ISSN 0097-4463

ANNALS of CARNEGIE MUSEUM

CARNEGIE MUSEUM OF NATURAL HISTORY

4400 FORBES AVENUE • PITTSBURGH, PENNSYLVANIA 15213

VOLUME 47 | 10 MARCH 1978 | ARTICLE 5

BATS FROM SOUTHERN HAITI

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ABSTRACT

A collection of 450 specimens of bats from the Departement du Sud, Haiti, is described. Fifteen of the 17 species previously recorded from Hispaniola are represented, and *Noctilio leporinus* is reported from Haiti for the first time. Reproductive information for the months of January, May, June, August, and December is presented. *Macrotus waterhousii* is seasonally monoestrous, as on the mainland. The two species of stenodermines, *Artibeus jamaicensis* and *Phyllops haitiensis*, do not show bimodal seasonal polyestry as do stenodermines in Central America. *Monophyllus redmani* and the phyllonycterines may be seasonally monoestrous. Differences in reproductive biology between Haitian bats and closely related species on the Central American mainland may be correlated with differences in climate between the two areas.

INTRODUCTION

Studies of the systematics, biogeography, and ecology of Antillean bats are often hampered by a paucity of data. It became possible recently to collect bats intensively in the Departement du Sud, Republic of Haiti, an area hitherto poorly known mammalogically. We present the results of our collections and analyses, including mensural data for

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series of bats of some species known previously from isolated specimens, and reproductive data for some species from the months of January, May, June, August, and December.

Owing to the difficulties of working in Haiti, most past collections of bats from Hispaniola were made in the Dominican Republic. Recent work in the Republic of Haiti dates from Miller's (1918, 1929) reports on bats found as skulls on the floors of caves near Port-de-Paix and St. Michel de l'Atalaye. In 1939 Ivan T. Sanderson collected in southern Haiti using a 1923 Rolls-Royce Silver Ghost as his field vehicle (Sanderson, 1939). Sanderson's bats were discussed by Sanborn (1941) and Hershkovitz (1951). In 1955 Koopman reported on a 1929 collection of cave remains of bats from the Ile de la Gonave. To our knowledge, no extensive netting of Haitian bats was done prior to 1973.

Between 29 December 1973 and 10 January 1974, D. Klingener, C. Woods, C. Butterfield, and V. Naples collected bats in the vicinity of Paillant, on the mountainside above Miragoâne, using nets that had been set for study of migratory birds. J. W. Bickham and J. C. Patton netted bats near Paillant and in the ravines above and below that town between 13 and 28 August 1974. Between 17 December 1974 and 12 January 1975, D. Klingener, C. Woods, and C. Butterfield obtained bats near Paillant and traveled out along the road to Anse-a-Veau, where bats were collected at Charlier. In May and June 1975, C. Woods and a field party from the University of Vermont collected bats at the western tip of the southern peninsula, including some from nets set on the slopes of the Pic de Macaya.

The island of Hispaniola is divided into two highland areas (the "North Island" and the "South Island," likely separated by a seaway in the past) by the Plaine du Cul de Sac, which isolates the southern peninsula of Haiti and the Barahona Peninsula of the Dominican Republic from the highlands of northern Haiti and the Dominican Republic (Williams, 1961). The southern peninsula of Haiti has two highland regions, the eastern Massif de la Selle (maximum elevation, 2,674 m) and the western Massif de la Hotte (maximum elevation being the Pic de Macaya, 2,347 m). The lowland isthmus between the two massifs is the Trouin Valley between Jacmel and Grand Goâve (Schwartz, 1973). Our collections were made at localities ranging from sea level to the slopes of the Pic de Macaya in the Massif de la Hotte, from Miragoâne westward to Anse d'Hainault.

Haiti is a mountainous country with few streams or playas. Caves in the limestone are abundant, but these are small and difficult for humans to enter. Depending on location, rainfall varies between 524 and 2,124 mm per year. There are two rainy seasons, one in the spring, the other in the autumn (Woodring et al., 1924). The evergreen tropical rainforest described by Columbus in 1493 is mostly gone owing to lumbering, agriculture, and the burning of wood for charcoal. In the southern peninsula, forest persists only in deep ravines and on steep mountainsides in the extreme west (C. Woods, personal communication). Elsewhere the uncultivated parts of mountains are covered by dry thorn scrub, with somewhat thicker vegetation persisting in ravines and dry washes. The human population and its domestic animals continue to increase in density, and further deforestation will probably occur.

