Isla de Mona (Mona Island) is a small (55.7 km²), elevated carbonate platform, isolated in the Mona Passage between Puerto Rico (68 km west of Punta Higuero) and Hispaniola (60 km east of Punta Espada, Dominican Republic). The climate is subtropical dry, typical of an offshore Puerto Rican island (Nieves-Rivera et al., 2005), with a mean annual precipitation of 600 to 1200 mm and mean annual temperature of 24 to 28°C. The chiropteran fauna is depauperate, although a recent survey has increased the number of species to seven (Nieves-Rivera, personal observations, 2009).

Although the greater fishing bat *Noctilio leporinus* is widespread in the West Indies and occurs in various places in Puerto Rico today (Gannon et al. 2005), all references to its presence on Isla de Mona may be traced back to an erroneous attribution in Elliot (1905). This was repeated by Anthony (1918, 1925) and the error has continued on (Woods, 1996:138; Gannon et al. 2005, and many other authors).

Fossil evidence and probable extinction of the greater fishing bat *Noctilio leporinus* (Chiroptera: Noctilionidae) on Isla de Mona, Puerto Rico

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ABSTRACT: The greater fishing bat *Noctilio leporinus* has long been erroneously attributed to Isla de Mona, Puerto Rico, based on specimens from Monos Island, Trinidad. There are no historical specimens from the island but a radius from a late Holocene cave deposit now establishes that the species was once present. Its apparent extinction may be caused by human intervention, a factor that should be taken into account in the biogeography of West Indian bats.

RESUMEN: Evidencia fósil y probable extinción del murciélago pescador *Noctilio leporinus* (Chiroptera: Noctilionidae) en Isla de Mona, Puerto Rico. Durante mucho tiempo el murciélago pescador *Noctilio leporinus* ha sido atribuido erróneamente a Isla de Mona, Puerto Rico, basándose en unos especímenes de la Isla de Monos, Trinidad. No hay especímenes históricos procedentes de la isla pero un radio obtenido de unos depósitos holocénicos de una cueva ahora establecen que la especie estuvo presente. Su aparente extinción pudo deberse a la intervención humana, un factor que debe ser tomado en consideración en la biogeografía de los murciélagos de las Indias Occidentales.

Keywords. Biogeography. Extinction. Mona Island. *Noctilio*. West Indies

long after it had been corrected by Choate and Birney (1968), who showed that the specimens in question actually came from Monos Island off of Trinidad, a place long renowned for its population of fishing bats (Benedict, 1926; Goodwin, 1928; Gudger, 1945). We have traced no modern specimen of *Noctilio leporinus* from Isla de Mona, Puerto Rico, in the major repositories where one might be expected (AMNH, FMNH, USNM) and the species was not encountered in a recent survey of bats on Mona (Nieves-Rivera, personal observations, 2009).

That the species once existed on Mona, however, can now be affirmed by a bone specimen excavated from a cave on the island. This was found in a box of bones of Audubon’s Shearwater *Puffinus lherminieri* that was originally cataloged in the Division of Birds, Smithsonian Institution, under USNM 428188. The specimen has now been recataloged in the Department of Paleobiology as USNM 530789. It consists of a complete right radius (Fig. 1), originally in two pieces but now repaired, that measures 82.7 mm in overall length, a size in excess of that in any West Indian bat except *N. leporinus*. The bone material was collected in 1951 by the geologist Clifford A. Kaye on the western side of the island near Playa Sardinera in a cavern known as Cueva Negra (Kaye, 1959: 165), where bones were found in a deposit “of 1 to 6 inches [25-150 mm] of a slightly plastic yellow silt” the upper half of which contained “many small charcoal fragments.” Kaye reported evidence of long occupancy of the cave by man including both Amerindians and Europeans and he concluded (p. 166) that the extremely abundant bones of shearwaters (which included the radius of *Noctilio*) “constitute a midden built with the refuse of many feasts, probably during Indian occupancy of the cave.” Charcoal from the surface of a deposit on a ledge at the eastern side of the same chamber gave a conventional $^{14}$C date of 380 ± 60 Radiocarbon Years before present (Frank, 1998a), which overlaps the period of first European contact and the removal of the last Taínos in 1578. This would be a minimum age for the bat bone, which occurred within the floor deposit (Kaye, 1959) and so is likely to be at least somewhat older than surface charcoal.

