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CHROMOSOMAL STUDIES OF SOME NEOTROPICAL BATS OF THE FAMILIES EMBALLONURIDAE, NOCTILIONIDAE, NATALIDAE AND VESPERTILIONIDAE *

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INTRODUCTION

Although a number of recent reports have dealt with the chromosomes of bats, a large number of species remain to be studied. Reviews of published data on bat chromosomes are YONENAGA *et al.* (1969), CAPANNA and CIVITELLI (1970), and BAKER (in press). This communication concerns nine species which have not been studied and four species which have been studied from an inadequate sample.

Data are from 44 specimens from thirteen species representing the families Emballonuridae, Noctilionidae, Natalidae, and Vespertilionidae. In this paper we have not reported data from two prominent New World families of bats, the Phyllostomatidae and the Mollossidae. They will be treated extensively elsewhere.

METHODS

Specimens were collected from natural populations with the aid of mistnets, and slides were prepared at field stations. Localities are presentend in Table 1. Bone marrow was cultured *in vivo* for two hours and treated for 10 minutes with a 1% sodium citrate solution. Fixation was by methanol; acetic acid (3:1). Slides were blaze dried and stained by Giemsa's blood stain. This chromosomal preparation is presented in detail elsewhere (BAKER, in press). Although a larger number were usually analyzed a minimum of 10 spreads were studied per specimen. Voucher specimens for all specimens are deposited in the Museum of Mammals, Department of Biology, Texas Tech University.

The terms metacentric, submetacentric, subtelocentric, and acrocentric are

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defined by PATTON (1967). Some elements which have a minute but visible second arm are considered to be acrocentric when the fundamental number was calculated. Fundamental number (FN) as used here is the number of arms of the autosomal complement.

RESULTS

The chromosomal data are summarized in the Table. A brief description of the chromosomes of each species follows:

Family Emballonuridae:

Rhynchonycteris naso (Wied-Neuwied) Fig. 1, $2n=22$; FN=36. The autosomes of this species consist of a graded series of large to medium metacentric or submetacentric elements plus two pairs of near acrocentric elements, the smallest pair often exhibits a distinct second arm. The X is a medium sized acrocentric, and the Y is distinctly the smallest chromosome. The second largest pair of autosomes has a secondary constriction near the end of the longer arm.

Saccopteryx bilineata (Temminck) Fig. 2, $2n=26$; FN=36. The autosomes of this species consist of six pairs of metacentric or submetacentric elements plus a series of medium-small near acrocentrics. Although some of the « near acrocentric » elements have a distinct arm, none were considered biarmed when calculating the fundamental number. The X chromosome is a medium sized acrocentric, and the Y is one of the smaller « near acrocentric » elements. As in *Rhynchonycteris*, the second largest pair of autosomes have a secondary constriction on the distal part of one arm.

Saccopteryx leptura (Schreber) Fig. 3, $2n=28$; FN=38. The autosomes of this species consist of five pairs of metacentric or submetacentric elements, a pair of medium sized subtelocentrics, and a series of medium-small near acrocentric elements. The X is an acrocentric, and the Y is a very small acrocentric element. The second largest pair of metacentric autosomes has a distally placed secondary constriction.

Cormura brevirostris (Wagner) Fig. 4, $2n=22$; FN=40. Only one specimen of this rare bat was obtained, and it is assumed that the most heteromorphic pair of chromosomes are the sex elements. The autosomes of this species consist of a large pair of subterminal elements which are somewhat heteromorphic, plus a series of nine pairs of medium sized metacentric or submetacentric elements. The X is an extremely large metacentric, and in all spreads, its length is greater than 20% of the total length of the haploid autosomal complements. The Y is a small biarmed element. In some

spreads there is a secondary constriction on the largest pair of autosomes, the longest arm of the second largest pair of autosomes, and on one of the smaller pairs of autosomes.



Fig. 1. — Karyotype of a *Rhynchonycteris naso* collected from Blanchisseuse, Trinidad.
 Fig. 2. — Karyotype of a *Saccopteryx bilineata* collected from Leticia, Colombia.
 Fig. 3. — Karyotype of a *Saccopteryx leptura* collected from Leticia, Colombia.

TABLE 1
Chromosomal data for some neotropical bats.