METHODS AND MATERIALS

Our specimens were taken primarily by netting and were preserved as skin/skull, skin/skeleton, skeleton only, or fluid preparations. The specimens are deposited in The American Museum of Natural History (AMNH), The Museum, Texas Tech University (TTU), and the Museum of Zoology, University of Massachusetts (UMA). We collected a total of 450 specimens, referable to 15 species. Two species, *Tadarida macrotis* and *Natalus major*, previously recorded from the island (Varona, 1974), are not represented in our collection. Some Cuban specimens of *Phyllonycteris poeyi* in the collection of the National Museum of Natural History were also used for comparative purposes. Measurements of forearm and cranial distances are standard ones and were taken by one of us (HHG) with dial calipers accurate to 0.1 mm. In the Tables (1 through 4), measurements of individual specimens are listed for series of four or fewer. For larger series, the mean, observed range, and standard deviation are indicated.

A few field weights were taken by one of us (DK) with a Pesola scale. Reproductive conditions were determined by gross dissection of skin/skeleton and skin/skull specimens in the field and by later dissections of fluid preserved animals. Sizes of embryos are given as crown-rump lengths. Reproductive data from some specimens in the University of Vermont collection are included and were taken by C. Woods. Those animals are not included in our list of specimens examined. In all cases pregnant bats were carrying single young. We observed no instances of twinning.

Varona (1974) provided a valuable summary of distribution of bats among the Greater and Lesser Antillean islands. His taxonomic treatment is in many cases unorthodox. As he has not given reasons for his taxonomic usage, we have chosen not to follow him in many instances. We did not compare our bats with series from northern Haiti or from the Dominican Republic. Buden (1975*b*) found no difference between series of *Macrotus waterhousii* from the North and South islands. Similar comparisons have not been made for other species.

ACKNOWLEDGMENTS

We thank the Government of the Republic of Haiti for issuing collecting permits, and Joseph Wainwright of Port-au-Prince for assistance in obtaining them and for other courtesies. Major Dimanche, Garde d'Haiti, facilitated travel among towns in the southern peninsula. We are especially indebted to Al and Natalie Butterfield and Reynolds Haitian Mines Inc. for their enthusiastic and generous support of all parts of our study.

Charles Woods, University of Vermont, provided the impetus for work on the island, assisted in the field work, and contributed reproductive data on bats collected by him and by his students. Field work was also done by Carl Butterfield, John Bickham, John Patton, and Virginia Naples. To all of these individuals we are grateful.

Charles O. Handley, Jr., and Karl F. Koopman permitted examination of specimens in their care, and Dr. Koopman unstintingly shared his insights into the systematics and evolution of Antillean bats. A number of colleagues read an earlier draft of this manuscript. We thank them for suggesting improvements.

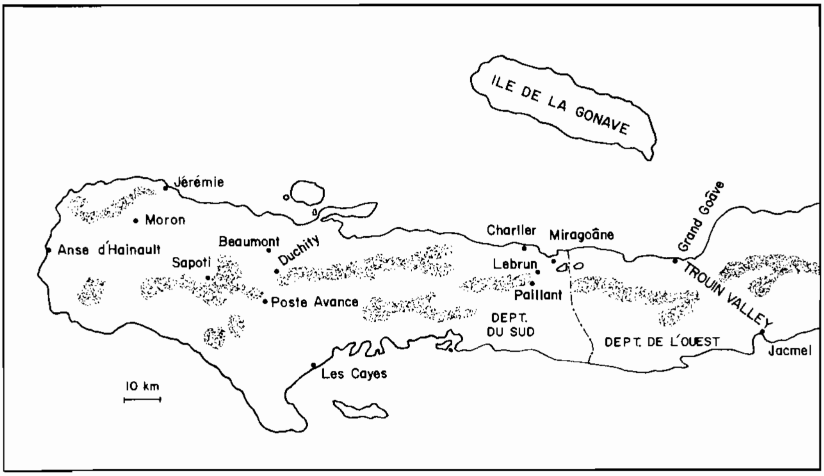

Fig. 1.—Map of the southern peninsula of Haiti showing localities mentioned in the text. The highest mountain peaks and ridges are shaded.

Field work was assisted by grants from the National Geographic Society (to C. Woods), from the University of Massachusetts Faculty Research Grant Program (to D. Klingener), and by National Science Foundation grant GB-41105 to R. J. Baker and H. H. Genoways.

Localities

Most of the bats were collected in the vicinity of Miragoâne (Fig. 1). Paillant is 8 km SW Miragoâne, 1 km S, 1 km E Lebrun at an elevation of 580 m. Paillant is the site of the Reynolds Haitian Mines residential compound. Surrounding habitat is dry thorn scrub, but thicker vegetation persists in ravines and draws. Nets were also set in ravines some distance from Paillant. Locations of these are given with reference to Lebrun, a town bypassed by the road between the Reynolds bauxite mine and the loading dock, 1 km W Miragoâne.

Charlier is a town 10 km W Miragoâne and is at sea level. The Rivière Charlier breaks up into stagnant pools before emptying here into the Caribbean. Nets were set along the stream as it passes through a banana plantation and over pools near the ocean.

