest date for a Cuban sloth. It is also >4 $\sigma$  from the youngest date reported for any Antillean megalonychid by Steadman et al. (2005), and therefore becomes the new benchmark LAD for individual megalonychid taxa in the Greater Antilles. Although Woods [1989] reported a “whole bone” date of 3715 ± 50 yrbp for unspecified sloth remains recovered at Trou Wòch Sa Wo in southern Haiti, five different sloth species have been recovered from this cave [MacPhee et al., 2000] and there is thus no way of relating this date to a single taxon as we have done here.

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In any case, the accuracy of this age estimate should be confirmed, minimally by AMS dating of individual, systematically identified elements.

#### CONTEXT OF DISCOVERY

The dated tooth was found in the course of excavations at Solapa de Silex, a rock shelter in the Lomas de Cacahual located on the southern border of Ciudad de La Habana (Crespo Díaz and Jiménez Vázquez 2004) (Fig. 1). Two layers in the excavated part of the shelter were distinguished: the upper one contained cultural debris and bones of humans and animals, while the lower only yielded animal bones. The dark brown matrix comprising the upper or cultural layer (36 cm thick where measured; Fig. 1) contained ash, artifacts of preceramic-mesolithic tradition, a few human bones, and remains of various extant and extinct vertebrates. Faunal elements identified by Crespo Díaz and Jiménez Vázquez (2004) included mammals (*Megalocnus rodens*, *Brotomys* sp., *Geocapromys* sp., *Capromys* sp., *Mysateles* sp., *Mesocapromys* sp., and *Solenodon* cf. *S. cubanus*), birds (*Nesotrochis* sp.) and reptiles (*Epicrates* cf. *E. angulifer*, *Cyclura* cf. *C. nubila*, *Trachemys* cf. *T.*

*decusata*, and *Crocodylus* sp.). The lower or noncultural layer, composed of red sandy clays, yielded *Capromys pilorides*, *Crocodylus* sp., and a partial jaw of *Parocnus browni*. Among the mammals, *Megalocnus*, *Brotomys*, and *Parocnus* are extinct; some of the rodents identified only at the genus level probably represent extinct species as well.

Unfortunately, the only specimen referable to *Megalocnus rodens* was the molariform sacrificed for dating. The human skeletal remains, dated to  $2987 \pm 37$  yr BP (3010-3330 cal BP,  $\delta^{13}\text{C}$  corrected; Institut für Umweltphysik, Heidelberg) are considerably younger. Evidence is therefore lacking which might temporally connect this particular sloth with dated human presence in the shelter.

In an attempt to establish dating control for the lower layer, two molariforms from the *Parocnus browni* jaw were submitted for AMS dating. On pre-testing the sample for the presence of bone proteins ("collagen"), the dating laboratory reported a negligible analytical result, which precluded calculation of a radiocarbon age (R. E. Hatfield, pers. comm., January 25, 2006). Lack of bone proteins is presumably due to leaching. Leaching is a frequent problem with fossil material from caves in the West Indies, where hot, wet conditions result in the rapid disappearance of the organic fraction of bones, even those of apparently young age. Whether the *Parocnus* teeth are as old as or older than the *Megalocnus* tooth from the cultural layer is thus indeterminate.

#### DISCUSSION

As we have shown, recently published sloth dates are consistent with the argument that the final collapse of megalonychids on both Hispaniola and Cuba may have occurred toward the middle of the 5th millennium BP, ca. 4200 yr BP. However, it is rarely possible to show that an empirically acquired LAD corresponds to the true time of extinction of a given species (cf. MacPhee et al. 1999), if only because the odds are overwhelmingly against one actually finding (and radiocarbon dating) the very last member or population of a taxon.