Family and Species	2n	FN	Sex Chromosomes		Specimens Studied		Locality
			X*	Y*	♂ ♂	♀ ♀	
Emballonuridae							
<i>Rhynchonycteris naso</i>	22	36	A	Λ	3	1	8
<i>Saccopteryx bilineata</i>	26	36	A	A	1	0	1a
					0	1	2
					0	1	3a
					1	0	7
					2	0	5
<i>Saccopteryx leptura</i>	28	38	A	Λ	1	0	1a
					1	0	7
					1	0	5
<i>Cormura brevirostris</i>	22	40	M	M	1	0	1a
Noctilionidae							
<i>Noctilio leporinus</i>	34	58	M	Λ	0	2	8
<i>Noctilio labialis</i>	34	58	M	A	8	2	1a
Natalidae							
<i>Natalus tumidirostris</i>	36	56	M	Λ	6	1	6
Vespertilionidae							
<i>Myotis auriculus</i>	44	50	SM	A	0	2	9
<i>Myotis nigracans</i>	44	50	SM	A	0	1	4
<i>Myotis simus</i>	44	50	SM	A	1	1	1b
<i>Myotis riparius</i>	44	50	SM	A	1	1	1a
<i>Eptesicus brasiliensis</i>	50	(48)	SM	?	0	3	4
<i>Lasiurus borealis</i>	28	48	SM	A	1	0	3b

* Classification after PATTON 1967.

A = acrocentric
M = metacentric
SM = submetacentric

Localities:

- Colombia, Amazonas, a. Leticia
b. 2 mi. W. Leticia
- Colombia, Meta, Puerto Lopez, 1 mi. from Meta bridge
- Colombia, Meta, Villavicencio, a. la escuela de las mesitas
b. Quebrada Honda
- Colombia, Meta, Restrepo, Upin salt mine
- Trinidad, Guayaguayare
- Trinidad, Cave at Saut d'Eau, vicinity Maracas Bay
- Trinidad, Las Cuevas
- Trinidad, Blanchisseuse
- Mexico, 67 km S. Cd Victoria on Hwy 85.

Family Noctilionidae:

Noctilio leporinus (Linnaeus) $2n=34$; FN=58. YONENAGA *et al.* (1969) reported the karyotype of this species from a specimen from Brazil. Speci-