Most of the bats from the extreme western part of the southern peninsula came from two localities (Fig. 1). Duchity (spelled Dichity on some maps) is 6 km S Beaumont on the road between Beaumont and Poste Avance. It is on the Rivière Glace and is 732 m above sea level. The area is planted in coffee, but forest persists in the deeper ravines. Sapoti (also spelled Zapoti) is 19 km SW Beaumont at 1,211 m on the

Table 1.—*Measurements of noctilionid and mormoopid bats from southern Haiti.*

Number and sex	Forearm	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Breadth of braincase	Length of maxillary toothrow	Breadth across upper molars
			Noctilio leporinus					
AMNH 236,651 ♂	88.0	29.6	25.3	20.5	7.2	13.8	10.5	13.2
AMNH 236,652 ♂	85.6	29.0	25.1	20.3	7.4	14.0	10.6	12.8
AMNH 236,653 ♀	86.1	26.3	23.7	19.0	7.2	13.7	10.2	12.2
			Pteronotus fuliginosus					
AMNH 236,654 ♀	37.7	14.7	13.2	7.7	2.9	6.6	5.7	5.3
			Pteronotus parnellii					
TTU 22,508 ♂	50.6	19.0	17.3	10.3	3.7	9.2	7.9	6.8
TTU 22,501 ♂	49.7	19.0	17.4	10.3	3.7	9.1	7.9	6.7
TTU 22,502 ♂	50.0	19.4	17.5	10.6	3.9	9.6	8.0	6.9
TTU 22,507 ♂	50.6	19.3	17.8	10.8	3.7	9.2	8.0	6.9
TTU 22,504 ♀	51.4	19.0	17.4	10.5	3.8	9.1	7.9	7.0
TTU 22,509 ♀	50.0	19.0	17.2	10.4	3.6	9.5	8.1	6.8
TTU 22,510 ♀	52.9	19.3	17.6	10.6	3.7	8.9	6.0	6.8
TTU 22,511 ♀	50.3	18.9	17.0	10.3	3.6	9.1	8.0	6.8
			Mormoops blainvillii					
TTU 22,497 ♂	46.1	13.8	13.6	8.6	4.3	7.3	7.6	6.1
TTU 22,490 ♂	45.5	14.2	13.9	8.5	4.1	7.5	7.4	6.2
TTU 22,491 ♂	47.2	14.1	13.7	8.3	4.2	7.3	7.3	6.1
TTU 22,493 ♂	46.9	14.3	14.0	8.1	4.2	7.3	7.5	6.1
TTU 22,496 ♀	47.1	13.6	13.5	8.2	4.2	7.2	7.5	5.9
TTU 22,492 ♀	47.1	14.0	13.7	8.1	4.2	7.3	7.4	5.8
TTU 22,494 ♀	48.4	14.5	14.2	8.4	4.3	7.5	7.4	5.7

north slope of the Pic de Macaya. The mountain above the settlement is forested.

ACCOUNTS OF SPECIES

Family Noctilionidae

Noctilio leporinus mastivus (Vahl)

Specimens examined (4).—Charlier, 2 (1 AMNH, 1 UMA); 1 km W Miragoâne, 2 (AMNH).

Measurements of three of our specimens are listed in Table 1. They agree with measurements given for *N. l. mastivus* by Davis (1973). One male weighed 78 g; a female weighed 60 g.

The only previous records of this species from Hispaniola are from the Dominican Republic (Armstrong and Johnson, 1969). Our bats represent the first records from the Republic of Haiti.

The two bats from Charlier were netted at dusk over a shallow stagnant pool in which small fish were active. The specimens from 1 km W Miragoâne were shot as they fished over the Caribbean in a lagoon used as a loading area for bauxite ships by Reynolds Haitian Mines. Bats were observed on several nights at this location, flying regular patterns, passing repeatedly over and touching water at places where schools of small fish clustered. Bats were not there on windy evenings when the water was not smooth. Attempts to net the bats over the Caribbean were unsuccessful.

The female taken on 10 January was not pregnant. Two males taken on 21 December and 10 January had scrotal testes measuring 6 mm. A male taken on 21 December had partially scrotal testes which measured 7 mm.

Family Mormoopidae

Pteronotus fuliginosus fuliginosus (Gray)

Specimen examined (1).—Sapoti, 1 (AMNH).

Measurements of our single specimen are given in Table 1. It is a female taken on 27 May while carrying a single 14 mm embryo.

Pteronotus parnellii pusillus (G. M. Allen)

Specimens examined (13).—Paillant, 8 (TTU); 4 km S Lebrun, 4 (TTU); Sapoti, 1 (AMNH).

Measurements of seven specimens are listed in Table 1. In general, measurements of our specimens agree with those given for other Hispaniolan examples by Smith (1972: 110).

