

19. NATURAL HISTORY AND KARYOLOGY OF THE YUCATÁN VESPER MOUSE, *OTONYCTOMYS HATTI*

HUGH H. GENOWAYS,¹ ROBERT M. TIMM,² AND MARK D. ENGSTROM³

¹University of Nebraska State Museum, University of Nebraska-Lincoln

²Natural History Museum and Department of Ecology and Evolutionary Biology, University of Kansas

³Centre for Biodiversity and Conservation Biology, Royal Ontario Museum

Abstract

Seventeen specimens of the rare Yucatán vesper mouse, *Otonyctomys hatti*, are now known from Belize, Guatemala, and the Mexican states of Campeche, Quintana Roo, and Yucatán. We herein report a second specimen of *O. hatti*, from Belize, extending the known geographic range of the species 95 km to the southeast in the country. This is the first location at which *O. hatti* has been taken sympatrically with the Central American vesper mouse, *Nyctomys sumichrasti*. We also report data on three additional specimens of *O. hatti* from Campeche. *Nyctomys* and *Otonyctomys* share similar habits and habitat requirements, and might compete where they overlap. However, the distribution of *O. hatti* corresponds closely to that of other Yucatán endemics, and the distinct distributions of the two genera probably reflects biogeographic history and different habitat requirements, rather than result from direct competition. The karyotype of *O. hatti* is $2n=50$, $FN=58$. Although superficially similar, it differs in important respects with the karyotypes reported for *N. sumichrasti*.

Key words: Belize, chromosomes, ecology, México, *Nyctomys sumichrasti*, *Otonyctomys hatti*, reproduction

Resumen

Diescisiete especímenes del ratón *Otonyctomys hatti*, especie rara de Yucatán, son ahora conocidos de Belice, Guatemala y los Estados de Campeche, Quintana Roo y Yucatán. Aquí, informamos de un segundo espécimen de *O. hatti* de Belice, extendiendo la distribución 95 km al suroeste de este país. Esta es la primera vez que se coleta *O. hatti* simpátricamente con una especie similar de cenotramérica, *Nyctomys sumichrasti*. Asimismo, presentamos datos sobre tres especímenes adicionales de *O. hatti* de Campeche. *Nyctomys* y *Otonyctomys* comparten requisitos de hábitos y hábitat similares y, por tanto, pueden competir si coinciden geográficamente. Sin embargo, la distribución de *O. hatti* corresponde de manera más similar a otras especies endémicas de Yucatán y la distribución diferentes de ambos géneros probablemente refleja una historia biogeográfica y requisitos de hábitat diferentes, respectivamente, más que una exclusión por competencia. El cariotipo de *O. hatti* es $2n=50$, $FN=58$. No obstante, es superficialmente similar, muestra importantes diferencias con los cariotipos reportados para *N. sumichrasti*.

Palabras clave: Belize, cromosomas, ecología, México, *Nyctomys sumichrasti*, *Otonyctomys hatti*, reproducción.

The Yucatán vesper mouse, *Otonyctomys hatti* (Rodentia: Muridae), is among the world's most poorly known rodents, with only 13 specimens and fragmentary material from cave deposits at Actun Spukil, southwest of Mérida, Yucatán, México having been reported (Hatt, 1953; Woodman, 1995; Fig. 1, locality 10). Anthony (1932) described the genus and species based on two specimens from Chichén-Itzá, Yucatán (Fig. 1, locality 1). Subsequently, two additional topotypes have been reported, including one specimen mentioned as a skin only by Hatt (1953) and listed as a male with catalogue number British Museum (Natural History) 52.323 by Laurie (1953), but later correctly reported by Peterson (1966) as consisting of a skin with a skull. Jones *et al.* (1974) reported the fourth topotype taken at Cenote Xtoloc, Chichén-Itzá, as well as the first specimen from the Mexican state of Campeche from Dzibalchén (locality 3). Rick (1965) reported the genus from Guatemala based on two females taken at Tikal, Petén (locality 8). Peterson (1966) was the first to report a Yucatán vesper mouse from Belize based on a young adult male from Rockstone Pond ($17^{\circ}45' - 18^{\circ}00'N$, $88^{\circ}15' - 88^{\circ}30'W$; locality 7). More recently, Aranda *et al.* (1997) reported four specimens from Quintana Roo—three from 30 km south of Felipe Carrillo Puerto (locality 4) and one from 25 km NNE Leona Vicario ($21^{\circ}13' N$, $87^{\circ}11' W$; locality 2). Finally, Hernández-Huerta *et al.* (2000) report the second specimen from Campeche, a subadult female from the Archaeological Zone of Calakmul ($18^{\circ}06'29'' N$, $89^{\circ}48'57'' W$; locality 5). The listing of "*Ototylomys hatti*" from the Columbia River Forest Reserve, Belize, by Parker *et al.* (1993) actually refers to specimens of *Ototylomys phyllotis* not *Otonyctomys hatti*, as confirmed by specimens in the National Museum of Natural History.