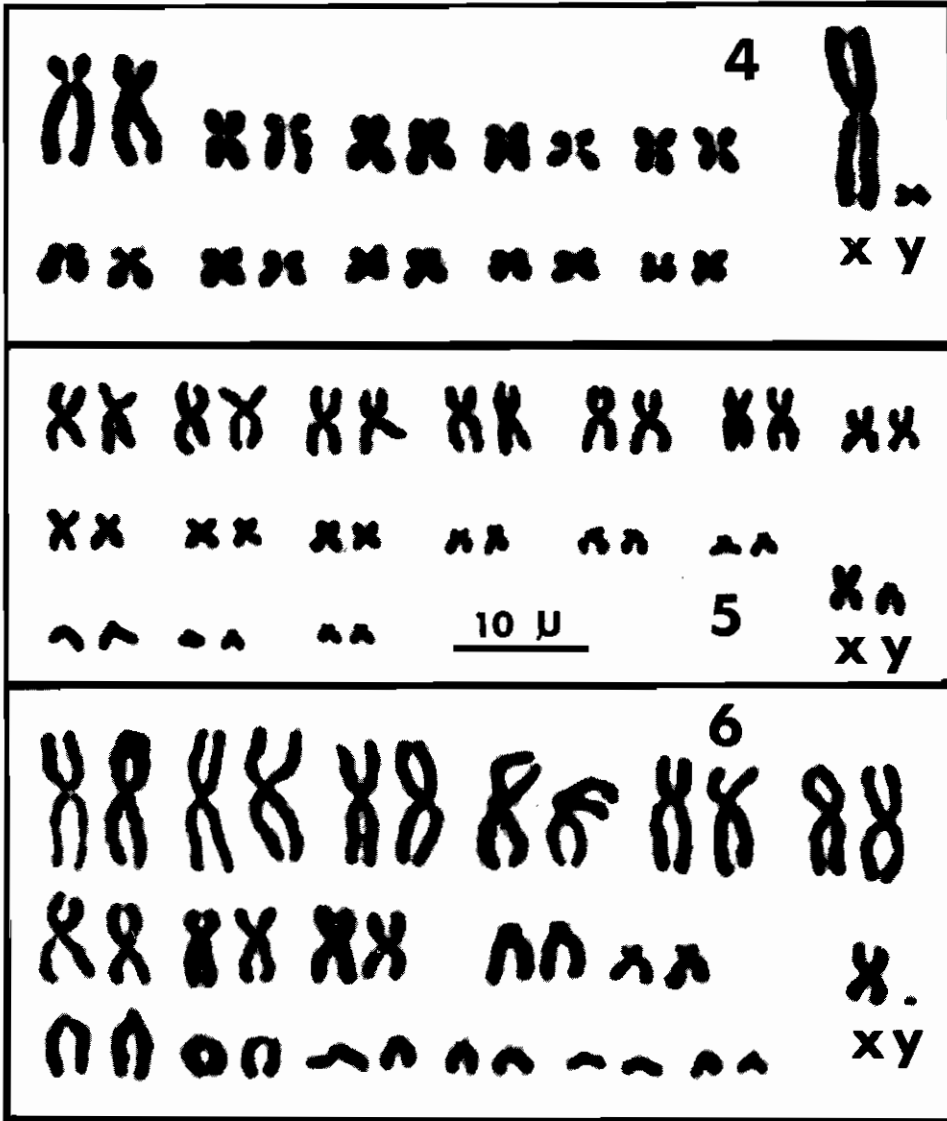


Fig. 4. — Karyotype of a *Cormura brevirostris* collected from Leticia, Colombia.

Fig. 5. — Karyotype of a *Noctilio labialis* collected from Leticia, Colombia.

Fig. 6. — Karyotype of a *Natalus tumidirostris* from cave at Saut d'Eau, Trinidad.

mens from Mexico (BAKER, in press) and Trinidad have a karyotype similar to that found by YONENAGA *et al.* (1969). The autosomes consist of a graded series of 13 pairs of biarmed chromosomes plus three pairs of acrocentric or near acrocentric elements. The X is a medium sized metacentric, and the Y is a small « near acrocentric ». See account of *Noctilio labialis* below and Fig. 5.

Noctilio labialis (Kerr) Fig. 5, $2n=34$; FN=58. The karyotype of this species appears to be identical to that found in *Noctilio leporinus* (see above).

Family Natalidae:

Natalus tumidirostris Miller Fig. 6, $2n=36$; FN=56. The nine largest pairs of autosomes are metacentric or submetacentric, two of the medium sized pairs are subtelocentric, and the six acrocentric pairs range from medium to small in size. The X is a metacentric, and the Y is the smallest element in the complement.

Family Vespertilionidae:

Species of the genus *Myotis*, $2n=44$; FN=50. The chromosomes of *Myotis auriculus* Baker and Stains, *Myotis nigracans* (Schinz), *Myotis simus* Thomas, and *Myotis riparius* Handley were studied, and all were found to have identical karyotypes. The autosomes consist of three large pairs and one small pair of metacentrics, with a graded series of 17 pairs of acrocentrics ranging in size from medium to small. The X chromosome is a medium submetacentric, and the Y is a small acrocentric. This karyotype is characteristic of eighteen other species of *Myotis* and has been published a number of times: *Myotis velifer* (HSU and BENIRSCHKE 1967; BAKER and PATTON 1967), *Myotis grisescens* (HSU and BENIRSCHKE 1968), *Myotis myotis* (CAPANNA *et al.* 1968), and *Myotis blythi* (BAKER, in press). For a review see CAPANNA (1968), CAPANNA and CIVITELLI (1970), or BAKER (in press).

The karyotype of *Myotis auriculus* was described under the name of *Myotis keenii* by BAKER and PATTON (1967). The status of these long eared bats has been reviewed (GENOWAYS and JONES 1969), and the forms from the southwestern United states and northwestern Mexico, and eastern Mexico deserve a status specific from *Myotis keenii* found in the northern United States. We have examined the chromosomes of *M. a. auriculus*, and as indicated they are identical to those described for *M. a. apache* (= *Myotis keenii* in the paper by BAKER and PATTON 1967). The chromosomes of *Myotis keenii* have not been studied.

Eptesicus brasiliensis (Demarest) $2n=50$; FN=48. The chromosomes of females of this species are like those reported for females of three other North American species of this genus (BAKER and PATTON 1967). One of the largest pairs of chromosomes is metacentric and assumed to be the X's. The other chromosomes are acrocentric and form a graded series ranging in size from as large as the X to dot size.