A female netted on 27 May was not pregnant; five females collected between 19 and 23 August also showed no sign of reproductive activity.

Table 2.—*Measurements of phyllostomatine, glossophagine, and stenodermine bats from southern Haiti.*

Number and sex	Forearm	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Breadth of braincase	Length of maxillary toothrow	Breadth across upper molars
				Macrotus waterhousii				
TTU 22513 ♂	53.2	26.7	22.7	12.9	4.4	9.6	9.8	8.3
TTU 22522 ♂	52.5	25.9	—	12.3	4.3	10.0	10.0	8.2
9 ♀♀	54.4	25.9	22.0	12.4	4.2	9.6	9.9	7.9
	(53.3–55.5)	(25.0–26.4)	(21.5–22.6)	(11.8–12.9)	(4.0–4.4)	(9.2–10.1)	(9.6–10.2)	(7.7–8.2)
	±0.70	±0.45	±0.32	±0.32	±0.11	±0.28	±0.20	±0.16
				Monophyllus redmani				
9 ♂♂	40.5	21.7	20.2	9.3	4.1	9.0	7.8	5.0
	(39.5–41.4)	(21.2–22.3)	(19.9–20.7)	(9.1–9.5)	(3.9–4.3)	(8.7–9.4)	(7.6–7.9)	(4.8–5.1)
	±0.71	±0.34	±0.27	±0.14	±0.13	±0.21	±0.10	±0.11
10 ♀♀	39.4	21.7	20.2	9.1	4.2	9.0	7.8	4.9
	(38.6–40.8)	(21.3–22.0)	(19.8–20.7)	(8.8–9.3)	(4.1–4.3)	(8.7–9.3)	(7.6–8.0)	(4.6–5.2)
	±0.64	±0.20	±0.05	±0.11	±0.24	±0.22	±0.13	±0.19
				Artibeus jamaicensis				
16 ♂♂	57.3	27.4	24.4	16.6	7.0	11.9	9.6	12.1
	(55.0–59.0)	(26.5–28.2)	(23.2–25.2)	(15.8–17.3)	(6.5–7.4)	(11.6–12.3)	(9.0–10.2)	(11.2–12.6)
	±1.38	±0.48	±0.54	±0.50	±0.24	±0.20	±0.26	±0.36
24 ♀♀	57.7	27.5	24.3	16.5	6.9	11.9	9.5	12.1
	(54.5–60.9)	(26.8–28.3)	(23.6–25.4)	(16.0–17.3)	(6.5–7.0)	(11.5–12.8)	(9.0–10.1)	(11.4–12.8)
	±1.73	±0.41	±0.37	±0.31	±0.24	±0.29	±0.24	±0.31
				Phyllops haitiensis				
17 ♂♂	40.6	19.7	17.5	13.1	5.4	9.8	5.7	7.9
	(38.6–42.1)	(19.0–20.2)	(16.8–17.8)	(12.5–13.6)	(5.2–5.7)	(9.6–10.1)	(5.5–5.9)	(7.8–8.2)
	±1.11	±0.31	±0.24	±0.30	±0.14	±0.15	±0.11	±0.15
25 ♀♀	42.6	20.3	18.1	13.4	5.5	10.0	6.0	8.2
	(40.5–44.8)	(19.6–20.7)	(17.3–18.5)	(12.6–13.8)	(5.3–5.7)	(9.5–10.3)	(5.7–6.2)	(7.5–8.5)
	±1.08	±0.26	±0.26	±0.27	±0.15	±0.19	±0.13	±0.22

Testes in three males netted on 19 August were small, measuring 2 mm or less.

Family Phyllostomatidae

Macrotus waterhousii waterhousii Gray

Specimens examined (22).—Paillant, 5 (4 TTU, 1 UMA); 2 km N, 2 km E Lebrun, 9 (TTU); 1 km S Lebrun, 1 (TTU); 4 km S Lebrun, 5 (TTU); 2 km SE Duchity, 2 (AMNH).

Greenbaum and Baker (1976) discussed the relationships among mainland and Antillean populations of this species, including the population of southern Haiti. According to Anderson and Nelson (1965) and Buden (1975*b*) the name for this population is *M. w. waterhousii*, which was described from Haiti. Measurements of our bats are listed in Table 2. One female weighed 19.5 g.

One female netted on 7 January was not pregnant. Of six adult females taken on 16 May, five were pregnant. The largest embryo measured 34 mm. None of the 14 females taken between 19 and 27 August was pregnant. Testes of the single male netted on 23 August were 2 mm long.

Monophyllus redmani clineadaphus Miller

Specimens examined (72).—Paillant, 40 (13 AMNH, 17 UMA, 10 TTU); 2 km N, 2 km E Lebrun, 2 (TTU); 1 km E Lebrun, 26 (TTU); 1 km S Lebrun, 3 (TTU); 8 km N Beaumont, 1 (TTU).