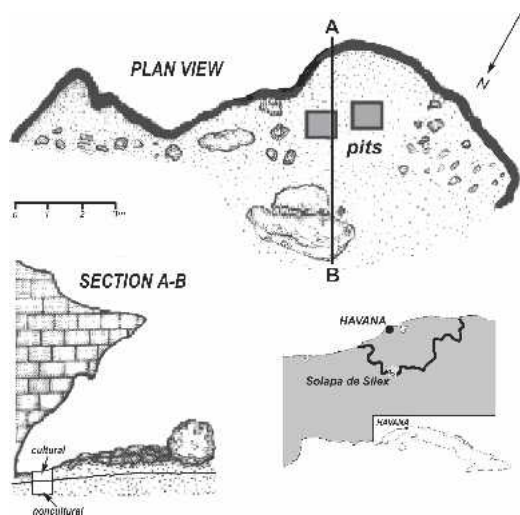


FIG. 1. Solapa de Silex: geographical location with plan and section views (to same scale; modified from Crespo Díaz and Jiménez Vázquez [2004]).

The same consideration applies to “first” appearance dates (FADs): it is highly unlikely, for example, that the earliest radiometric record of humans in the Greater Antilles actually corresponds to the first time *Homo sapiens* reached these islands (Burney et al. 1994). Although it is widely accepted that humans reached the large islands about 6000 years ago, perhaps from Yucatán (e.g., Rouse and Allaire 1978; Rouse 1992; Wilson 1997), the empirical evidence for this remains rather limited (Allaire 1997). One frequently-mentioned FAD for humans is based on radiocarbon dates from the Haitian coastal site of Vignier III (Moore 1991), the oldest of which is  $5580 \pm 80$  yr BP (6210–6550 cal BP). As Allaire (1997, p. 21) points out, however, the date is derived from surface-collected sea shells, “perhaps not the most reliable context.” Properly, in view of the source material the Vignier III radiocarbon ages should be corrected for marine reservoir effects. Using the global ocean correction factor (Hughen et al. 2004), the oldest Vignier III radiocarbon date can be calibrated to 5780–6180 cal BP, a range which is younger than the uncorrected version by nearly a half millennium. Interestingly, this result closely corresponds to dating at the oldest archeological site in Cuba, a rock shelter near the Levisa River (prov. Holguín) having a basal radiocarbon age of  $5140 \pm 170$  BP (5590–6280 cal BP) (Kozłowski 1974). Earlier non-radiometric dates for the settlement of Cuba are sometimes mentioned (cf. Jull et al. 2004), but these are controversial and have not been confirmed by rigorous testing.

For many years Cano Hondo was considered the oldest reliably dated Puerto Rican archeological site, with a single date of  $3010 \pm 70$  yr BP (3000–3370 cal BP) (Rouse 1992). Burney et al. (1994) claimed a date of ca. 5300 cal BP for human arrival in Puerto Rico on the basis of an analysis of a charcoal particle record recovered from Laguna Tortuguero on the island’s north-central coast. Recently, Rodríguez (1999) cited a dating interval of 3895–4840 yr BP for the archeological site of Maruca, based on the end-members of the  $2\sigma$  ranges for 8 unpublished radiocarbon dates. No indication of

the source materials of the samples utilized for these dates was provided. Rodríguez (1999) also cited an even earlier radiocarbon age, 5960 yr BP, for a singleton date for the site of Angostura published by Ayes (1989). This date, which corresponds to a calibrated date of >6700 cal BP, must be regarded as extremely early and requires corroboration in our view.

By contrast, the current FAD for humans in Jamaica is very young, ca. 1500 yr BP (Rouse 1992), which may simply reflect the fact that the search for early evidence of human settlement on this island has been less intense than elsewhere in the Greater Antilles. Incidentally, unlike the other Greater Antilles, Jamaica lacked sloths (White and MacPhee 2001).