New Records

Herein, we report four additional specimens of *Otonyctomys hatti*, bringing the total number of specimens known to 17. We have identified a specimen of *O. hatti* collected in 1965 in Belize as the second to be recorded from the country. The specimen (NMNH 583192) is an adult male represented by a skin and skull taken at ca. 8 miles from San Diego [Georgeville] along Chiquibul Road, Cayo District, on 5 August 1965 (Fig. 1; $17^{\circ}06' N$, $88^{\circ}58' W$; locality 9). The specimen was taken by a field party lead

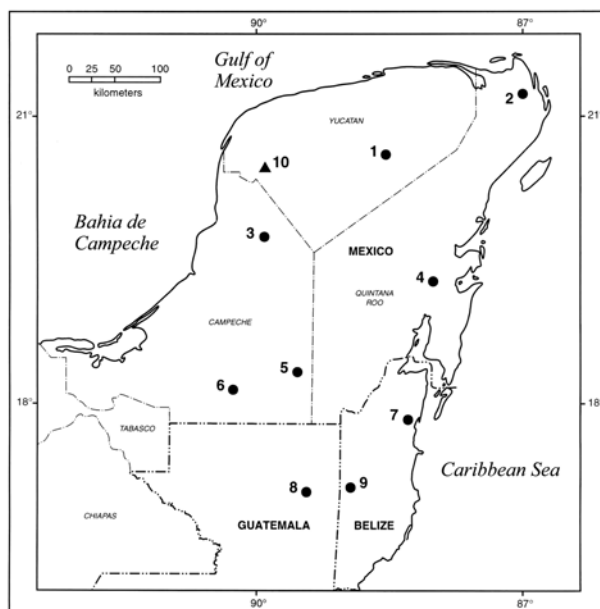


Fig. 1 Map of Belize, Guatemala, and southern México showing the sites of capture of the known specimens (closed circles) and fossil material (closed triangle) of *Otonyctomys hatti*. The precise location of sites is identified by number in the text.

by R. H. L. Disney surveying for mammalian reservoirs of leishmaniasis and other tropical diseases; it was originally identified as *Nyctomys sumichrasti* when cataloged at the National Museum of Natural History. This record extends the known geographic range of *O. hatti* approximately 95 kilometers to the southwest in Belize.

The Yucatán vesper mouse resembles the much more widely distributed Central American vesper mouse, *Nyctomys sumichrasti*. Reid (1997) noted that the distributions of these two genera approach, but do not overlap, in Guatemala and Belize. However, the collections of the National Museum of Natural History house an adult female *N. sumichrasti* taken by the Disney field party on 20 January 1965 at the same locality in Belize as the *Otonyctomys hatti* of this report. Whether this represents true microsympatry of these genera or simply an overlapping of their geographic ranges can not be ascertained with the data at hand. Much of the area where the specimens were collected has been cleared today, but both species of vesper mice might still be found in the Slate Creek Preserve.