We follow Schwartz and Jones (1967) and Buden (1975*a*) in their taxonomic treatment of the *Monophyllus* of Hispaniola. Measurements of our speciments are in Table 2. Weight of 21 individuals averaged 10.9 g (range, 8–13).

Monophyllus is one of the more commonly collected bats in Haiti. It was taken in numbers, along with *Artibeus jamaicensis*, in dry thorn scrub. It was also commonly seen with that species during the day roosting in shallow caves and excavations.

Twenty-one females were taken between 3 and 9 January, and 28 between 14 and 27 August. None were pregnant, and none showed any sign of recent parturition. Two females taken on 27 May were pregnant, the embryos measuring 15 and 18 mm. Males netted in January and August had small abdominal testes ranging in length from 1 to 3 mm.

Artibeus jamaicensis jamaicensis Leach

Specimens examined (151).—Paillant, 58 (32 UMA, 12 AMNH, 14 TTU); 2 km N, 2 km E Lebrun, 5 (TTU); 1 km E Lebrun, 53 (TTU); 1 km S Lebrun, 11 (TTU); 4 km S Lebrun, 2 (TTU); Charlier, 21 (15 UMA, 6 AMNH); 8 km N Beaumont, 1 (TTU).

Measurements of our specimens are listed in Table 2. Average weight of 19 individuals was 35.5 g (range, 32–40.5).

Presence of both upper and lower third molars varies geographically in this species. In samples from the Pacific versant of México north of Oaxaca, 99% of the individuals have M^3 present (Handley, 1966). In samples drawn from the remainder of the range of the species in Middle America, 98% show bilateral absence of this tooth (Davis, 1970). The tooth is absent in all of our Hispaniolan specimens. Elsewhere in the Antilles the M^3 is present in 100% of a sample from Trinidad, 94% of a sample from Grenada, and 12% of a sample from St. Vincent (Jones and Phillips, 1970). However, further north in the Lesser Antilles (Barbados and St. Lucia) the tooth is absent in all bats examined (Jones and Phillips, 1970). Absence of M_3 is rare in mainland Middle American populations, less than 3% of the bats studied by Davis (1970) showing loss of the tooth on one or both sides. In the specimens that have crania available for examination in our Haitian sample, in contrast, the M_3 is absent bilaterally in 21% (4 specimens), absent on one side only in 11% (2 specimens), and present bilaterally in 68% (13 specimens).

Artibeus jamaicensis is the most abundant bat in our collections, accounting for about a third of the specimens preserved. In addition to these, many more were released in the field. It is extremely common in the dry deforested regions and abundant in the vicinity of cultivated fruit. It is also the bat most commonly seen in small caves and excavations near Miragoâne. A cluster of six was seen hanging during the daytime in a shallow embrasure (less than a meter deep) in the limestone in a canyon downhill from Paillant.

Two of three females obtained on 13 June were not pregnant, whereas one had a large embryo. Of 41 females netted between 14 and 16 August, 17 were not pregnant, 20 had enlarged uteri, and four had embryos measuring 6, 8, 9, and 10 mm. Eighteen females taken between 21 December and 9 January evinced the following reproductive conditions: 12 were not pregnant; six had enlarged uteri with visible embryos (smaller than 3 mm); two had larger embryos (12 and 18 mm).

Length of testes in 10 males netted in late August averaged 7.1 mm (range, 3–10). The same measurement averaged 6.9 mm (range, 4–8) in 21 males caught in late December and early January.

Phyllops haitiensis J. A. Allen

Specimens examined (104).—Paillant, 44 (34 TTU, 7 AMNH, 3 UMA); 2 km N, 2 km E Lebrun, 9 (TTU); 1 km E Lebrun, 21 (TTU); 1 km S Lebrun, 1 (TTU); 4 km S Lebrun, 29 (TTU).

Phyllops haitiensis appears to show secondary sexual dimorphism in most dimensions of body and cranium, with the female being the larger. Similar variation is characteristic of the closely related Puerto Rican species *Stenoderma rufum* (Jones et al., 1971). *Phyllops haitiensis* may be conspecific with *P. falcatus* of Cuba (Jones and Carter, 1976). Measurements of our specimens are listed in Table 2.

Phyllops is second in abundance only to *Artibeus jamaicensis* in our collections. It was netted more frequently, however, in thickly vegetated ravines than in drier scrub thorn habitats.

All six females taken between 4 and 9 January were pregnant; lengths of embryos ranged from 6.5 to 14 mm. Of 54 females netted between 14 and 27 August, 27 were not pregnant, eight had enlarged uteri, 14 had embryos ranging in length from 10 to 43 mm, and five had enlarged postpartum uteri. Five of eight females caught on 27 May were pregnant. Length of testes averaged 4.3 mm (range, 1–6) in 10 males netted in late August.

