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# KARYOTYPIC STUDIES OF THE INSULAR POPULATIONS OF BATS ON PUERTO RICO \*

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Karyotypic studies of bats are of interest for several reasons. In the total number of living species of mammals, bats rank second only to rodents. Yet, of the more than 800 living species, less than 140 have been karyotypically studied (see YONENAGA *et al.* 1969; BAKER, in press). Also there are indications that karyotypes may be good phylogenetic indicators in bats (BAKER and PATTON 1967; BAKER 1967 and in press). This is of particular interest because of the potential for convergent evolution in such families as the Phyllostomatidae (BAKER 1967 and in press) and since there are many places where bat phylogeny is unclear. At least three chromosomal sex determining systems exist within the family Phyllostomatidae (HSU *et al.* 1968; BEČAK *et al.* 1969; BAKER and HSU, in press; and BAKER, in press).

The scope of this report is to describe the karyotypes of nine species of bats studied from the island of Puerto Rico. Six of these species and none of the subspecies have been previously studied. Puerto Rico is the eastern limit of the Greater Antilles. From a zoogeographic standpoint, it has a reduced bat fauna and contains several of the endemic genera known only from the Antillian chain of islands.

From a standpoint of factors affecting the establishment of karyotypic changes, the populations of these islands are isolated by the position of the island and limited in size by the land mass of the island. Puerto Rico has an area of 3,423 square miles. The island is ecologically diverse and our collecting suggested that most species did not occupy the entire island. Therefore, actual population size would be less than suggested by the total square miles of the island.

The following results are of interest because the populations studied

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were insular in nature. Also because several endemic forms are reported for the first time.

#### MATERIALS AND METHODS

Specimens were collected from natural populations with the use of « Mist-nets ». Bone marrow *in vivo* cultures were made with the use of Velban and specimens were sacrificed two hours after injection. A 10-minute treatment of 1% sodium citrate hypotonic solution was followed by a fixation with Carnoy's fixative (1 part glacial acetic acid, 3 parts absolute methanol). After changing the fixative three-four times, slides were prepared by the blaze dry method. Giemsa's blood stain was used as a dye. This technique is described in detail by BAKER (in press). All specimens are prepared as museum skins and skulls and are deposited in the collection of mammals, Department of Biology, Texas Tech University. A minimum of 25 spreads were counted from each specimen examined.

#### RESULTS

A total of 65 specimens were studied involving nine species, eight genera, and three families. A summary of these data is shown in Table 1. Brief comments on the chromosomes of each species follows.

TABLE 1  
Chromosomal data for bats from Puerto Rico.

	2n	FN	X	Y	♂♂	♀♀
Family Phyllostomatidae						
<i>Pteronotus parnellii</i>	38	60	SM	A	3	1
<i>Pteronotus fuliginosa</i>	38	60	SM	A	1	0
<i>Monophyllus redmani</i>	32	60	SM	A	5	2
<i>Artibeus jamaicensis</i>	30-31	56	ST	A-A	4	1
<i>Brachyphylla cavernarum</i>	32	60	SM	A	7	4
<i>Stenoderma rufum</i>	30-31	56	ST	A-A	12	4
<i>Erophylla bombifrons</i>	32	60	?	?	0	11
Family Vespertilionidae						
<i>Eptesicus fuscus</i>	50	48	?	?	0	2
Family Molossidae						
<i>Molossus molossus</i>	48	56	SM	A	0	7

#### *Pteronotus parnellii* (Gray).

2n = 38, FN = 60. The chromosomes of this species have been studied from specimens from Mexico (BAKER 1967) and Trinidad (BAKER, in press), and no geographic variation was found. The chromosomes of the Puerto Rican specimens were indistinguishable from those previously reported for the species (BAKER 1967).

*Pteronotus fuliginosa* (Gray). Fig. 1.

$2n=38$ ,  $FN=60$ . This species which is endemic to the Greater Antilles has a karyotype identical to that reported for the other three species of *Pteronotus* which have been studied (BAKER 1967).