External and cranial measurements of the *Otonyctomys hatti* from Belize followed by those of an

adult male topotype (BMNH 52.323) and those of the sympatric *Nyctomys sumichrasti* (NMNH 360477) are as follows (all in millimeters): total length, 197, 187, 251; length of tail, 101, 97, 131; length of hind foot, 22, 21, 22; length of ear, 15, 14, 17; greatest length of skull, 27.8, 27.2, 31.8; zygomatic breadth, 14.4, 14.6, 17.8; interorbital breadth, 5.1, 5.0, 5.6; breadth of braincase, 14.3, 13.8, 14.1; rostral breadth, 5.2, 4.8, 5.9; length of rostrum, 9.2, 8.8, 11.1; depth of braincase, 11.7, 11.5, 11.7; length of maxillary tooththrow, 4.2, 3.9, 4.9; length of incisive foramina, 4.6, —, 5.4; length of palatal bridge, 4.6, 3.9, 4.7; length of auditory bullae, 8.0, —, 4.2.

In January 1989 three specimens of *Otonyctomys hatti* were collected in Campeche, by M. D. Engstrom, Karen E. Petersen, Fiona A. Reid, Robert C. Dowler, and Duke S. Rogers. An adult male was trapped on 5 January at 27.5 km S Constitucion [27.5 km S, 70 km E Escárcega; 18°23' N, 90°07' W; not mapped on Fig. 1 to avoid crowding of symbols, but very near locality 6]. The external measurements of this specimen, after being held in captivity for nearly 2 months, were: total length, 228; length of tail, 118; length of hind foot, 23; length of ear, 15. This is the individual used for the illustration provided in Reid (1997). On the night of 15 January, two individuals were collected at 44 km S Constitucion [44 km S, 70 km E Escárcega; Fig. 1; 18°15' N, 90°04' W; locality 6]. A nulliparous, subadult female (CNMA 30792, formerly ROM 95785) had the following measurements: total length, 185; length of tail, 93; length of hind foot, 23; length of ear, 19; and weight, 23 g. The other specimen taken that night was a young adult male (ROM 95790) represented in the collection by a skin, skull, and skeleton. External and cranial measurements of this specimen are as follows: total length, 209; length of tail, 106; length of hindfoot, 23; length of ear, 20; weight, 27; greatest length of skull, 28.2; zygomatic breadth, 15.1; interorbital breadth, 5.4; breadth of braincase, 14.1; rostral breadth, 4.9; length of rostrum, 9.4; depth of braincase, 12.0; length of maxillary tooththrow, 4.2; length of incisive foramina, 4.5; length of palatal bridge, 4.4; length of auditory bullae 8.3. These specimens mark the western boundary of the known geographic range of the species on the Yucatán Peninsula (Fig. 1).

The measurements of these new specimens confirm the observation of previous investigators that *Otonyctomys hatti* is smaller than *Nyctomys sumi-*

chrasti in most measurements, although the former has relatively inflated auditory bullae. Thus, measurements such as length of auditory bullae, breadth of braincase, and depth of braincase (measured by placing cranium on a microscope slide so bullae are included) are larger because of the greatly inflated auditory bullae of *O. hatti*. The maxillary tooththrow of *O. hatti* measures smaller than that of *N. sumichrasti*, but direct observation of the two taxa reveals that this difference is obvious without measurement. An interesting similarity in the two taxa is the length of palatal bridge, which does not seem to be affected by the size of the auditory bullae. The subspecies of *N. sumichrasti* found in the northern part of the species' range are the smallest populations. The considerable size difference described by Anthony (1932) still holds in Belize, where the two genera now are known to occur sympatrically, but would be even be more noticeable if samples of *N. sumichrasti* from other geographic areas were compared with *O. hatti*.

Ecology

The specimen tag of the new individual from Belize notes "up tree in medium bush." The specimen from 27.5 km S Constitucion was captured in a Sherman live trap baited with bananas that was set on a dead branch that paralleled the ground at a height of about 2 m (Fig. 2). The vegetation in the area consisted of a relatively mature subdeciduous-subperennial forest. The female from 44 km S Constitucion was taken about 400 m into the forest from the nearest small road. The trap was placed at one end of a large dead log about 1 meter above the ground. The log was resting on the ground and abutting a large tree in an area of relatively open, mature forest. Other species of rodents taken in this same trapline include *Heteromys gaumeri*, *Oryzomys melanotis*, *Peromyscus yucatanicus*, and *Ototylomys phyllotis*. The male from this area was caught in a trap near the middle of a fallen tree that was estimated to be one-third meter in diameter and 2 meters above the ground. The fallen tree was about 5 m in length and lying parallel to the ground. The vegetation was relatively open near the trap, with a partial canopy overhead.