Brachyphylla pumila Miller

Specimens examined (6).—Paillant, 4 (TTU); 1 km E Lebrun, 1 (TTU); Charlier, 1 (UMA).

Buden (1977) viewed *B. pumila*, and all other named populations of *Brachyphylla*, as members of a single species, *B. cavernarum*. We withhold judgment on the taxonomic assignment of our Haitian material until the systematic studies of Pierre Swanepoel, now in progress, are complete. Measurements of our specimens are listed in Table 3.

Brachyphylla is apparently a rare bat in southern Haiti. In mist nets set in ravines near Paillant and alongside and across a stream near a banana plantation at Charlier, *Artibeus jamaicensis* outnumbered *Brachyphylla* approximately 50 to 1.

A female netted on 21 December and four females netted between 21 and 25 August were not pregnant, but one of the August females was lactating. A male taken on 14 August had testes 3 mm long.

Erophylla sezekorni bombifrons (Miller)

Specimens examined (5).—1 km S Lebrun, 2 (TTU); 1 km E Lebrun, 2 (TTU); 4 km S Lebrun, 1 (TTU).

Buden (1976) placed all Caribbean populations of *Erophylla* in *E. sezekorni*, but recognized the Puerto Rican and Hispaniolan bats as a distinct subspecies. Measurements of two females are listed in Table 3.

Our specimens were taken in ravines near Paillant. None of the five females netted between 16 and 21 August were pregnant.

Phyllonycteris poeyi obtusa Miller

Specimens examined (37).—Paillant, 6 (2 AMNH, 1 UMA, 3 TTU); 2 km N, 2 km E Lebrun, 1 (TTU); 1 km E Lebrun, 10 (TTU); 1 km S Lebrun, 14 (TTU); 4 km S Lebrun, 6 (TTU).

Table 3.—*Measurements of phyllonycterine bats from southern Haiti.*

Number and sex	Forearm	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Breadth of braincase	Length of maxillary toothrow	Breadth across upper molars
			Brachyphylla pumila					
TTU 22761 ♂	58.8	28.2	25.0	14.7	6.2	11.2	9.5	9.4
TTU 22760 ♀	58.0	28.4	25.1	15.5	6.3	11.7	9.5	10.1
TTU 22764 ♀	58.3	28.1	24.8	14.6	6.4	11.9	9.5	10.1
TTU 22762 ♀	58.8	28.1	25.3	14.9	6.3	11.7	9.4	9.9
			Erophylla sezekorni					
TTU 22767 ♀	46.8	24.4	22.5	11.7	4.5	10.2	8.1	6.7
TTU 22768 ♀	46.5	23.4	21.1	—	4.4	9.8	7.9	6.1
			Phyllonycteris poeyi					
7 ♂♂	48.4	25.1	22.6	—	5.5	10.5	7.4	7.1
	(47.5–49.8)	(24.5–25.7)	(21.6–23.4)	—	(5.3–5.7)	(10.2–11.0)	(7.2–7.6)	(6.7–7.5)
	±0.80	±0.43	±0.55	—	±0.12	±0.30	±0.14	±0.34
11 ♀♀	47.9	24.2	22.2	—	5.5	10.3	7.4	7.0
	(42.6–49.8)	(23.7–24.7)	(21.6–23.1)	—	(5.2–5.7)	(10.0–10.9)	(7.1–7.7)	(6.8–7.2)
	±1.13	±0.35	±0.41	—	±0.13	±0.30	±0.17	±0.13

Forearm and cranium dimensions of our specimens do not differ from those of a series of three males and three females of *P. poeyi poeyi* from Guanajay, Cuba, in the National Museum of Natural History. There are also no observable qualitative cranial differences between these populations. Measurements of our specimens are listed in Table 3. Two adult females weighed 20.0 and 21.1 g; a male weighed 20.5 g.

Our specimens were taken in ravines, though a few were found in the drier scrub on hillsides. One bat was carrying fruit when it was caught in the net.

Three females caught on 17 December were pregnant, the embryos measuring 15, 20, 22 mm. A female netted on 6 January and 22 females netted between 19 and 27 August were not pregnant. Length of testes in seven males collected between 21 and 27 August averaged 4.1 mm (range, 2–7).

Family Vespertilionidae

Eptesicus fuscus hispaniolae Miller

Specimens examined (4).—Sapoti, 4 (AMNH).

Measurements of our specimens are listed in Table 4. All were males taken on 27 May and had testes ranging from 5 to 6 mm in length.

Lasiurus borealis minor Miller

Specimen examined (1).—Paillant, 1 (TTU).

Measurements of our specimen are listed in Table 4. The animal was a non-pregnant female taken on 14 August. Hall and Kelson (1959: 191) recognized a number of distinct species of red bats, including *L. minor*, in the Antilles. Koopman et al. (1957) and Varona (1974) considered them to represent subspecies of the mainland species *L. borealis*. We follow this latter course in this paper.