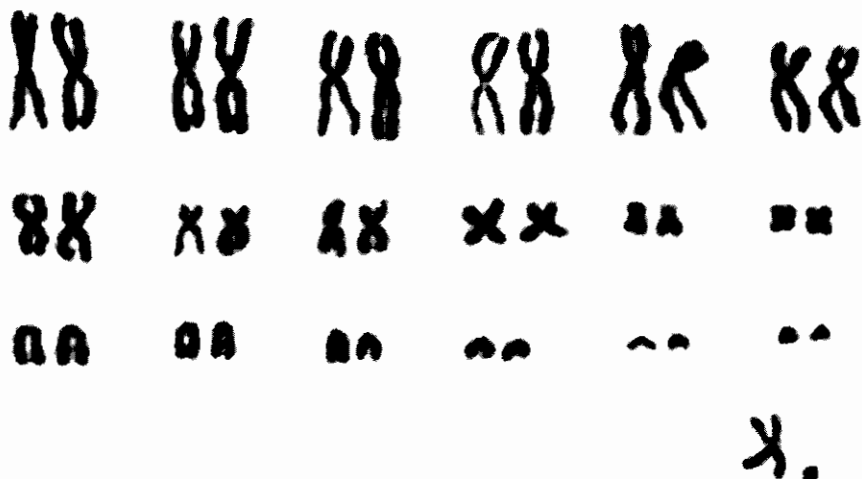


Fig. 1. — Representative karyotype of *Pteronotus fuliginosa*.

*Monophyllus redmani* Leach. Fig. 2.

$2n=32$ ,  $FN=60$ . All autosomes are metacentric or submetacentric. One of the smallest pairs has a secondary constriction on the long arm. The X is a submetacentric and the Y a minute element. The closest living rela-

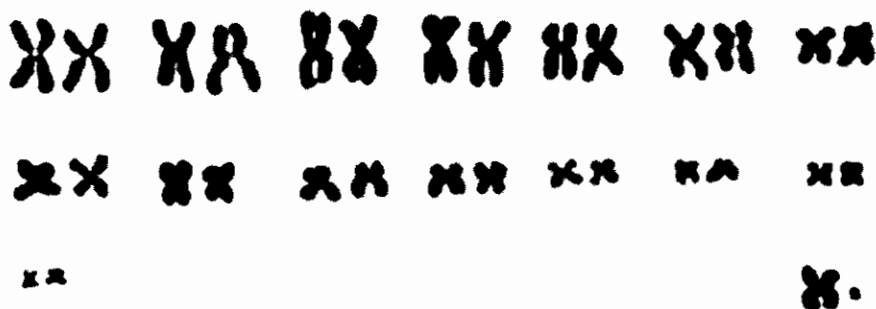


Fig. 2. — Representative karyotype of *Monophyllus redmani*.

tive of this genus is *Glossophaga* of which three species have a karyotype much like that reported for this genus (see BAKER 1967).

*Artibeus jamaicensis* Leach. Fig. 3.

$2n=30$  ♀  $31$  ♂♂. This species has been studied from a variety of localities (see BAKER 1967; HSU *et al.* 1968; BAKER, in press), and all males examined have had two Y chromosomes. This is true of the Puerto Rican specimens. There also appears to be no detectable variation in the autosomes.

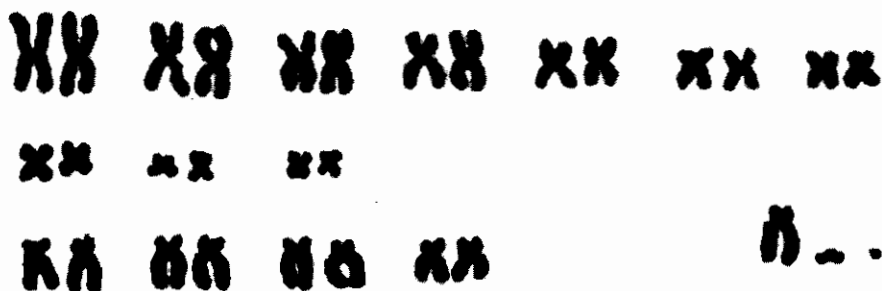


Fig. 3. — Representative karyotype of *Artibeus jamaicensis*.

*Brachyphylla cavernarum* Gray. Fig. 4.

$2n=32$ , FN=60. All of the autosomes are metacentric or submetacentric in nature. The X is a submetacentric and the Y is a minute element. There is a secondary constriction on one of the smallest pairs of autosomes.

