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Karyotypes of Six Species of Bats (Chiroptera) from the Dominican Republic

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Abstract—Karyotypes of *Mormoops blainvilli*, *Macrotus w. waterhousii*, *Phyllops haitiensis*, *Brachyphylla pumila*, *Phyllonycteris obtusa*, and *Erophylla bombifrons* from the Dominican Republic were analysed. Chromosomal characteristics of the genera *Phyllops* and *Phyllonycteris* are described for the first time. Karyotypic data from these species are compared with those of related species, and phylogenetic implications are discussed.

[karyotypes; phylogeny; Chiroptera; Hispaniola; Dominican Republic]

Introduction—The Greater Antilles have a diverse chiropteran fauna that includes a number of endemic taxa, but the insular bat populations of this region have not been researched systematically as intensively as those of the Lesser Antilles. Generally more conservative than other morphological characters, the karyotype is a useful indicator of chiropteran phylogenetic relationships (Baker, 1970a, 1973). Although Baker and Lopez (1970) analysed chromosomes and discussed the possible phylogeny of nine species of Puerto Rican bats, cytogenetic data for other Antillean bats are lacking. We describe here karyotypes of six species of bats from the

Dominican Republic and discuss the phylogenetic implications of these data. Cytological material was obtained during field studies in the Dominican Republic in September 1974 by the senior author.

Materials and Methods—Slides of somatic chromosomes were prepared using the *in vivo* bone marrow technique as described by Baker (1970a, 1970b). Slides were stained in the laboratory, and metaphase spreads were photographed using a Reichert Zetopan photomicroscope at a magnification of 630 $\times$. Twelve or more metaphase spreads were counted to determine the diploid number (2n) of each specimen. Nomenclature for chromosome morphology is that of Patton (1967). Fundamental number (FN) is defined as the number of autosomal arms; metacentric, submetacentric, and subtelocentric chromosomes are assigned a value of two, and acrocentric chromosomes are given a value of one. The fundamental number and chromosome morphology were determined from photographs of six or more metaphase spreads of each species. Voucher specimens are in the collections of the Department of Mammalogy, Royal Ontario Museum (ROM).

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Specimens Examined

Mormoops blainvilli Leach. Provincia de San Cristóbal: Mil Tareas, 4 km (2.5 mi) N Boca Chica (18°29'N, 69°37'W), 1♂ (ROM 72792).

Macrotus w. waterhousii Gray. Provincia Duarte: Cueva Cerrejón, 5 km (3.1 mi) S Hostos (19°08'N, 69°58'W), 3♀ (ROM 72737, 72738, 72739); Provincia Maria Trinidad Sánchez: Cueva La Capilla, 35 km (21.7 mi) N Nagua (19°34'N, 69°57'W), 1♀ (ROM 72765).

Phyllops haitiensis J. A. Allen. Provincia de San Cristóbal: Jardín Botánico, Santo Domingo (18°30'N, 69°56'W), 3♀ (ROM 72781, 72782, 72797).

Brachyphylla pumila Miller. Provincia de San Cristóbal: Cueva Sierra de Agua (18°50'N, 69°35'W), 2♂♂, 2♀ (ROM 72809, 72811, 72812, 72798).

Phyllonycteris obtusa Miller. Provincia de San Cristóbal: Jardín Botánico, Santo Domingo, 1♂ (ROM 72783).

Erophylla bombifrons santacristobalensis Elliot. Provincia de San Cristóbal: Jardín Botánico, Santo Domingo, 1♂ (ROM 72787); Cueva de Pomier, 6 km (3.7 mi) NW San Cristóbal (18°27'N, 70°09'W), 3♂♂ (ROM 72702, 72703, 72705).

Results

Mormoops blainvilli (1♂), $2n = 38$, $FN = 60$ Autosomes (Fig. 1A) consist of four pairs of metacentrics, eight pairs of submetacentrics, and six pairs of acrocentrics. The X-chromosome is a submetacentric, and the Y is an acrocentric. One pair of acrocentrics has secondary constrictions adjacent to the centromere and another acrocentric pair appears to have satellites. This satellited region, which stained only lightly, was not observed in all metaphase spreads and even when present was apparent in only one homologue. Further cytogenetic analyses of *M. blainvilli* are necessary to determine whether only one or both chromosomes of the pair have satellites. We considered this satellited chromosome to be an acrocentric and assigned it a value of 1 when calculating the fundamental number.

Macrotus w. waterhousii (4♀), $2n = 46$, $FN = 60$

The chromosomal complement (Fig. 1B) consists of three pairs of metacentrics, six pairs of submetacentrics, and a graded series of 14 pairs of acrocentrics. Secondary constrictions occur in the region adjacent to the centromere in one pair of acrocentrics. We did not distinguish the sex chromosomes because males were not obtained. But, if we assume the X-chromosome to be biarmed, then the fundamental number would be 60.