Family Molossidae

Tadarida brasiliensis constanzae Shamel

Specimens examined (3).—Anse d'Hainault, 2 (AMNH); Sapoti, 1 (AMNH).

Measurements of our three specimens are listed in Table 4. The specimens from Anse d'Hainault were taken in attics. The one from Sapoti was netted.

A female taken on 27 May was pregnant. Two females taken on 10 June were also pregnant, carrying embryos measuring 15 and 20 mm. A male taken on 27 May had testes 2.5 mm long.

Table 4.—*Measurements of vespertilionid and molossid bats from southern Haiti.*

Number and sex	Forearm	Greatest length of skull	Condylobasal length	Zygomatic breadth	Postorbital constriction	Breadth of braincase	Length of maxillary toothrow	Breadth across upper molars
Eptesicus fuscus								
AMNH 236699 ♂	48.5	18.7	17.1	12.3	4.2	8.6	6.5	7.7
AMNH 236700 ♂	47.6	19.0	17.5	12.4	4.2	8.1	6.7	7.6
AMNH 236701 ♂	46.6	18.1	16.8	12.4	4.3	8.4	6.7	7.4
AMNH 236702 ♂	45.5	17.9	16.4	11.9	4.2	8.4	6.3	7.2
Lasiurus borealis								
TTU 22804 ♀	39.8	13.2	12.0	8.9	4.3	7.2	4.3	6.4
Tadarida brasiliensis								
AMNH 236705 ♂	40.0	16.0	14.7	9.2	3.6	8.5	5.5	6.6
AMNH 236703 ♀	41.7	15.7	14.6	9.2	3.6	8.5	5.5	6.4
AMNH 236704 ♀	40.2	15.9	14.5	9.1	3.8	7.9	5.7	6.5
Molossus molossus								
7 ♂♂	38.7	16.9	15.0	10.7	3.9	9.0	5.8	7.7
	(37.4–39.3)	(16.5–17.2)	(14.6–15.2)	(10.5–11.0)	(3.8–4.1)	(8.8–9.2)	(5.6–5.9)	(7.1–8.1)
	±0.77	±0.32	±0.21	±0.21	±0.11	±0.13	±0.11	±0.35
AMNH 236706 ♀	38.4	16.1	14.3	10.4	3.8	8.6	5.7	7.5
AMNH 236707 ♀	38.5	16.3	14.4	10.3	3.7	8.7	5.4	7.6

Molossus molossus verrillii J. A. Allen

Specimens examined (14).—2 km N, 2 km E Lebrun, 1 (TTU); 3 km S Beaumont, 4 (TTU); Charlier, 9 (AMNH).

Comparison of measurements of cranium and forearm of our series (Table 4) with values from specimens from elsewhere in the Caribbean and the South American mainland (Husson, 1962; Smith and Genoways, 1974) indicates that the Haitian bats can be referred to *M. molossus*. Relationships of Antillean and South American populations of this species to Central American and Mexican forms of *Molossus* remain problematical.

The bats from Charlier were netted shortly after sundown over a stagnant pool. Houses are present in the vicinity.

Two females taken on 21 December and five females taken on 24 August were not pregnant. Length of testes in seven males caught on 21 December averaged 3.9 mm (range, 2–5).

Discussion

On the basis of their studies of species at several different localities in Costa Rica and Panamá, Fleming et al. (1972) distinguished four different reproductive patterns in tropical bats—1) seasonal monoestry (characteristic of insectivores), 2) seasonal polyestry (two distinct birth peaks, characteristic of frugivores), 3) extended season with short inactive period (characteristic of *Myotis nigricans*), and 4) year-round activity (characteristic of vampires). Even in tropical situations production of young appears to be adjusted through evolution to coincide with times of maximum availability of food.

Our reproductive data on most Haitian insectivorous species are so incomplete that comparison with mainland bats is not worthwhile, except to point out that *Macrotus waterhousii* shows reproductive inactivity in August and January and a high rate of pregnancy in May. Apparently, it is seasonally monoestrous.

Substantial numbers of female *Artibeus jamaicensis* are pregnant in December–January and in May, both in Haiti and on the mainland. In August, however, many Haitian females are also visibly pregnant, whereas in the mainland populations the embryos are in a period of delayed development and are not detectable by gross dissection (Fleming, 1971; Fleming et al., 1972). Absence of visible embryos in August is also usual for most other Panamanian and Costa Rican stenodermines (Fleming et al., 1972). In Haiti, however, many females of *Phyllops haitiensis* show measurable embryos in August (as well as in May and January). We believe that Haitian stenodermines may not show the seasonal bimodal polyestry characteristic of mainland stenodermines.