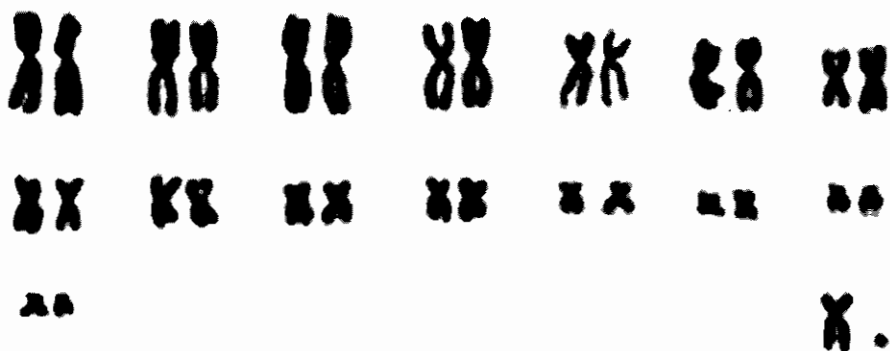


Fig. 4. — Representative karyotype of *Brachyphylla cavernarum*.

*Stenoderma rufum* St.-Hilaire. Fig. 5.

$2n=30$  ♀  $31$  ♂. All of the autosomes are biarmed and, except for two pair of submetacentrics, are metacentric or submetacentrics. The X is a submetacentric and the Y's are two small acrocentrics, one of which is larger than the other.

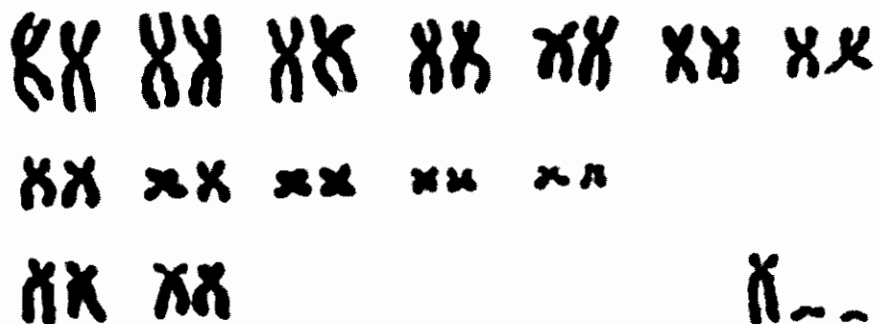


Fig. 5. — Representative karyotype of *Stenoderma rufum*

*Erophylla bombifrons* (Miller). Fig. 6.

$2n=32$ , FN=60. All of the chromosomes of females are biarmed elements and most are metacentric or submetacentric in nature. One of the smallest pairs has a distinct secondary constriction on the long arm. Since only females were collected, the sex chromosomes could not be determined.

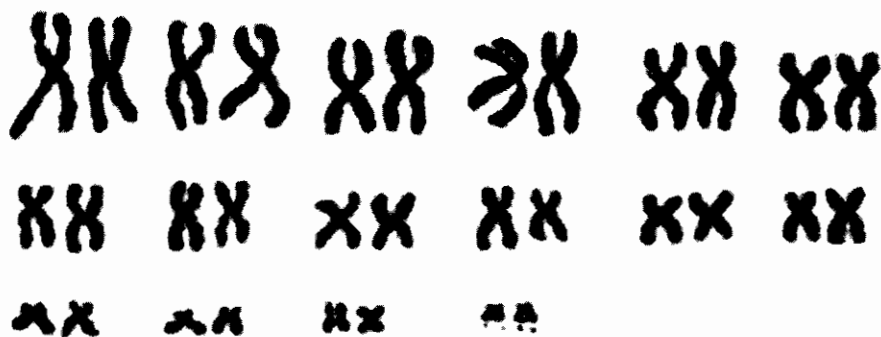


Fig. 6. — Representative karyotype of *Erophylla bombifrons*.

*Eptesicus fuscus* Palisot de Beauvois.

$2n=50$ , FN=48. The chromosomes of the two Puerto Rican specimens were like those described for this species from the United States and Mexico (BAKER and PATTON 1967).

*Molossus molossus*.

$2n=48$ , FN=56. The autosomes consist of a large pair of submetacentrics, three medium pairs of submetacentrics, a pair of medium sized subtelocentrics, and a graded series of 18 pairs of acrocentrics. One of the two largest pairs of acrocentrics has a secondary constriction very near the centromere. The X is a submetacentric and the Y is a small, but by no means minute, acrocentric. This karyotype is not shown because a manuscript on molossid (Molossidae) chromosomes is in preparation.