These points carry an important implication for extinction studies. If it is accepted that humans entered the Greater Antilles between ca. 5500–6000 cal BP, then people and sloths must have coexisted for an appreciable period before the latter became completely extinct. In the comparable case of Madagascar, it is now clear that there is a substantial gap (>1000 yr) between the estimated time of first biological contact and the probable final disappearance dates of all Malagasy hippos and giant lemurs (MacPhee and Burney 1991; Alcover et al. 1998; Burney et al. 2004; Perez et al. 2005). On the evidence presented here, it seems likely that the survival interval for sloths following human arrival in the Greater Antilles met or exceeded the millennial level as well. Such long survival times are in conflict with the usual finding that prehistoric extinctions of endemic species occurred extremely rapidly after first biological contact with humans, on a centennial or even decadal scale (e.g., MacPhee and Marx 1997; Holdaway and Jacomb 2000; Steadman et al. 2002)—the familiar “blitzkrieg” scenario originally developed to explain the rapidity of late Quaternary continental extinctions (e.g., Martin and Steadman 1999). Yet if our interpretation of the extinction record for Antillean sloths is substantially correct, the losses did not occur quickly.

One possibly fruitful approach to the problem of evaluating the nature of prehis-

toric human impacts on the West Indian fauna would be to revisit the argument that there should be little or no evidence of human/faunal interaction during the “crisis” period between first human occupation and onset of extinctions (e.g., Martin and Steadman 1999). For example, Perez et al. (2005) have shown that, contrary to previous views, taphonomic evidence that people were hunting and processing megafaunal species in Madagascar is actually rather abundant. Although on several occasions isolated bones of Cuban sloths have been reportedly found commingled with cultural remains (e.g., Harrington 1921; Rodríguez Suárez et al. 1984; Pino and Castellanos 1985), at present there is no objective basis for determining whether such associations were real or merely accidental. What is needed now is a detailed taphonomic study, using modern methods and concentrating on undisturbed sites where early human activity is suspected. This may help to test the “long fuse” model now emerging in the study of late Quaternary extinctions in the West Indies—that, for whatever reason, extinction of endemics occurred on a longer time scale than previously believed (MacPhee, in press).

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#### LITERATURE CITED

- Allaire, L. 1997. The Lesser Antilles before Columbus. In *The Indigenous People of the Caribbean*, ed. S.M. Wilson, 20-28. Gainesville FL: University of Florida Press.
- Alcover, J., A. Sans, and M. Palmer. 1998. The extent of extinctions of mammals on islands. *Journal of Biogeography* 25:913-918.
- Ayes Suarez, C. 1989. Excavaciones arqueológicas en Angostura, Bo. Florida Afuera, Barceloneta, Puerto Rico. *Ecos de Plazuela* 1(3):9-11. Centro Cultural de Barceloneta, Puerto Rico (cited by Rodríguez, 1999).
- Burney, D. A., L. P. Burney, and R. D. E. MacPhee. 1994. Holocene charcoal stratigraphy from Laguna Tortuguero, Puerto Rico, and the timing of human arrival on the island. *Journal of Archaeological Science* 21:273-281.
- Burney, D. A., et al. 2004. A chronology for late prehistoric Madagascar. *Journal of Human Evolution* 47: 25-63.
- Crespo Díaz, R., and O. Jiménez Vázquez. 2004. Arqueología precolombina del municipio Boyeros. *Revista de Gabinete de Arqueología* 3:67-74.
- Harrington, M. R. 1921. *Cuba before Columbus*, 2 vols., *Indian Notes and Monographs*, Museum of the American Indian/Heye Foundation, New York.
- Holdaway, R. N., and C. Jacomb. 2000. Rapid extinction of the moas (Aves: Dinornithiformes): model, test, and implications. *Science* 287:2250-2254.
- Hughen, K. A., et al. 2004. Marine04 marine radiocarbon age calibration, 1-26 cal kyr BP. *Radiocarbon* 46:1059-1086.
- Jull, A. J. T., et al. 2004. Radiocarbon dating of extinct fauna in the Americas recovered from tar pits. *Nuclear Instruments and Methods in Physics Research B* 223/224:668-671.
- Kozłowski, J. K. 1974. Pre-ceramic Cultures of the Caribbean. *Zeszyty Naukowe*, vol. 386, Prace Archeologiczne, Zezyt 20. Uniwersytetu Jagiellońskiego, Kraków, Poland.
- MacPhee R. D. E. (in press) *Insulae infortunatae*: establishing the chronology of Late Quaternary mammal extinctions in the West Indies. In *American Megafaunal Extinctions at the End of the Pleistocene*, ed. G. Haynes. Dordrecht NL: Springer.
- MacPhee, R. D. E., and D. A. Burney. 1991. Dating of modified femora of extinct dwarf *Hippopotamus* from southern Madagascar: implications for constraining human colonization and vertebrate extinction events. *Journal of Archaeological Science* 18: 695-706.
- MacPhee, R. D. E., and P. A. Marx. 1997. The 40,000-year plague: humans, hyperdisease, and first-contact extinctions. In *Natural Change and Human Impact in Madagascar*, ed. S. M. Goodman and B. D. Patterson, 169-217. Washington, D.C.: Smithsonian Institution Press.
- MacPhee, R. D. E., C. Flemming, and D. P. Lunde. 1999. “Last” occurrence of the Antillean insectivore *Nesophontes*: new radiometric dates and their interpretation. *American Museum Novitates* 3264:1-19.
- Martin, P. S., and D. W. Steadman. 1999. Prehistoric extinctions on islands and continents. In *Extinctions in Near Time: Causes, Contexts, and Consequences*, ed. R. D. E. MacPhee, 17-56. New York: Kluwer Academic/Plenum Publishers.
- Moore, C. 1991. Cabaret: lithic workshop sites in Haiti. In *Proceedings of the 13th International Congress of Caribbean Archaeology*, ed. E. N. Ayubi and J. B. Havisser, *Reports of the Archaeological-Anthropological Institute of the Netherlands Antilles* 9:922-1004.
- Perez, V. R., et al. 2005. Evidence of early butchery of giant lemurs in Madagascar. *Journal of Human Evolution* 49:722-742.
- Pino, M., and N. Castellanos 1985. Acerca de la asociación de perezosos cubanos extinguidos con evi-