Phyllops haitiensis (3♀), $2n = 30$, $FN = 56$

The chromosomal complement (Fig. 1C) consists of four pairs of metacentrics, eight pairs of submetacentrics, and three pairs of subtelocentrics. As males were not examined, the sex chromosomes were not determined. Nonetheless, since the two X-chromosomes in the female karyotype must be biarmed, the fundamental number is 56.

Brachyphylla pumila (2♂♂, 2♀), $2n = 32$, $FN = 60$

Autosomes (Fig. 2A) consist of four pairs of metacentrics and 11 pairs of submetacentrics. Secondary constrictions are present in the long arm of the smallest pair of submetacentrics. In some metaphase spreads with

Fig. 1—Representative karyotypes of *Mormoops blainvilli*, *Macrotus w. waterhousii*, and *Phyllops haitiensis*. Arrows indicate pairs of chromosomes with secondary constrictions or satellites. Scale bars = 10µm.
A. *Mormoops blainvilli*, male, $2n = 38$, $FN = 60$.
B. *Macrotus w. waterhousii*, female, $2n = 46$, $FN = 60$.
C. *Phyllops haitiensis*, female, $n = 30$, $FN = 56$.

XX XX XX

XX XX XX XX x4 xx

nn nn nn nn nn nn

↑

nn nn nn nn nn nn

condensed chromosomes, however, these constrictions are not apparent. The X-chromosome is submetacentric, and the Y is a minute acrocentric.

Phyllonycteris obtusa (1 ♂), $2n = 32$, $FN = 60$

The chromosomal complement (Fig. 2B) appears to be identical with that of *B. pumila*, i.e., four pairs of metacentrics and 11 pairs of submetacentrics. A submetacentric pair of chromosomes with secondary constrictions in the long arm also occurs in this species. The sex chromosomes, which consist of a submetacentric X-chromosome and a minute acrocentric Y, are identical with those of *B. pumila*.

Erophylla bombifrons santacristobalensis (4 ♂♂), $2n = 32$, $FN = 60$

The karyotype (Fig. 2C) appears to be identical with that of *B. pumila* and *P. obtusa*. Autosomes consist of four pairs of metacentric and 11 pairs of submetacentric chromosomes, the latter including a small pair with secondary constrictions. The X-chromosome is submetacentric, and the Y is a minute acrocentric.

Discussion—The diploid number of 38 and fundamental number of 62 reported by Baker (1970b) for a female *Mormoops megalophylla* indicates that the karyotype of this mainland species may be similar to that of *M. blainvilli*, a species that is endemic to the Greater Antilles. As Baker (1970b) did not illustrate the chromosomes of *M. megalophylla*, the karyotypes of *M. blainvilli* and *M. megalophylla* cannot be compared. Identical karyotypes ($2n = 38$, $FN = 60$) were described by Baker (1967) and Baker and Lopez (1970) for *Pteronotus parnelli*, *P. davyi*, *P. personatus psilotus* (= *P. psilotus*), and *P. fulginosa*. The pair of acrocentric

chromosomes with secondary constrictions and the satellited chromosome present in *M. blainvilli* were not reported in *Pteronotus*, but the chromosomal complements of species of these two genera appear to be alike. Although species of the genus *Mormoops* are considered by Smith (1972) to be the most anatomically specialized and divergent of the family Mormoopidae, the karyotype in species of *Mormoops* differs little from those of other bats in the family.

Species of the stenodermine genus *Phyllops* of Cuba and Hispaniola are closely related to taxa of the monotypic genera *Stenoderma* of Puerto Rico and the Virgin Islands, *Ardops* of the Lesser Antilles, and *Ariteus* of Jamaica (Jones and Schwartz, 1967; Koopman, 1968). The chromosomal complement of *Phyllops haitiensis* is similar to that of *Stenoderma rufum* (Baker and Lopez, 1970), and lends evidence for a close systematic affinity between these two stenodermine bats. Baker (1973), who constructed a phyletic tree of the subfamily Stenoderminae, proposed that the genera *Phyllops*, *Ardops*, and *Ariteus* be associated with *Ametrida* and *Stenoderma* in a phyletic line derived from *Artibeus*. Although karyotypic data have not been published for species of *Ardops* and *Ariteus*, cytogenetic data from *P. haitiensis* are consistent with this proposed phylogeny. Cytogenetic analysis of male *P. haitiensis* is required to verify that this bat has the XY_1Y_2 male sex-chromosome system found in *S. rufum* (Baker and Lopez, 1970) and other species of Stenoderminae (Baker, 1973).