Earlier specimens have been taken in similar situations at Chichén-Itzá "in a small tree" (Jones *et al.* 1974:11) and "top of vine covered tree" as noted by collector I. T. Sanderson for the specimen (BMNH



Fig. 2 Mature subdeciduous, subperennial forest 27.5 km S Constitucion, Campeche, Mexico. Karen E. Petersen captured a male *Otonyctomys hatti* on the horizontal branch in the middle of the photograph.

52.323) taken 14 October 1940. At Rockstone Pond, the specimen was captured from the top of a coconut palm that had been cut down (Peterson 1966). The specimen from the Calakmul Biosphere Reserve was trapped in a tree in “medium height, semideciduous forest” (Hernández-Huerta *et al.* 2000:342). The other situations in which most specimens have been taken are in association with human structures. The original two specimens were taken by R. T. Hatt “on successive nights at the line between the thatch and wall of the guest house of the Carnegie Institution at Chichén-Itzá” (Hatt 1938:337). The first specimen from Campeche was “trapped on a rafter under the roof of a house” (Jones *et al.* 1974:11). The specimen from northeast of Leona Vicario, Quintana Roo, was found dead in the main building of the station La Sabana in the central part of the ecological reserve El Edén (Aranda *et al.* 1997). The arboreal habitats of *Otonyctomys hatti* almost certainly contribute to its rarity in scientific

collections. Although these data are limited, they suggest that *O. hatti* has habits and habitat requirements similar to those of the closely related *Nyctomys sumichrasti* (Genoways and Jones 1972). McCarthy (1993) reported that *O. hatti* feeds on seeds on the ground or shrubs. Based on our examination of available data, we believe that *O. hatti* is an arboreal feeder, taking not only seeds, but also small soft-bodied fruits. McCarthy (1998) considered *O. hatti* to be restricted to the broad-leaved forests of the northern plains and watersheds of the Belize-Sibun rivers.

Sympatry of *Otonyctomys hatti* and *Nyctomys sumichrasti* in the foothills of the Maya Mountains extends the distribution of *N. sumichrasti* significantly further north than Hall’s distribution map (1981; Map 374) suggests and the distribution of *O. hatti* significantly further south in Belize than Reid’s map (1997; Map 200) suggests. The relatively similar size of these two highly arboreal mice and their probable concomitant reliance upon fruit in their diet suggests that competition might occur between the two and may help explain the lack of geographic overlap elsewhere in their ranges. However, the distribution of *O. hatti* corresponds closely to that of other Yucatán endemics (e.g. *Ototylomys phyllotis phyllotis*, *Oryzomys melanotis yucatanensis*, *Heteromys gaumeri*). The distinct distributions of the two genera probably reflect biogeographic history and different habitat requirements, rather than direct competition.

Reproduction

Our specimen from Belize had testes that were 12 mm long when captured and the male from 44 km S Constitucion had nonscrotal testes measuring 8 by 5 mm. A female taken in February was lactating (Aranda *et al.* 1997). The specimen from northeast of Leona Vicario was a subadult (greatest length of skull, 21.9) taken on 7 August (Aranda *et al.*, 1997). One of the specimens from Guatemala was a juvenile with erupting third molars when caught on 25 July. The paratype taken on 26 October was an adult female with an enlarged uterus (Hatt, 1938), as was the uterus of the female taken at Cenote Xtoloc on 27 July.

Rainfall patterns on the Yucatán Peninsula, in particular the timing of the onset of the summer rainy season, vary annually. The extremes are more

severe, and the patterns less predictable, from north to south. Reproduction in *Otonyctomys hatti* probably is timed to coincide with the onset of rains and highest availability of seeds, fruits, and perhaps insects. Thus, timing of reproduction in this species is likely to vary annually and with latitude. The few available data from throughout its geographic distribution suggest a summer and winter reproductive peak. Multi-annual studies at latitudinally disparate localities are needed, however, to more fully elucidate the reproductive cycle in *O. hatti*.