- dencias culturales de aborígenes cubanos. *Reporte de Investigación del Instituto Ciencias Sociales* 4.
- Rodríguez, M. 1999. Excavations at Maruca, a Pre-ceramic site in southern Puerto Rico. In *Proceedings of the Seventeenth Congress of the International Association for Caribbean Archaeology*, ed. by J. H. Winter, 166-180. Rockville Centre, New York: Molloy College.
- Rodríguez Suárez, R., O. Fernández Leyva, and E. Vento Canosa 1984. La convivencia de la fauna de desdentados extinguidos con el aborígen en Cuba. *Kobie, Revista de Ciencias* 14:561-566.
- Rouse, I. 1992. *The Tainos: Rise and Decline of the People Who Greeted Columbus*. New Haven C: Yale University Press.
- Rouse, I., and L. Allaire 1978. The Caribbean. In *Chronologies in New World Archeology*, ed. R. E. Taylor and C. W. Meighan, 431-481. New York: Academic Press.
- Steadman, D. W., et al. 2002. Rapid prehistoric extinction of iguanas and birds in Polynesia. *Proceedings of the National Academy of Sciences USA* 99:3673-3677.
- Steadman, D. W., et al. 2005. Asynchronous extinction of late Quaternary sloths on continents and islands. *Proceedings of the National Academy of Sciences USA* 102:11763-11768.
- Stuiver, M., P. J. Reimer, and R. Reimer. 2005. CALIB 5.0.1 (radiocarbon calibration program). <http://www.calib.org>
- White, J., and R. D. E. MacPhee 2001. The sloths of the West Indies: a systematic and phylogenetic review. In *Biogeography of the West Indies: Patterns and Perspectives*, 2<sup>nd</sup> ed, ed. C. A. Woods and F. E. Sergile, 201-236. Boca Raton, FL: CRC Press.
- Wilson, S. M. 1997. Introduction to the study of the indigenous people of the Caribbean. In *The Indigenous People of the Caribbean*, ed. S. M. Wilson, 20-28. Gainesville FL: University of Florida Press.