The once extensive deposits of guano in the caves of Isla de Mona were heavily exploited by mining during the nineteenth and early twentieth centuries (Hübener, 1898; Cadilla and Vázquez, 1961; Wadsworth, 1973, 1977; Cardona Bonet, 1985; Frank, 1998b). Kaye (1959) reviewed earlier opinions that the guano deposits of Mona were derived from birds (e.g. Gile and Carrero, 1918: 8; Hutchinson, 1950: 326-327) and countered with arguments for their origin in bats, citing Anthony’s (1918) erroneous attribution of *Noctilio leporinus* to Mona Island. This gave rise to continuing attribution of the Mona guano deposits to fish-eating bats (e.g. Wadsworth 1973, 1977; Frank and Benson, 1998). The evidence presented

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**Fig. 1.** Right radii of *Noctilio leporinus* in dorsal (left) and ventral (right) views: A, USNM 391025, modern comparative specimen from Brazil, B, USNM 530789 from deposits in Cueva Negra, Isla de Mona, Puerto Rico; Scale bar = 20 mm.
here is the first documentation that the species once existed on the island, where it is now evidently extinct.

The diet of *Noctilio leporinus* is not confined to fish and aquatic crustaceans as it may also take insects and other prey either from the air or directly from the ground (Goodwin, 1928; Hood and Jones, 1984; Gannon et al., 2005; Bordignon, 2006) and has been characterized as having a “flexible foraging strategy that can adjust to local conditions” (Brooke, 1994:212). Aquatic foraging for this species on Isla de Mona would presumably have been confined to the immediate vicinity of the shoreline and during stormy weather would have been restricted to the lee shore at best. This, combined with the small size of the island for terrestrial foraging and competition with other species of bats for flying insects would suggest that population sizes of *N. leporinus* on Mona were probably never large. Females of *Noctilio leporinus* roost communally, with the same individuals occupying the same roosting site over several years (Brooke, 1997), a habit that may have made them particularly susceptible to predation. Factors in the apparent extinction of the species on Mona may have included human occupation of caves rendering roosting sites uninhabitable through light, smoke, noise and other perturbations, or direct hunting by humans for food. Although bats had importance in the symbolism and culture of the Taínos in Puerto Rico (García Goyco, 1984; García Arévalo, 1992; Narganes Storde, 1993; Rodríguez-Durán, 2002), the early Spanish chronicler Oviedo also described in some detail the culinary preparation of bats by Tainos in Puerto Rico (García Goyco, 1984; García Arévalo, 1992; Narganes Storde, 1993; Rodríguez-Durán, 2002), the use of bats for food was discounted by Rodríguez-Durán (2002) on the grounds of their apparent general absence in midden deposits, but that may be an artifact of archeological collecting that did not use techniques suitable for recovering small bones (Maíz López, in press). Regardless, on Isla de Mona, where resources were limited, nutritional deficiencies would probably have trumped societal considerations in the disposition of any bat in the hand.

*Noctilio leporinus* is commonly observed fishing in the lagoon and nearshore between Punta Guaniquilla and Joyuda beach in Cabo Rojo, the mangrove channels of La Parguera (Lajas), in inland bodies of water (Lago Guajataca and Lago Dos Bocas), small streams near Maricao in mainland Puerto Rico, and on Culebra and Vieques islands (Nieves-Rivera and McFarlane, 2001; Gannon et al., 2005), yet the species has not recolonized Isla de Mona. Its disappearance from the island, probably in the past millennium, suggests that biogeographers should pay closer attention to the possibility of prehistoric human-caused extinctions of populations of Antillean bats.

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**LITERATURE CITED**