Intraspecific chromosomal variation occurs only rarely in Chiroptera, but Nelson-Rees *et al.* (1968) reported two distinct karyotypes ($2n = 40$, $FN = 60$; $2n = 46$, $FN = 60$) in *Macrotus waterhousii californicus*. After detailed cytogenetic study and a morphometric analysis of cranial morphology, Davis and

Fig. 2—Representative karyotypes of *Brachyphylla pumila*, *Phyllonycteris obtusa*, and *Erophylla bombifrons*. Arrows indicate pairs of chromosomes with secondary constrictions. Scale bars = 10 μ m.

A. *Brachyphylla pumila*, female, $2n = 32$, $FN = 60$.

B. *Phyllonycteris obtusa*, male, $2n = 32$, $FN = 60$.

C. *Erophylla bombifrons*, male, $2n = 32$, $FN = 60$.

A

B

C

Baker (1974) concluded that these cytotypes represent distinct but parapatric mainland species of *Macrotus*. They classified the two cytotypes as *M. californicus* ($2n = 40$) and *M. waterhousii* ($2n = 46$) respectively, with the latter species consisting of two populations corresponding to the Mexican subspecies *M. w. mexicanus* and *M. w. bulleri* of Anderson and Nelson (1965). Although the sex chromosomes were not distinguished in our material, the female chromosomal complements of the Antillean subspecies *M. w. waterhousii* and the mainland subspecies of *M. waterhousii* are similar. The population of *M. waterhousii* from the Dominican Republic has not diverged karyologically from the Mexican populations of this species, and the limited karyotypic data are concordant with the conclusion of Anderson and Nelson (1965) that the West Indian populations of *Macrotus* are conspecific with the mainland populations of *M. waterhousii*.

Endemic to the Greater Antilles and the Bahama Islands (Hall and Kelson, 1959), the subfamily Phyllonycterinae consists of three species of the genus *Phyllonycteris* and two species of the genus *Erophylla* (Koopman and Jones, 1970). Baker and Lopez (1970) described the karyotype of *Erophylla b. bombifrons* and, although they did not distinguish the sex chromosomes, the chromosomal complement of the Puerto Rican subspecies appears to be identical with that of the Dominican subspecies *E. b. santacristobalensis*. The karyotype of *Phyllonycteris obtusa* is indistinguishable from that of *E. bombifrons*, and the chromosomal complement is apparently uniform in species of the Phyllonycterinae.

Data from karyotypic analyses of *Erophylla bombifrons* and *Brachyphylla cavernarum* (Baker and Lopez, 1970) support the contention of Silva and Pine (1969) that the genus *Brachyphylla* is allied with the Phyllonycterinae and not the Stenoderminae. Karyotypic data presented here further support this view. *Brachyphylla pumila*, *B. cavernarum*, *E. bombifrons*, and *Phyllonycteris obtusa* have identical chromosomal complements, including a pair of distinctive submetacentric

chromosomes with secondary constrictions and a minute acrocentric Y-chromosome.

Resumen—Se analizaron los cariotipos de seis especies de murciélagos de la República Dominicana, una de ellas de la familia Mormoopidae y cinco de la familia Phyllostomatidae. El número diploide ($2n$) y el número fundamental (NF) de estas especies son respectivamente: *Mormoops blainvilli* $2n = 38$, NF = 60; *Macrotus w. waterhousii* $2n = 46$, NF = 60; *Phyllips haitiensis* $2n = 30$, NF = 56; *Brachyphylla pumila* $2n = 32$, NF = 60; *Erophylla bombifrons santacristobalensis* $2n = 32$, NF = 60; *Phyllonycteris obtusa* $2n = 32$, NF = 60.

El complemento cromosomal de *Mormoops blainvilli* (Mormoopidae) varía muy poco de los cariotipos descritos para otras especies de la misma familia. *Macrotus w. waterhousii* de la República Dominicana posee características cromosomales similares a las de *M. w. mexicanus* y *M. w. bulleri* de México, lo cual es compatible con el punto de vista existente de que las poblaciones de *Macrotus* de las Indias Occidentales son conspecíficas con las de *M. waterhousii* de México. Los datos de los cariotipos de *Phyllips haitiensis* sugieren una relación sistemática íntima entre esta especie y *Stenoderma rufum*, la última asociada con una línea filogenética de los Stenoderminae derivada de *Artibeus*. Los cariotipos de *Brachyphylla pumila*, *Brachyphylla cavernarum*, *Phyllonycteris obtusa*, y *Erophylla bombifrons* son idénticos, resultado que constituye evidencia adicional para incluir el género *Brachyphylla* en la subfamilia Phyllonycterinae.

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