Glossophaga soricina in Panamá shows the bimodal polyestry

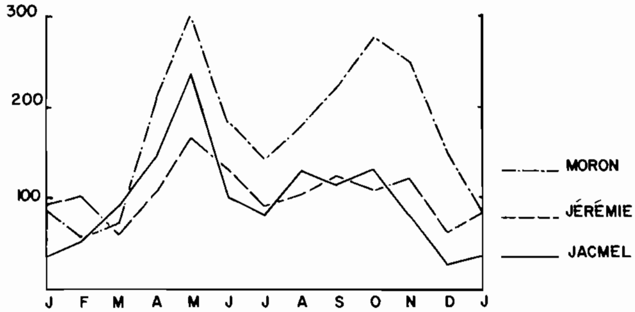

Fig. 2.—Average monthly rainfall in mm at three localities in southern Haiti. Values for Jérémie and Jacmel are 14-year averages; for Moron, nine-year averages. Data are from Woodring et al., 1924.

characteristic of other frugivorous species in Central America (Fleming et al., 1972). According to our data, the closely related *Monophyllus redmani* in Haiti does not show this pattern, as pregnant females were found only in May. Buden (1975) however reported pregnant females from Hispaniola taken in December and February. Our specimens of phyllonycterines taken in January and August include no pregnant females, but pregnant females of *Phyllonycteris* were taken in December. Young are apparently born in late spring or early summer elsewhere in the Antilles in *Erophylla* and *Phyllonycteris* (Walker et al., 1964: 320–321). Neither *Monophyllus* nor the phyllonycterines in the Antilles appear to show bimodal polyestry, and they may be seasonally monoestrous.

Although we lack 12-month data on reproduction of Hispaniolan species, we can conclude that some Antillean frugivorous bats differ reproductively from close relatives on the Central American mainland. These reproductive differences may be related through long-term evolution to differences in seasonality of abundance of food (on which we have no data) and indirectly to differences in rainfall patterns. In Costa Rica and Panamá the marked wet and dry seasons are associated with yearly bimodality in availability of fruit (Fleming et al., 1972). In Haiti there are no marked single wet and dry seasons, but rather two wet seasons (which are not very wet) separated by moderate dry seasons (Fig. 2). It is possible that the pattern of rainfall in Haiti leads to a more even production of fruit throughout the year, and allows more or less continuous reproduction of stenodermine bats. In west central Colombia, where fruit is continuously available, *Artibeus lituratus* breeds throughout the year (Tamsitt and Valdivieso, 1963).

Artibeus jamaicensis feeds primarily on ripe fruit, but some flower products, leaves, and insects may also be eaten (Gardner, 1977). *Artibeus* was observed feeding heavily on fruit of the trumpet tree (*Cecropia peltata*) at Paillant. This tree grows commonly in deforested areas in the Antilles, and in Jamaica flowers and fruits sporadically throughout the year (Adams, 1972). *Artibeus* in Haiti probably eats cultivated fruit also. Feeding habits of *Phyllops haitiensis* are unknown, but the bat is thought to feed primarily on fruit (Gardner, 1977). Haitian *Artibeus* and *Phyllops* differ in weight by a factor of 2:1, a ratio expected in insular species competing for the same general food resource. In lowland Panamá, in contrast, the canopy frugivore guild is filled by six species of stenodermines which differ incrementally by a weight factor of 1.44 (Bonaccorso, 1975). Feeding habits of *Monophyllus redmani* are not known, but it probably eats pollen, insects, and stages of fruit not used by stenodermines, as do other glossophagines (Howell, 1974). Stomachs of five Haitian specimens of *Monophyllus* taken in January contained plant material, and two of these contained insects in addition. Cuban phyllonycterines feed primarily on pollen but also eat soft fruit pulp, nectar, and insects (Silva Taboada and Pine, 1969: 15). Reproduction in *Monophyllus* and the phyllonycterines may be adjusted to seasonal availability of insects or flowers or both, and the difference in food requirements may account for the differences in reproductive biology observed between Haitian stenodermines on the one hand and *Monophyllus* and the phyllonycterines on the other.

The bat faunas of the Greater Antilles are depauperate compared to those of the mainland and of the islands on the continental shelf. Koopman (1958: 436) suggested that past environmental changes on the islands led to extinction of some species, and that water barriers prevented immediate recolonization. Empty niches would be present on the islands for some time. Niche expansion could occur in surviving species (see Lister, 1977, on niche expansion in species of Antillean *Anolis*, and Lack, 1976, on birds), an event which could hinder establishment of new colonizers. Hispaniola is a large island and is ecologically diverse in comparison with the other islands. Unfortunately we lack information on composition of its bat fauna in the Tertiary and early Quaternary, and detailed information on niche structure of its Recent bat fauna in comparison with the fauna on the mainland. Hence we cannot at this time substantiate or modify Koopman's hypothesis.

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