Karyology

The three new specimens of *Otonyctomys hatti* from Campeche were all karyotyped and there was no autosomal variation among individuals. The autosomal complement of *O. hatti* ($2n = 50$, FN = 62) consists of 7 pairs of large to small metacentric to submetacentric chromosomes and a graded series of 17 pairs of large to small acrocentric elements. The *X* is metacentric and is the largest chromosome in the complement. The *Y* is large and submetacentric (Fig. 3).

Two distinctive karyotypes have been reported for *Nyctomys sumichrasti*. Lee and Elder (1977) reported a $2n = 50$, FN = 52 [given as AN] karyotype from near Chamela, Jalisco, and Haiduk *et al.* (1988) listed a $2n = 52$, FN = 54 from the same locality [note that the legends for Fig. 1 and 2 are reversed in Haiduk *et al.* 1988, and that the haploid complement of *Nyctomys* is actually presented as the right hand set of chromosomes in their Fig. 2]. The *X* chromosome in both publications is a large submetacentric/metacentric chromosome, whereas the *Y* was reported as a small acrocentric by Lee and Elder (1977), but as a much larger chromosome by Haiduk *et al.* (1988). The morphology of the *Y* chromosome was not described explicitly by Haiduk *et al.* (1988), but from their G-banded figure it appears to be submetacentric or, less likely, acrocentric. The discrepancy between reported conformations and size of the *Y* in *Nyctomys* might have resulted from an incorrect interpretation of homology among pairs of chromosomes in the standard karyotype in Lee and Elder (1977), but from their figure it is difficult to find a larger chromosome that might represent the *Y*. The autosomal karyotype of *O. hatti* is distinct from that of *N. sumichrasti*, in that several additional autosomal pairs are biarmed. In *Otonyctomys*,

the *Y* is large and submetacentric, similar to that reported for *Nyctomys* by Haiduk *et al.* (1988), but unlike the small acrocentric figured by Lee and Elder (1977).

As noted by Haiduk *et al.* (1988), the underlying cause of the autosomal differences between the two divergent karyotypes of *Nyctomys sumichrasti*, essentially from the same geographic locality, is unknown. Both studies examined multiple individuals ($n = 2$, Lee and Elder 1977; $n = 4$, Haiduk *et al.* 1988) and *Nyctomys* is a very distinctive arboreal mouse, so the discrepancy cannot easily be attributed to an error in labeling samples or in species identification. Interestingly, a karyotype for which the autosomal complement purportedly was "identical to that reported by Lee and Elder (1977)" was described by Bradley and Ensink (1987:172) for *N. s. florencei* from Honduras. Resolution of variation within *Nyctomys* and the degree of homology, if any, between the karyotypes of *Nyctomys* and *Otonyctomys* await additional sampling and chromosome banding studies. Given the unresolved and likely basal phylogenetic position of *Nyctomys* and *Otonyctomys* relative to neotomine-peromyscine rodents, these data would be especially illuminating.

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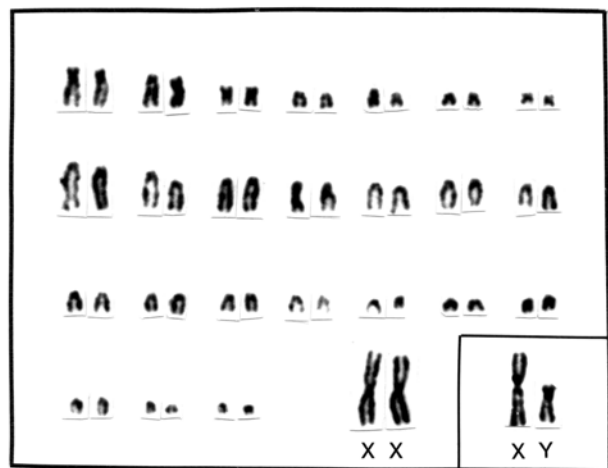


Fig. 3 Karyotype of a female *Otonyctomys hatti* ($2n = 50$, FN = 62) from 44 km S Constitucion, Campeche, México (ROM 95785). Insert shows sex chromosomes of a male (CNMA 30792, formerly ROM 95790) from the same locality.

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