## DISCUSSION

Even though the Puerto Rican populations are isolated, the karyotypes do not vary within species (*Artibeus jamaicensis*, *Pteronotus parnellii*, and *Eptesicus fuscus*) which occur both on the mainland and on Puerto Rico. Further, the karyotype of *Monophyllus* is much like that reported for three species of *Glossophaga* which occur on the mainland. *Monophyllus* is believed to be a close relative of *Glossophaga* (MILLER 1907). *Pteronotus fuliginosa* also has a karyotype like that reported for three other species within that genus (BAKER 1967). These data suggest that there has been little or no karyotypic evolution within these forms since reaching this island. This lack of change is in agreement with a significant amount of data reported from the Vespertilionidae (BAKER and PATTON 1967; CAPANNA 1968) and the Phyllostomatidae (BAKER 1967 and BAKER, in press) that suggest in most cases karyotypic evolution in bats is at a conservative rate, especially when compared to the rate in rodents (see BAKER, in press). For this reason, karyotypes of bats seem to be good phylogenetic indicators. In some cases, however, a number of karyotypic changes have occurred in closely related forms. This is the case in *Macrotus* (NELSON-REES *et al.* 1968) and in *Uroderma bilobatum*. In *Uroderma bilobatum*, at least three chromosomal races exist (BAKER and LOPEZ, unpubl. data).

Since the rate of change in most cases is low, similarity of karyotypes should be considered as possibly indicative of a phylogenetic relationship. Such cases as *Macrotus* and *Uroderma* point out the danger of using only one character in an evolutionary study. The following comments concerning evolutionary relationships as suggested by karyotypes should be evaluated in this light.

From an anatomical standpoint, *Stenoderma* is one of the most aberrant forms found in the subfamily Stenoderminae of the family Phyllostomatidae. Chromosomally it is quite similar to the more typical stenodermine genus, *Artibeus*. It shares with *Artibeus* a common diploid number and the same type of sex chromosome system. It differs from *Artibeus* by having two less pairs of subtelocentric autosomes (BAKER 1967). Two other stenodermine genera, *Ametrida* and *Centurio*, are, from a gross anatomical basis, more closely related to *Stenoderma* than is *Artibeus*. *Ametrida* has a diploid number of  $30 \text{♀♀}$ ,  $31 \text{♂♂}$ , with an autosomal complement much like *Stenoderma* (BAKER, in press). *Centurio* has only one Y chromosome and a diploid number of 28. Since *Stenoderma*, *Artibeus*, and *Enchisthenes* have a  $2n = 30 \text{♀♀}$ ,  $31 \text{♂♂}$ , it seems probable that their diploid number and sex chromosomal system is like that of their common ancestor. This would mean the  $2n = 28$ , XX/XY system of *Centurio* was derived from the  $2n = 30-31$ , XX/ $XY_1Y_2$  system.

*Brachyphylla* has been placed in several different subfamilies of the Phyllostomatidae. Recently, it was placed in the Phyllonycterinae (SILVA and PINE 1969). Prior to their work it was placed in the Stenoderminae. All Stenoderminae that have been karyotyped have either had two Y chromosomes or a biarmed Y. *Brachyphylla* has a minute Y element. The only species of the Phyllonycterinae that has been studied is *Erophylla* and no males were obtained. The karyotype of *Erophylla* is much like that of *Brachyphylla* in morphology and in a diploid number of 32. It should be pointed out that the karyotype of *Monophyllus* is like that of *Erophylla* and *Brachyphylla*. *Monophyllus* is a member of the subfamily Glossophaginae. Both the Phyllonycterinae and Glossophaginae are composed of nectar feeding bats. The possibility of a close phylogenetic relationship between *Brachyphylla*, *Erophylla*, and *Monophyllus* certainly should be considered. All three genera are endemic to the Antillian chain and may represent a small degree of adaptive radiation after a common ancestor reached the islands. Chromosomal data, inasmuch as is possible with the limited information available, support SILVA and PINE's (1969) interpretation that *Brachyphylla* is closely related to the Phyllonycterinae and not the Stenoderminae.

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#### SUMMARY

Karyotypes of nine species of Puerto Rican bats are described. In most cases karyotypes of these forms do not vary from their mainland relatives. Possible phylogenetic relationships of *Stenoderma*, *Brachyphylla*, *Erophylla* and *Monophyllus* are discussed in light of these chromosomal data.