Lasiurus borealis (Muller) $2n=28$; FN=48. The karyotype of this species was described from South American forms by WAINBERG (1966) as consisting of a diploid number of 22 and a fundamental number of 36. Specimens from North America were studied by BAKER and PATTON (1967), and a karyotype with a $2n=28$; FN=46 was described. Studies by BAKER and MASCARELLO (1969) agreed with a $2n=28$, but suggested the FN should be 48. We have studied only one specimen from South America (Villavicencio, Colombia), and it had a karyotype like the North American forms. The autosomes consisted of a graded series of ten pairs of metacentric or submetacentric elements and three distinctly smaller pairs which appear biarmed in some spreads. The X is a medium submetacentric, and the Y is a small acrocentric.

DISCUSSION

Family Emballonuridae:

The Emballonuridae is considered to be the most primitive family of bats found in the New World. The four species of the Emballonuridae reported here share a low diploid number in relationship to values reported for most mammals and other bats (see MATTHEY 1968; and BAKER, in press). MATTHEY, in summarizing the range of diploid numbers for Eutherian mammals, reported 48 to be the median number. Of the 13 species of bats reported in this paper, only *Eptesicus* ($2n=50$) has a diploid number greater than 48. The mean of the diploid numbers reported for 126 species of bats is 36.8 (BAKER, in press). Although *Rhynchonycteris*, *Saccopteryx*, and *Cormura* have diploid numbers much lower than the mean values for bats, there are some emballonurids which have a relatively higher diploid number. Two species of *Taphozous*, which is an Old World genus, have a diploid number of 42 (RAY-CHAUDHURI and PATHAK 1966). The highest diploid number reported for a New World emballonurid species is 32 (BAKER, in press) for *Balantiopteryx plicata*.

In *Saccopteryx* and *Rhynchonycteris* the X chromosome represents approximately 5% of the haploid genome. In *Cormura* where 10 spreads were measured the largest element of the heteromorphic pair of chromosomes

represents over 20% of the haploid autosomal complement, and in some cells this element is 30% of the haploid autosomal complement. Atypical sex chromosomes have been reported for several genera of phyllostomatids but not for species from the family Emballonuridae (BAKER 1967, in press; HSU *et al.* 1968; BECAK *et al.* 1969; YONENAGA *et al.* 1969; BAKER and HSU 1970).

Families Noctilionidae and Natalidae:

As presently understood the family Noctilionidae is composed of two species in one genus. The chromosomes of *Noctilio leporinus* and *Noctilio labialis* are identical, but unlike any described for other bat species.

The chromosomes of *Natalus stramineus* were described by BAKER (in press), and the chromosomes of *Natalus tumidirostris* are identical to the above mentioned species. These two species are thought to be closely related (see GOODWIN 1959) and are in the same subgenus (*Natalus*).

Family Vespertilionidae:

The types of chromosomal characteristics and evolution found within this family have been discussed in detail (CAPANNA 1968; CAPANNA and CIVITELLI 1970; BAKER, in press). The data presented here supplement that available for their discussions and support the trends outlined by these authors. Some comments, however, are warranted on the chromosomal reports for the genus *Lasiurus*.

Genus *Lasiurus*:

There are considerable differences in the karyotypes reported for specimens of *Lasiurus borealis* from Colombia and North America ($2n=28$; FN=48) and those reported by WAINBERG (1966) for Argentina material ($2n=22$; FN=36). Although this is greater karyotypic variation than has been reported for any other bat species, it is, of course, possible that chromosomal races of this magnitude exist within this species. WAINBERG (1966), however, studied another species that is currently placed in the genus *Lasiurus* = *Dasypterus* (see HANDLEY 1960). His *Dasypterus ega* ($2n=24$; FN=36) is the same species of bat studied by BAKER and PATTON (1967) as *Lasiurus ega* ($2n=28$; FN=48). In *L. ega* there is also a great difference in the values reported, and it seems unlikely that such differences in both species are natural, but more likely the values found by the more difficult testicular squash technique were incorrect. Only study of additional mate-

rial will determine if such chromosomal races exist. There is one report which describes a great amount of chromosomal variation for a bat species. In *Uroderma bilobatum*, three chromosomal races exist, and the diploid number varies from 38 to 44 and the fundamental number varies from 44 to 50 (BAKER and LOPEZ, in press). Chromosomal variation (geographic and populational) has been reported for 9 other bat species (see Review by BAKER, in press).

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ABSTRACT

The chromosomal characteristics of 14 species of Neotropical bats are reported. Four species of Emballonuridae were found to have low diploid numbers. No variation was found within the families Noctilionidae and Natalidae.